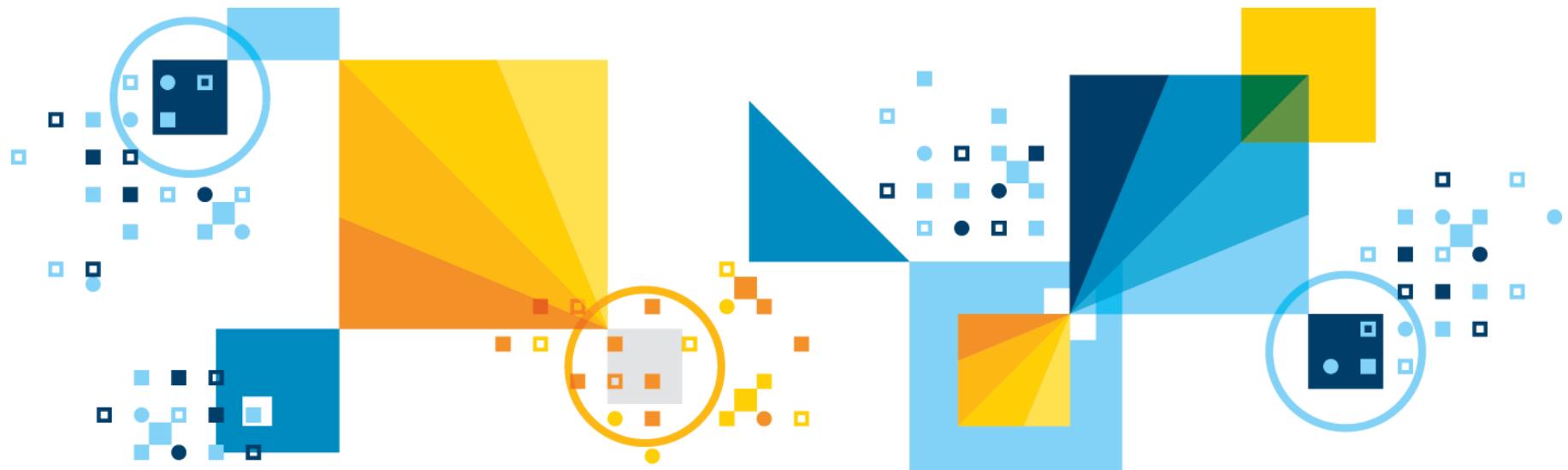


Sumeet Parashar, Technical Specialist – IBM Data Science and Decision Optimization

IBM Decision Optimization (Prescriptive Analytics)



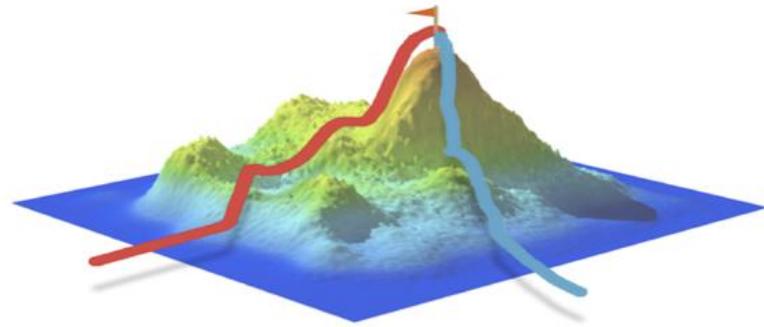
IBM Decision Optimization

Optimization

Why ?

**“Plans are nothing;
planning is everything”**

- Dwight D. Eisenhower



5	3			7			
6			1	9	5		
	9	8				6	
8			6				3
4		8	3				1
7			2			6	
	6			2	8		
		4	1	9			5
			8		7	9	

What differentiates Industry Leaders



vs.



vs.



vs.



vs.



vs.



vs.



*Source: The Optimization Edge, Steve Sashihara (New York, NY: McGraw Hill, 2011)
p. 3*

UPS story

<https://www.wsj.com/articles/at-ups-the-algorithm-is-the-driver-1424136536>

Prescriptive Analytics Solutions – Documented Results

2 Chilean Forestry firms	Timber Harvesting	\$20M/yr + 30% fewer trucks
UPS	Air Network Design	\$40M/yr + 10% fewer planes
South African Defence	Force/Equip Planning	\$1.1B/yr
Motorola	Procurement Management	\$100M-150M/yr
Samsung Electronics	Semiconductor Manufacturing	50% reduction in cycle times
SNCF (French Railroad)	Scheduling & Pricing	\$16M/yr rev + 2% lower op ex
Continental Airlines	Crew Re-scheduling	\$40M/yr
AT&T	Network Recovery	35% reduction spare capacity
Grantham Mayo van Otterloo	Portfolio Optimization	\$4M/yr

Source: Edelman Finalists, <http://www.informs.org> or <http://www.scienceofbetter.org>

Why invest in Pricing and Revenue Optimization (PRO)

“For most companies, better management of pricing is the fastest and most cost-effective way to increase profits.”

– conclusion of a pioneering study by McKinsey and Associates, 1992

Results of two studies on the average impact of a 1% improvement in different variables on operating profit

	McKinsey(1992)	A. T. Kearney (2000)
Price management	11.1%	8.2%
Variable cost	7.8%	5.1%
Sales volume	3.3%	3.0%
Fixed cost	2.3%	2.0%

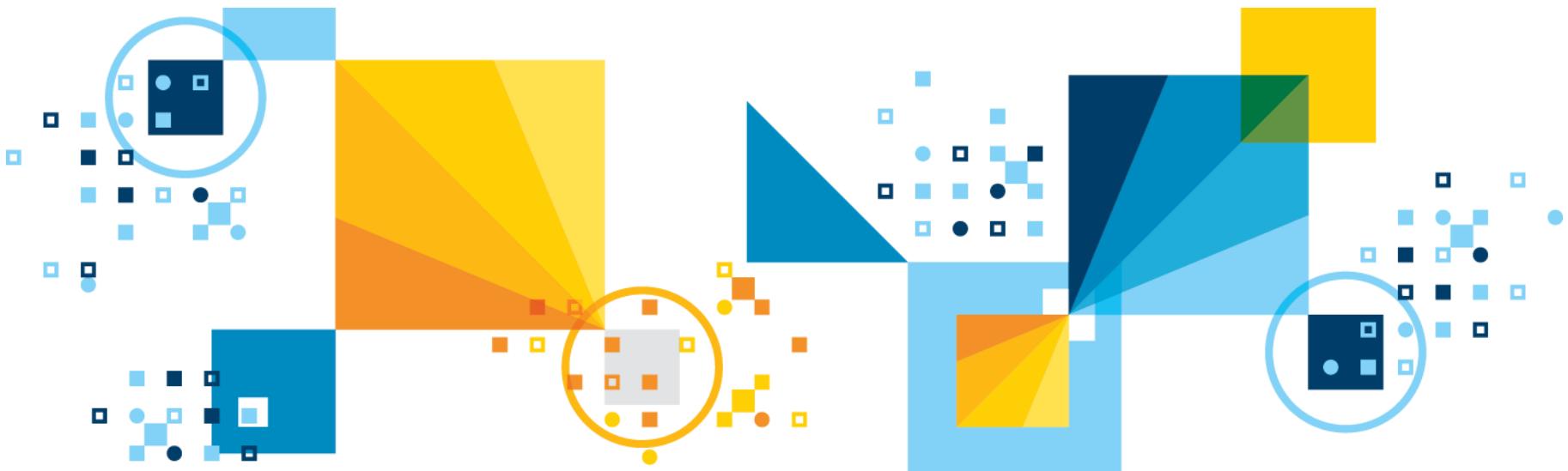
A Harvard Business Review article noted that some retailers are achieving ***“gains in gross margins in the range of 5-15%”*** from the use of optimization based assortment and pricing optimization systems.

Source: Pricing and Revenue Optimization, Robert L. Phillips (Stanford, CA,: Stanford Business Books, 2005)

Decision Optimization

aka

Prescriptive Analytics



Prescriptive Analytics within the Analytics Portfolio

Technology

DESCRIPTIVE



What is happening in my business today?

Discover
Report
Analyze

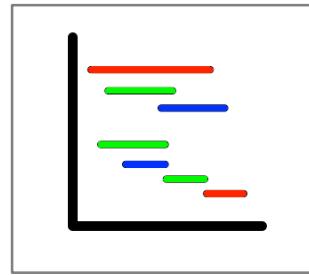
PREDICTIVE



What will happen in the future?

Forecast
Correlate
Anticipate

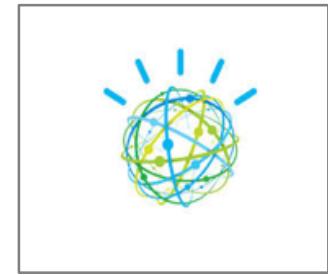
PRESCRIPTIVE



What should I do about it?

Recommend
Decide
Assign

COGNITIVE



Have you considered?

Understand
Reason
Learn

Need

Outcome

What is Prescriptive Analytics?

- Manage **resource efficiency, utilization and allocation**
- Resources can be a number of things, in different industries

Resources	Industries
Capital	Financial
People	Industrial, Public, Comms, Distribution, Financial
Equipment	Industrial, Comms
Facilities	Distribution, Industrial
Vehicles	Distribution
Material/Product	Distribution, Industrial

- **Keywords to look out for:**

- Minimize and maximize
- How many, how much, which, when, where
- Decide, choose, plan, schedule, assign, route, source, maintain, locate, trade-off

The Science of Better Decisions



What to build,
where and when?



How to best allocate
aircrafts and crews?



Inventory cost vs.
customer satisfaction

Optimization helps businesses:

- create the best possible plans
- explore alternatives and understand trade-off
- respond to changes in business operations



Risk vs. potential reward



Schedule jobs, sequence,
machines and people



How to best allocate
price and promotions?

IBM Decision Optimization (DO)



Media
Broadcasting
Retail
Workforce
Entertainment
Finance
Airlines
Hospitality
Automotive
Healthcare
Sports
Revenue

Infrastructure Data
Manufacturing
Transportation
Scheduling
Logistics
SupplyChain
Planning
Ships
Inventory
Travel
Ports
Rail

Energy
Manufacturing
Transportation
Scheduling
Logistics
SupplyChain
Planning
Ships
Inventory
Travel
Ports
Rail



IBM Decision
Optimization

What is inside ?



“CPLEX” and “Constraint Programming (CP)”
advanced mathematical optimization
algorithm/solver

CPLEX inside several industry software vendors

Airline reservation
systems

amadeus

Sabre

Finance

bondIT.

fiserv.

CLARIFI
lifelong financial literacy

Supply Chain,
Manufacturing

flexis jda.

FuturMaster
Deliver Business Performance

Energy & Utilities

PCI SIEMENS
ENERGY IN FOCUS.

Logistics

Geoconcept
THE GEOPORTIONAL COMPANY

navis®
Odyssey

Telecom Network

atesio

Revenue Management -
Transportation

ExPretio

Workforce

KRONOS®

Healthcare

ACCURAY®

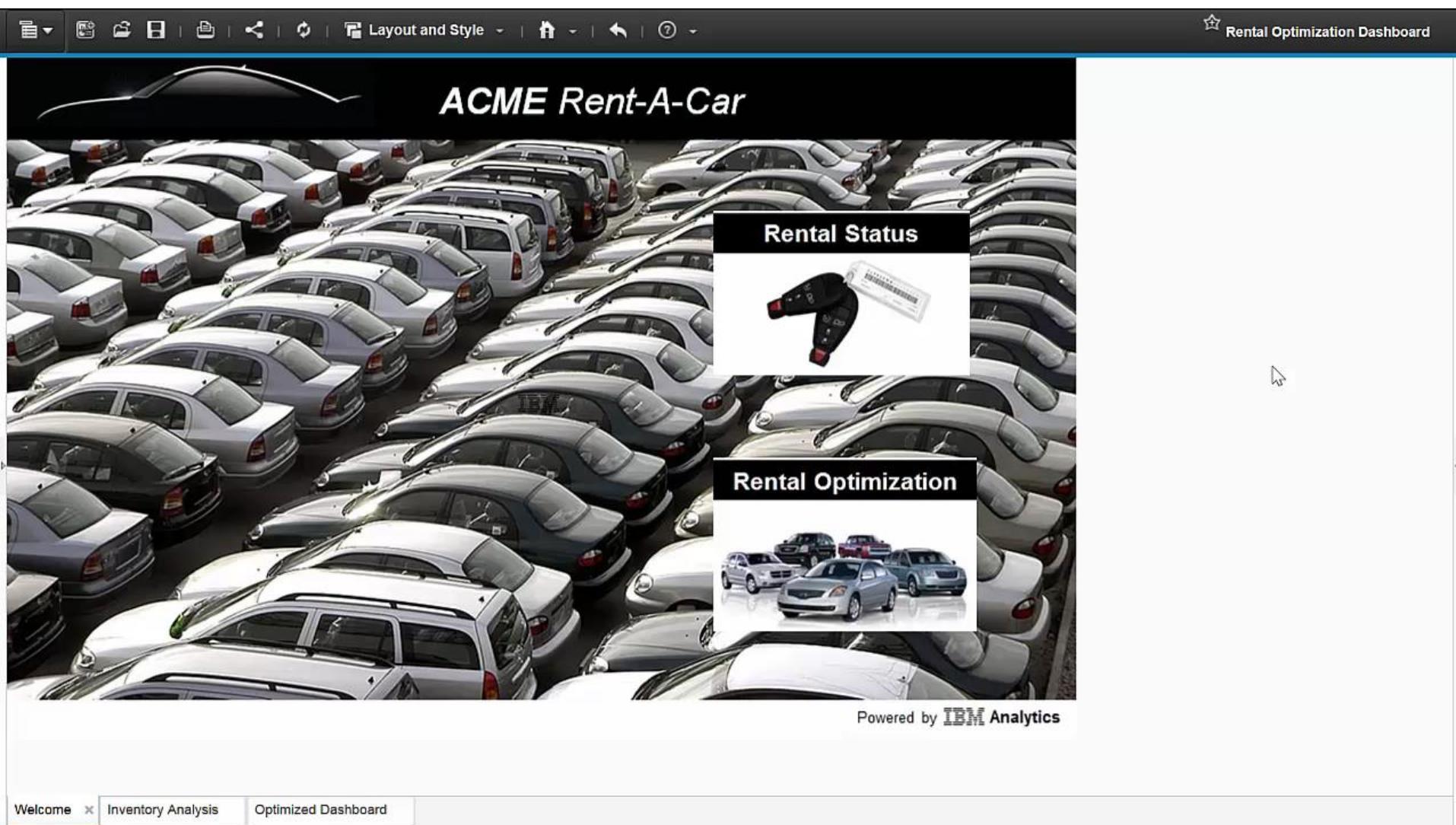
Precise, innovative tumor treatments™

What is inside ?



“CPLEX” and “Constraint Programming (CP)”
advanced mathematical optimization
algorithm/solver

Example: Rental Car Repositioning



The screenshot displays a dashboard titled "ACME Rent-A-Car" over a background image of a large parking lot filled with numerous cars. The dashboard includes two main callout boxes: "Rental Status" showing a car key fob and a barcode, and "Rental Optimization" showing a grid of five different car models. The bottom right corner of the dashboard area contains the text "Powered by IBM Analytics".

Layout and Style | Home | ? |  Rental Optimization Dashboard

ACME Rent-A-Car

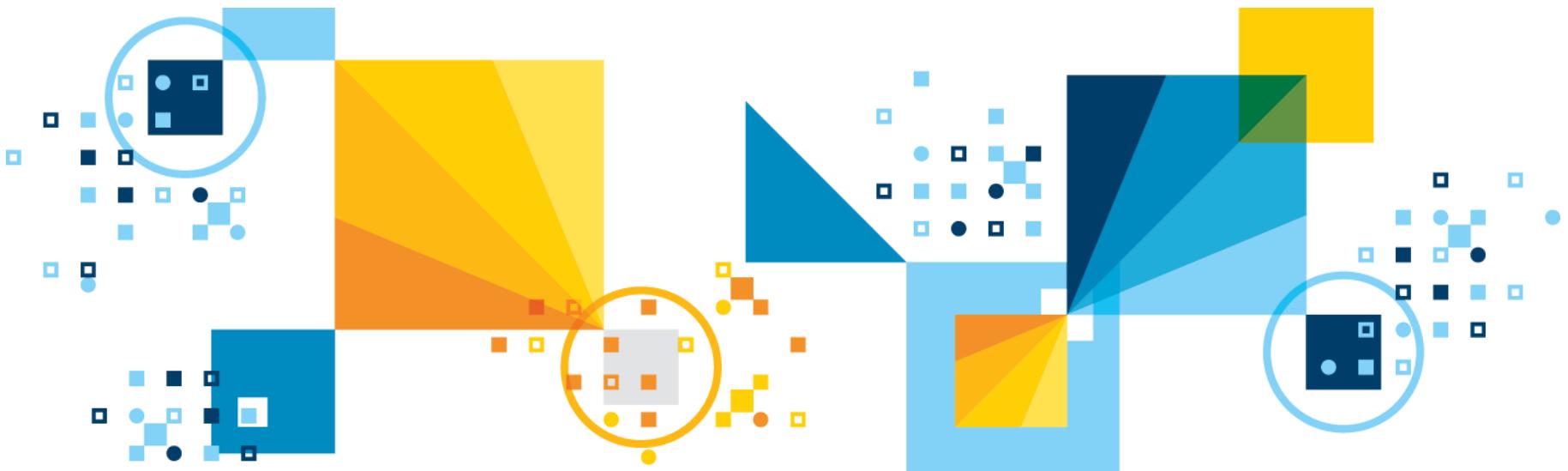
Rental Status

Rental Optimization

Powered by IBM Analytics

Welcome  Inventory Analysis Optimized Dashboard

Industry use cases



Sales & Operations Planning

▪ Business needs:

- Efficiently allocate production capacity to market demand
- Make difficult supply-demand trade-offs

▪ Typical Challenges:

- Lacks agility (planning 3 months in advance)
- Continuous manual re-adjustments of plan
- Lack of collaboration among planners at different levels

Typical S&OP Process



Typical Business Benefits:

75%

Reduction in planning figures that have to be filled in manually

50%

fewer planning shifts throughout the planning process

Minutes

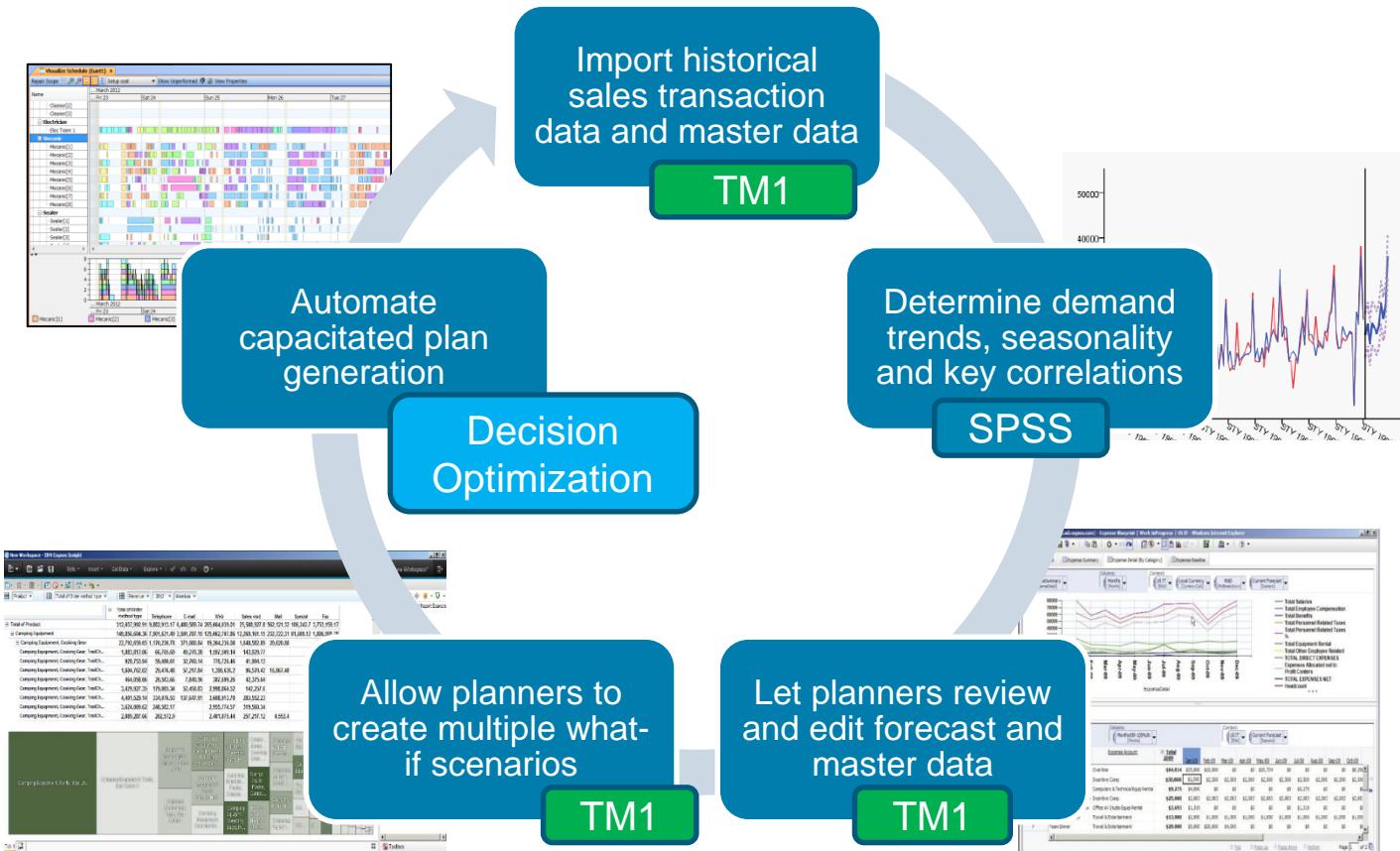
to create new plans down from one month

Prescriptive Analytics S&OP Solution

- **Automated breakdown from high-level goals to low-level assignments**
- **Optimized balancing of conflicting goals and constraints**
- **Common planning cockpit for all involved planners**

Decision Optimization in end-to-end IBM Analytics

Example: Advanced S&OP Lifecycle



JLG adopts IBM Decision Optimization to fast track production planning



Business Benefits:

Manual effort reduced from 10 days to 3 days / month
~ \$70K yearly savings

Accurate supplier forecast.
Reduced expediting and shortages
~ \$250K yearly savings

More accurate financial analysis of projected spend and budgets
~ \$20K yearly savings

Challenges:

- Production plans based on 24 month regional (spread across the globe) forecasts
- Plants across the globe with varying production capabilities, capacities and costs
- Very time and labor intensive excel based production plan rebalancing
- 3-5 person planning team would take 10 days/month to get one feasible plan, which may not even be optimum.

JLG integrates advanced analytics (IBM Decision Optimization) with their Planning Analytics for production planning

Optimization re-balances production plan within minutes instead of days when demand changes. Planners can also use it to account for unforeseen events as well as scheduled maintenance downtime.



JLG Industries, Inc., an Oshkosh Corporation company, is world's leading designer and manufacturer of industrial access equipment.

Variable	# of Data Points
Assembly Lines	35
Active Models	x 220
Forecast Groups	x 10
Periods (months)	x 24
TOTAL INTERSECTIONS	1.8M

Continental Tires Optimizes manufacturing of 10,000 products across 20 plants worldwide



Key Challenges:

- Manufacturing process of each tire variety needs around 100 steps and different combination of materials, some with long lead times
- 20 plants vary in size and equipment
- **1000 new products every year**
- Efficiency of production landscape is a key determiner of its commercial success.

Business benefits:

30% reduction
in planning activities

30 times

More What-If scenarios evaluated.

Predict and Prevent bottlenecks

Resulting higher revenues and profit

Optimization based Future Allocation and Capacity Tracking (FACT)

Determine which products to produce at which locations while considering logistics and several other constraints



Continental Tires is a major global tire manufacturer, generating annual revenues of around EUR9.8 billion and employing around 47,500 people. It produces more than 10,000 different types of tires.

WestRock uses Decision Optimization based solution for optimizing its internal supply chain to meet internal and external demand



Business benefits:

3% improvement

in box plant service levels
measured as % of SKUs without
stock outs

13 weeks out

visibility to trim needs of
production batches and
transportation needs by mode

Rapid replanning for unplanned events

Less than a day to replan and
reschedule the entire network
20

Key Challenges:

- Inventory stock outs at box plants
- High production and freight costs
- Inability to quickly react during unplanned events such as machine going down
- Inability to have visibility to trim situation and transportation planning more than a week out
- Disjointed production planning, supply planning and transportation planning

Optimization based demand sourcing, production planning & scheduling, transportation planning

Determine which demand to source to which mill; create optimized batches for production that minimizes production and transportation cost while meeting customer service levels



WestRock is one of the largest paper and packaging manufacturing company with \$15 billion annual revenue, 42000 employees in 30 countries. Its Supply Chain Network comprises of 80 box plants and 14 paper mills spread all across United States.

Marriott takes revenue management to next level by adopting optimization driven dynamic pricing



Business benefits:

US\$ 500 M / year

in revenue increase

Competitive Advantage

"As a result, no competitor has anything close to the solution Consolidated Inventory / Total Yield provides. The system puts the right information in employees' hands so they can deliver on the expectations of group customers and close the right business for the hotel." said Bruce Hoffmeister, Global CIO.

Opportunity:

- Develop a yield management application to plan room and service allocation levels and pricing at Marriott hotels worldwide
- Dynamically Price
Room Rates
Banquet/Meeting Space
Spa Services
Food & Beverage e.g.



Marriott International, Inc. is an American multinational diversified hospitality company that manages and franchises a broad portfolio of hotels, has more than 5700 properties in over 110 countries. Revenue over US \$14.4 B.

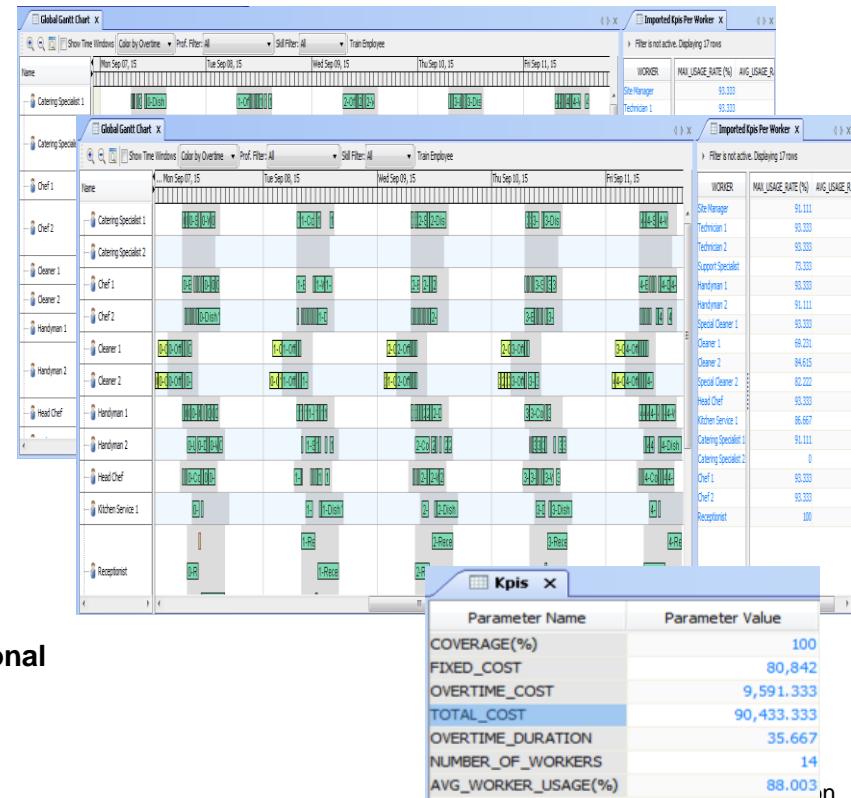
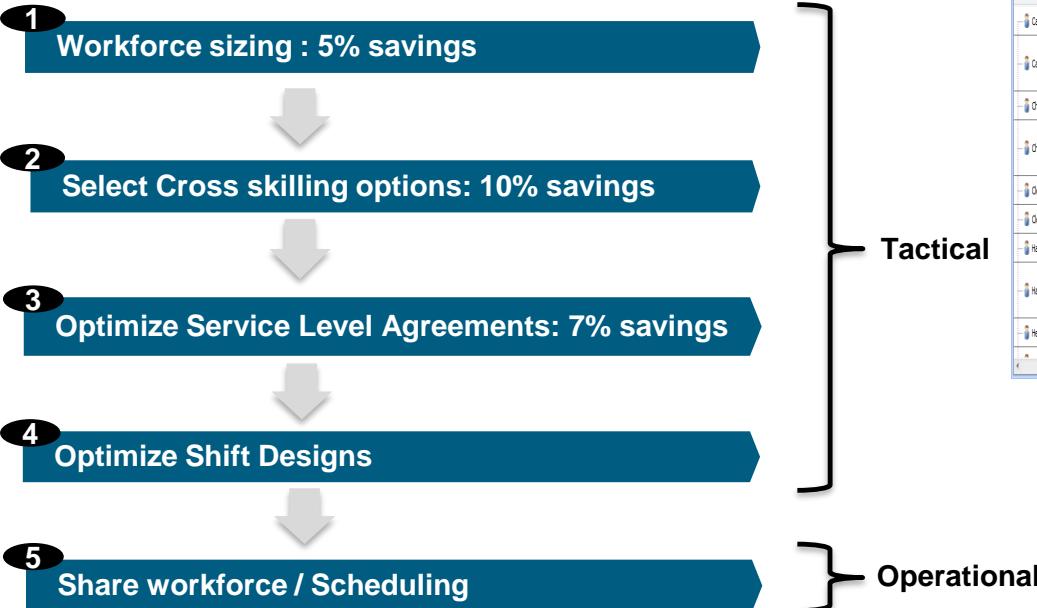
Marriott adopts IBM Decision Optimization based Yield Management for the lodging industry

Dynamically determine optimal pricing based on capacity constraints, fluctuating demand, variable price elasticity and changing supply to increase revenue.



Workforce Planning and Scheduling: Tactical/Operational Optimization

- Over capacitated workforce drive higher costs
- Under capacitated workforce drives higher cost due to
 - Overtime needed to meet SLA's
 - Penalties for under achieved SLA's



Nurse scheduling for University Hospital in the UK

Challenge

- The hospital needed a solution that could equitably allocate work shifts, while helping to ensure there are enough nurses with the right skills to meet the needs of the patients.

Solution

- IBM® ILOG CPLEX, serves as the mathematical solver in handling the complex calculations used to generate schedules and provides the optimum schedule considering all constraints as possible in real time.

Benefits/ROI

- Reduced labor cost by approximately £1.2m per year
- Improved plan accuracy and efficiency
- Generates new schedules in minutes
- Flexible solution addresses the business complexity of high number of conditions and constraints



Customer Profile

This university hospital provides general hospital services and specialist care in obstetrics and neonatology, fetal medicine and neuro-rehabilitation.

Workforce Planning and Scheduling Optimization

Screenshot of the IBM Workforce Planning and Scheduling Optimization interface.

Header:

- DASHBOARD
- JOB
- ASSIGN JOB
- ENGINEERS
- 92
- 3.75
- 81.39 Km
- 0
- 147
- planner

Current Assignment: IBM WORKFORCE PLANNING BLD 802 RM W100346 Project Slam 90 min

Status: 0 modified Planned Jobs, 0 unassigned Planned Jobs, 8 Issues found for current assignment

Search: search engineers

Filter: Only compatible Engineers (circled in red)

Timeline: 2 Feb 2016 – 3 Feb 2016

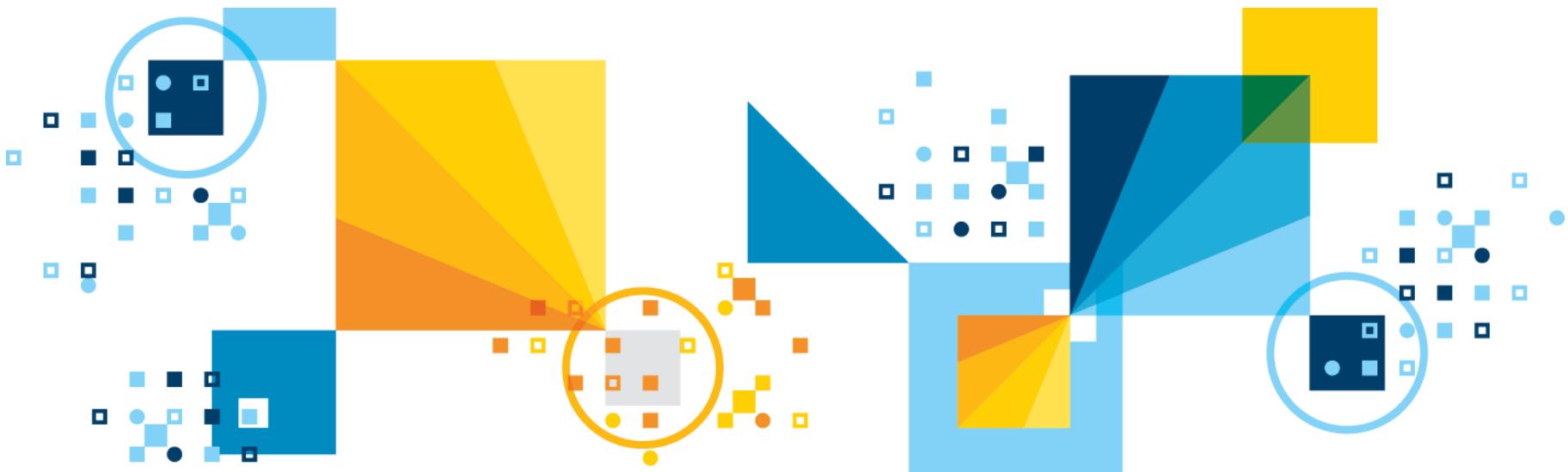
Engineers:

- MARK (9 Km)
- JON (15 Km)
- IAN (34 Km)
- MARK (36 Km)
- COLL (37 Km)
- IAN (37 Km)
- MARK (37 Km)
- ARD (38 Km)
- RY (41 Km)
- ONY (42 Km)
- IES (42 Km)
- HN (43 Km)

Map: Shows locations of assignments across the UK, including Middlesbrough, Stockton-on-Tees, Whitby, Scarborough, Bridlington, York, Harrogate, Bradford, Huddersfield, Sheffield, Chesterfield, Nottingham, Derby, Loughborough, Grantham, Lincoln, and Scunthorpe. Specific assignments are marked with icons and numbers (e.g., J100345, EM, JT) and color-coded markers (purple, green, orange).

Decision Optimization

How does it work ?

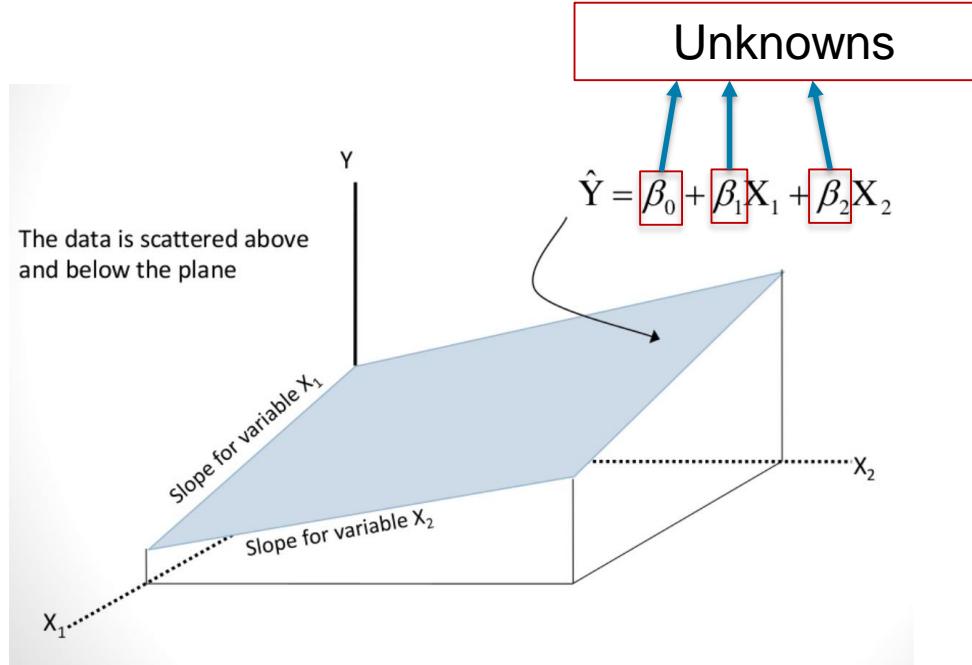


Predictive vs Prescriptive

Predictive model:

For given data, fit/find a model such as

- Regression
- Neural Network
- CHAID
- ...
- ...



Predictive vs Prescriptive

Optimization model:

Define business objectives and constraints, find decisions

Production Facility (PF) PF1 PF2 PF3

Units to Produce ? U1 U2 U3

Production Cost / Unit 100 150 80

DATA

Production Capacity 500 350 300

Total Demand = 1100

Optimization Model

Decision Variables:

Objective Function

Minimize Total Cost

Total Cost =

$100xU1 + 150xU2 + 80xU3$

Unknowns / Decision Variables

Constraints:

$U1 \leq 500 ; U2 \leq 350 ; U3 \leq 300$

$U1 + U2 + U3 == 1100$

What is an optimization model?

A translation of your business problem into math

Business goals /
KPIs

Increase profits

Levers / decisions
affecting goals

*How much product A
should we produce?*

Business “rules”
constraining
decisions

*Production must be less
than plant capacity*



Model objectives

Maximize Profit



Model variables

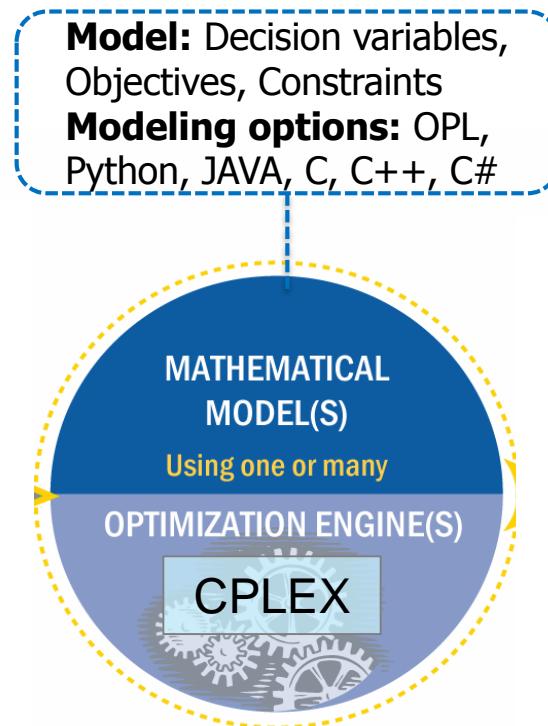
Production_ProductA



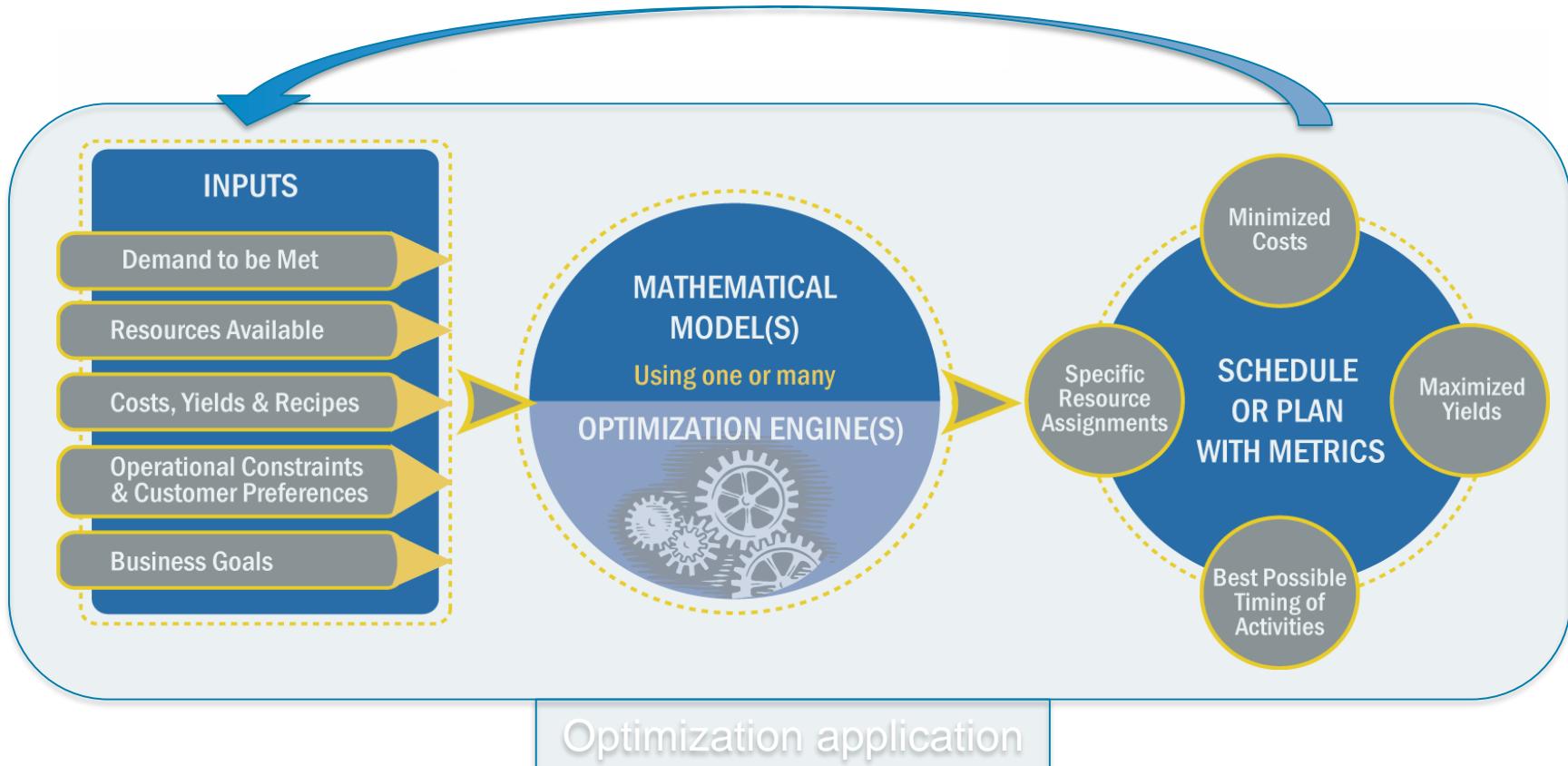
Model constraints

Production_ProductA
 \leq Capacity_A

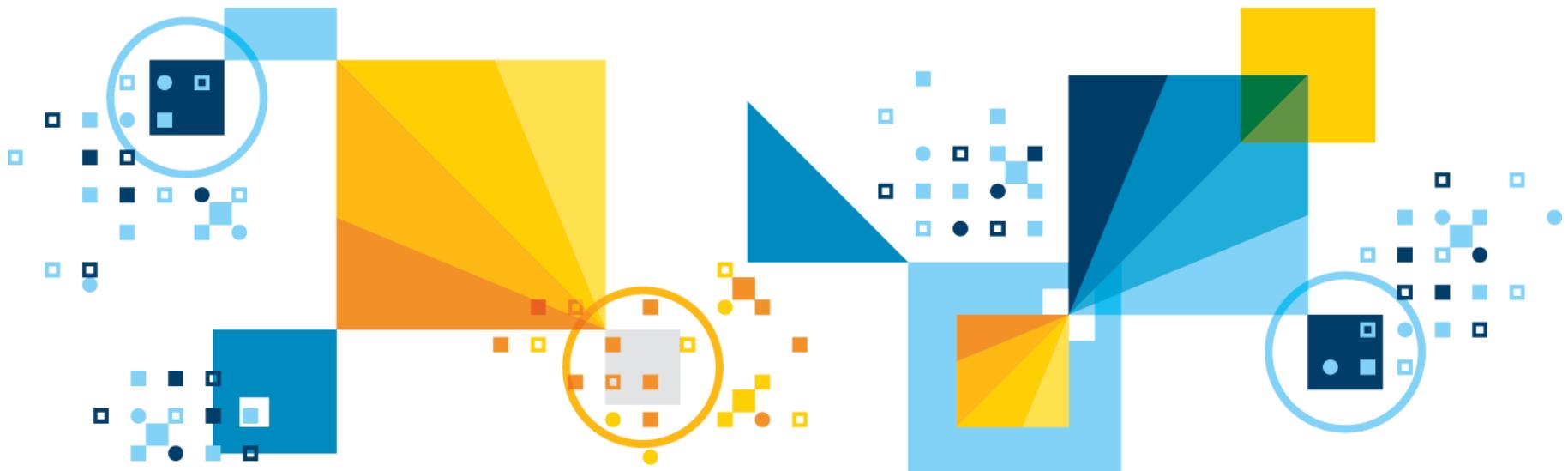
Application building and use



Prescriptive Analytics – How does it work?



Quick Product Review



IBM Decision Optimization (DO) - offering



**CPLEX Solver
On-Prem**



- Solver + model development environment
- Various deployment options



**Decision
Optimization on
Cloud
(DOcplexCloud)**



**Decision
Optimization
Center (DOC)**

- CPLEX Solver on cloud
- Various APIs available to submit, monitor and manage remote solves
- Platform offering for DO applications
- Client Server architecture of distributed applications with thick client, REST API, and scenario management



IBM Data Science Experience

- DO is one of the two key advanced analytics services in DSX
- Can be consumed from Notebooks, R-studio



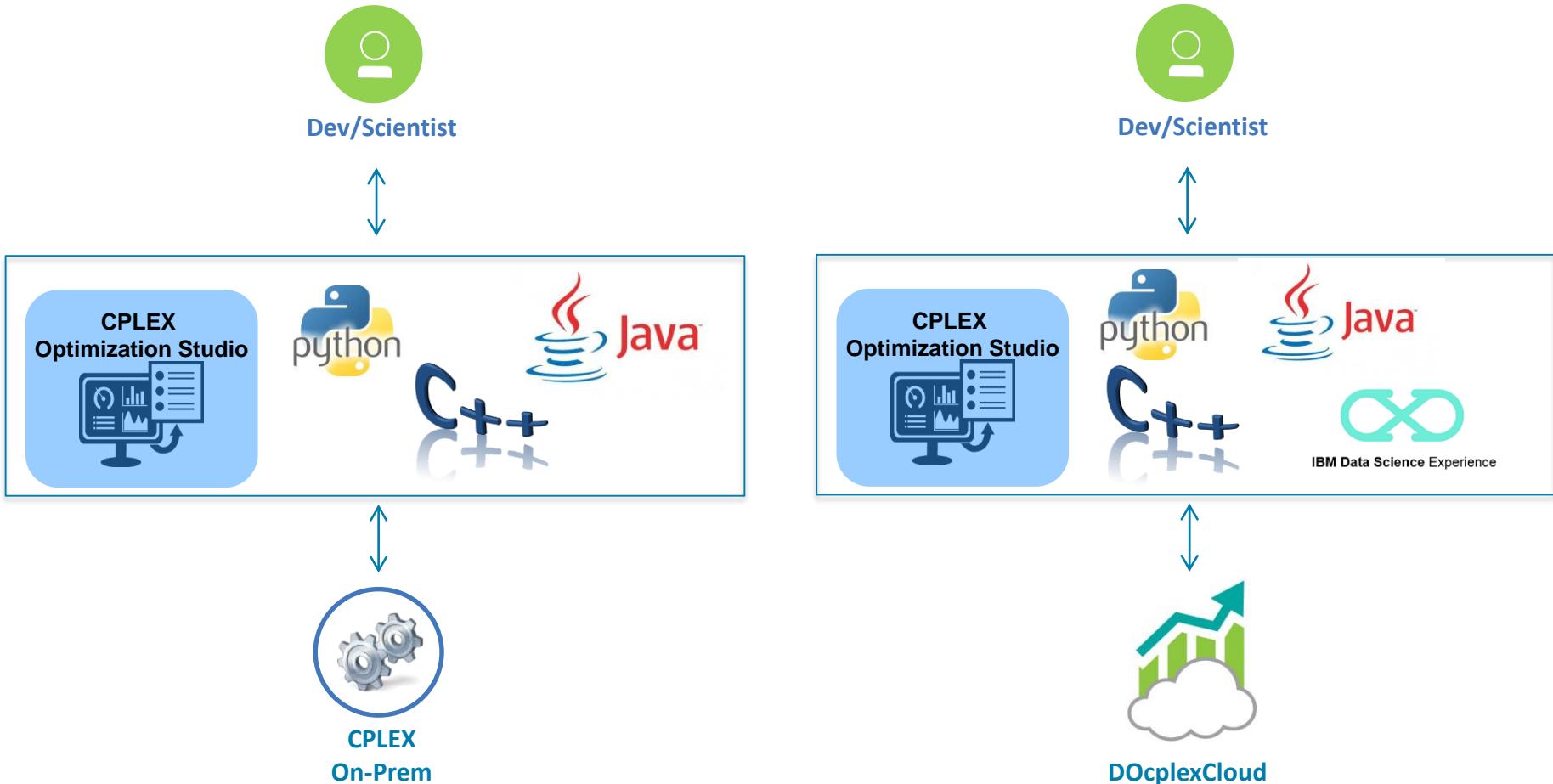
IBM Bluemix™

- DO Catalog service within IBM's cloud development and deployment platform
- APIs are available in REST, Java, Node.js, and Python.



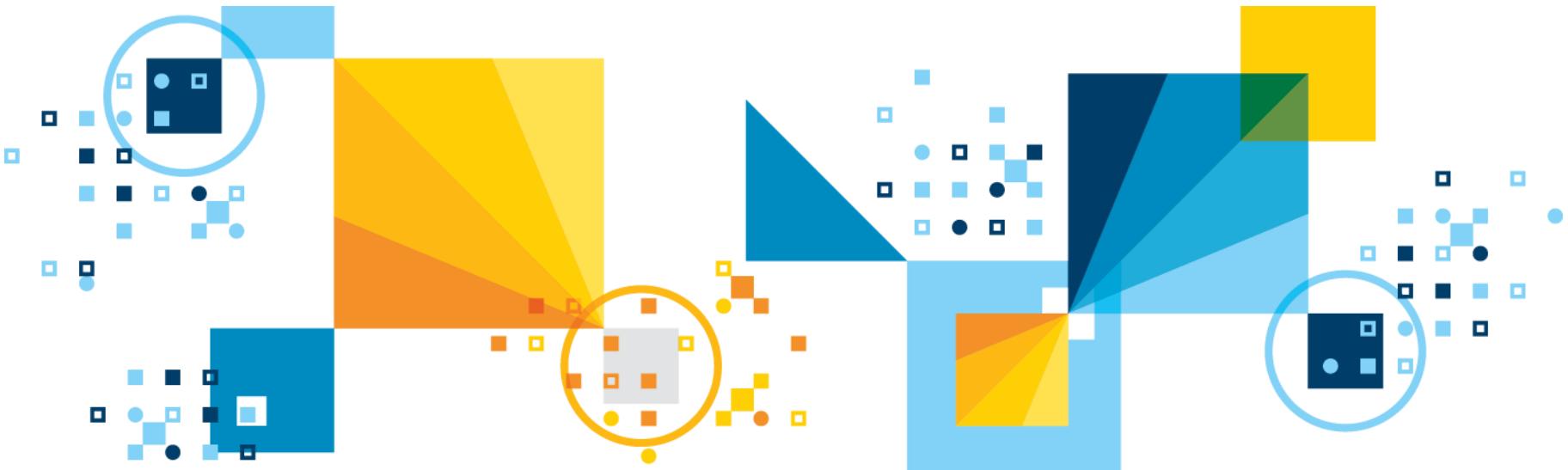
- CPLEX node in SPSS Modeler 18.1
- Default includes limited Community Edition (CE) of CPLEX solver

CPLEX Development options



Product Details

CPLEX Optimization Studio (COS)



CPLEX Studio IDE – Model Development Tools



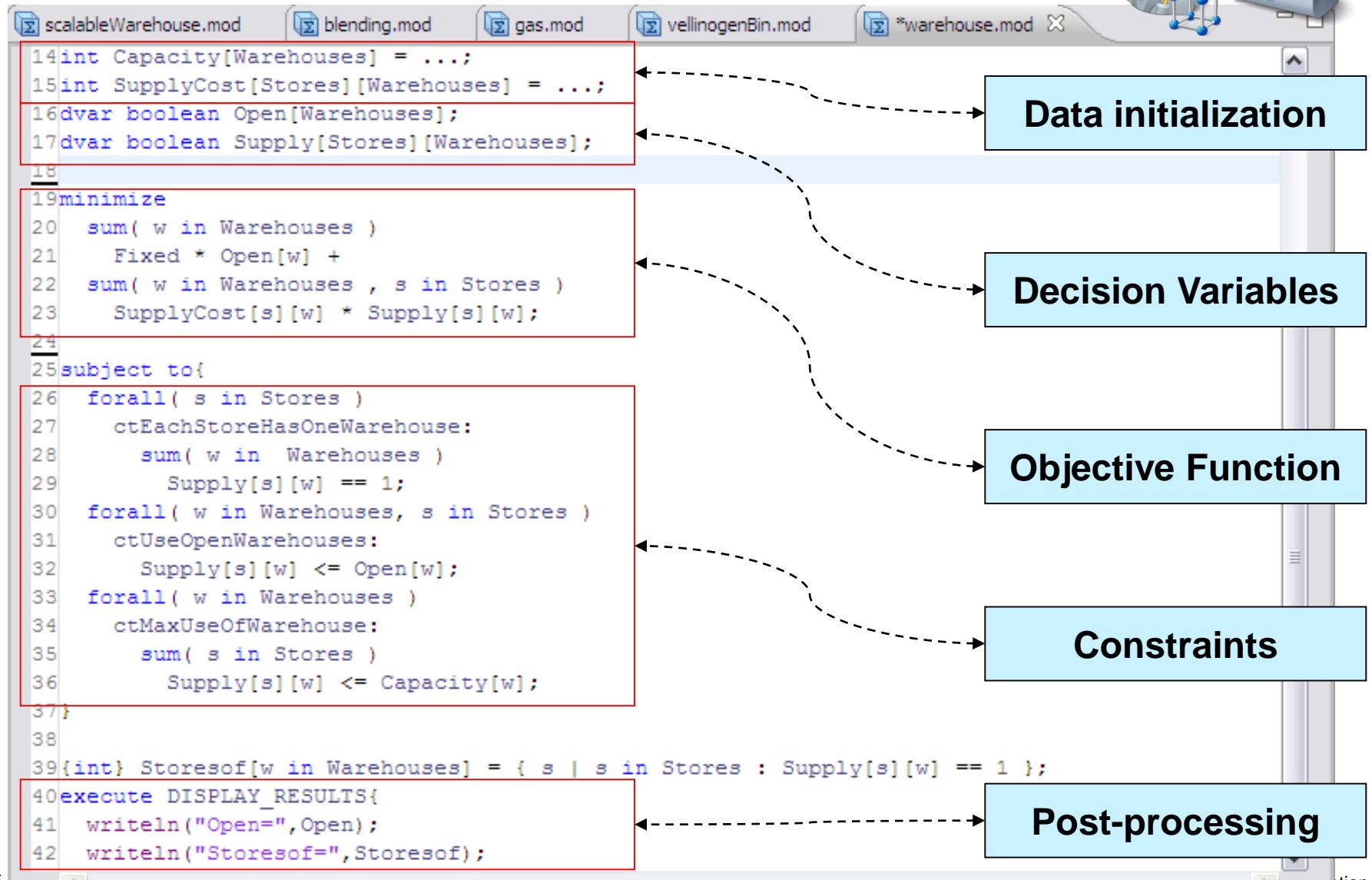
Project navigator

Model/script code editor

The screenshot displays the IBM ILOG CPLEX Optimization Studio interface, which includes the following components:

- Project navigator:** Shows the OPL Projects tree, including vellinocommon.dat, volsay (A simple chemical mix problem, MILP), warehouse (A warehouse location model, Mixed Integer Programming), and several configuration and script files.
- Model/script code editor:** Displays the scalableWarehouse.mod file with CPLEX OPL code. The code defines variables for Warehouses and Stores, sets up constraints for capacity and supply, and minimizes total cost.
- Problem browser:** Shows the Solution with objective 1,480, listing variable values such as NbWarehouses (50), NbStores (200), and various constraint definitions.
- Inspector/output tabs:** Contains tabs for Breakpoints, Problems, Scripting log, Solutions, Conflicts, Relaxations, Engine log, Statistics, and Profiler. The Statistics tab shows Cplex statistics like Constraints (250), Variables (50), and Objective (1,480).
- Problem outline:** A tree view of the model structure, showing nodes like using CPLEX, Internal data, and various decision variables and constraints.
- Graph:** A line graph showing the progress of the optimization process over time (seconds). The Y-axis represents the objective value, starting at 1,500 and decreasing to 1,480. The X-axis represents time from 0 to 6 seconds. The graph tracks Best node (red line), Best integer (green line), and Integer solution (yellow squares).

An example of a model



```
scalableWarehouse.mod blending.mod gas.mod vellinogenBin.mod *warehouse.mod

14 int Capacity[Warehouses] = ...;
15 int SupplyCost[Stores][Warehouses] = ...;
16 dvar boolean Open[Warehouses];
17 dvar boolean Supply[Stores][Warehouses];
18
19 minimize
20   sum( w in Warehouses )
21     Fixed * Open[w] +
22     sum( w in Warehouses , s in Stores )
23       SupplyCost[s][w] * Supply[s][w];
24
25 subject to{
26   forall( s in Stores )
27     ctEachStoreHasOneWarehouse:
28       sum( w in Warehouses )
29         Supply[s][w] == 1;
30   forall( w in Warehouses, s in Stores )
31     ctUseOpenWarehouses:
32       Supply[s][w] <= Open[w];
33   forall( w in Warehouses )
34     ctMaxUseOfWarehouse:
35       sum( s in Stores )
36         Supply[s][w] <= Capacity[w];
37}
38
39{int} Storesof[w in Warehouses] = { s | s in Stores : Supply[s][w] == 1 };
40execute DISPLAY_RESULTS{
41   writeln("Open=",Open);
42   writeln("Storesof=",Storesof);
```

Data initialization

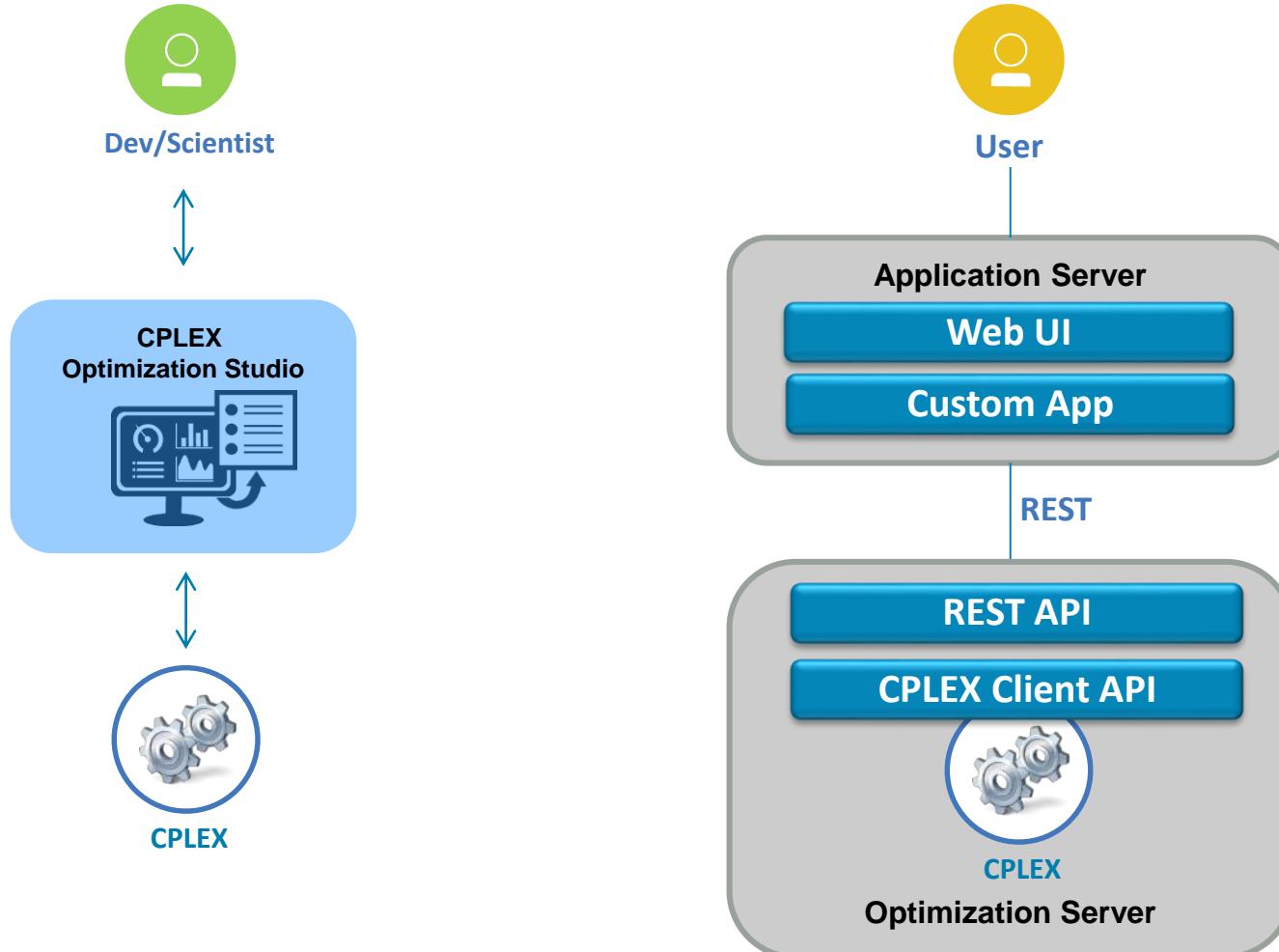
Decision Variables

Objective Function

Constraints

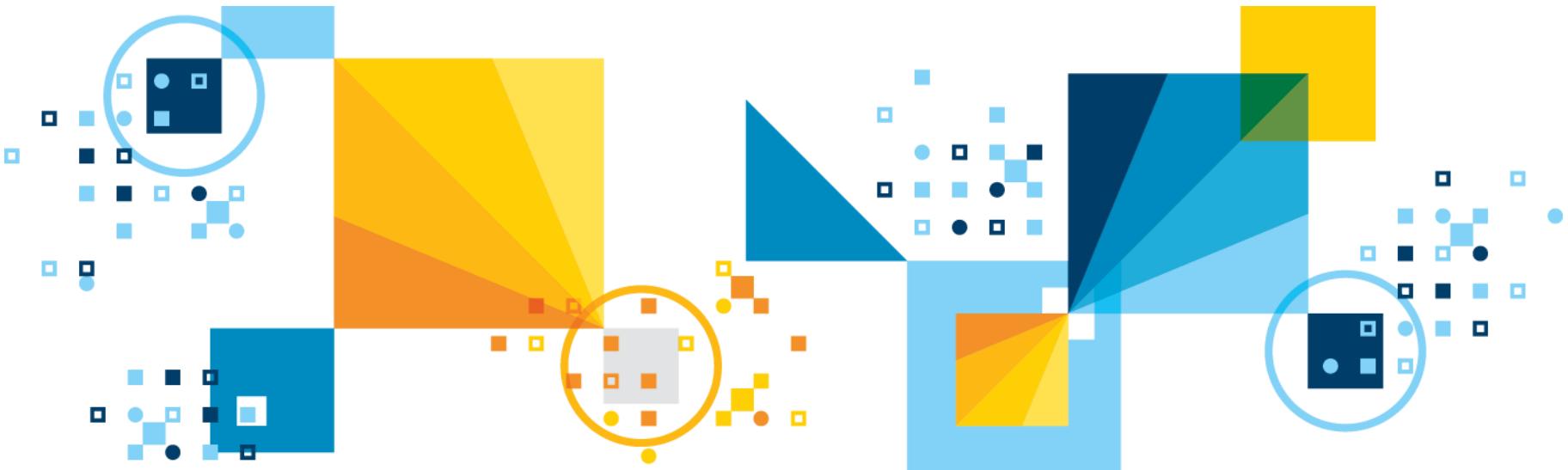
Post-processing

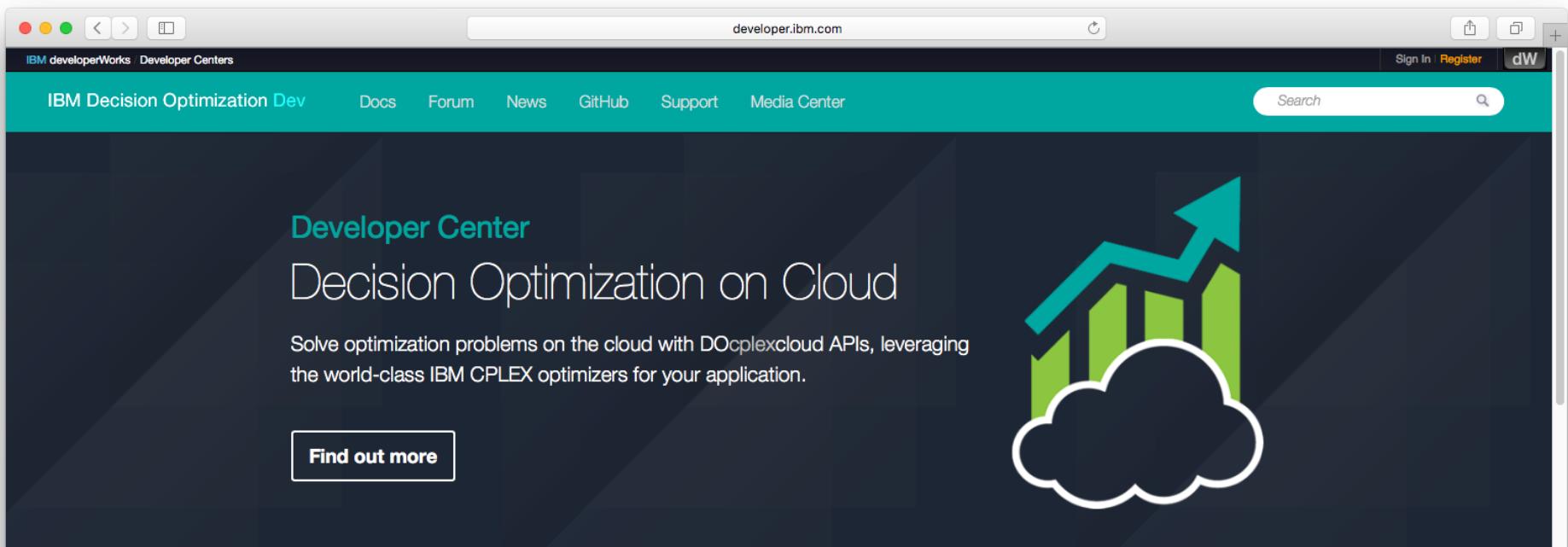
COS – Development and Deployment options



Product Details

Decision Optimization on Cloud (DOcplexcloud)





The screenshot shows the developer.ibm.com website with a teal header bar. The header includes links for IBM Decision Optimization Dev, Docs, Forum, News, GitHub, Support, Media Center, Sign In, Register, and a search bar. The main content area features a dark background with a large white graphic of a bar chart rising from a cloud. The text "Developer Center" and "Decision Optimization on Cloud" is displayed, along with a subtext: "Solve optimization problems on the cloud with DOcplexcloud APIs, leveraging the world-class IBM CPLEX optimizers for your application." A "Find out more" button is visible.



Explore Docs

The information you need at your fingertips.



Find Samples

Get up and running in no time.

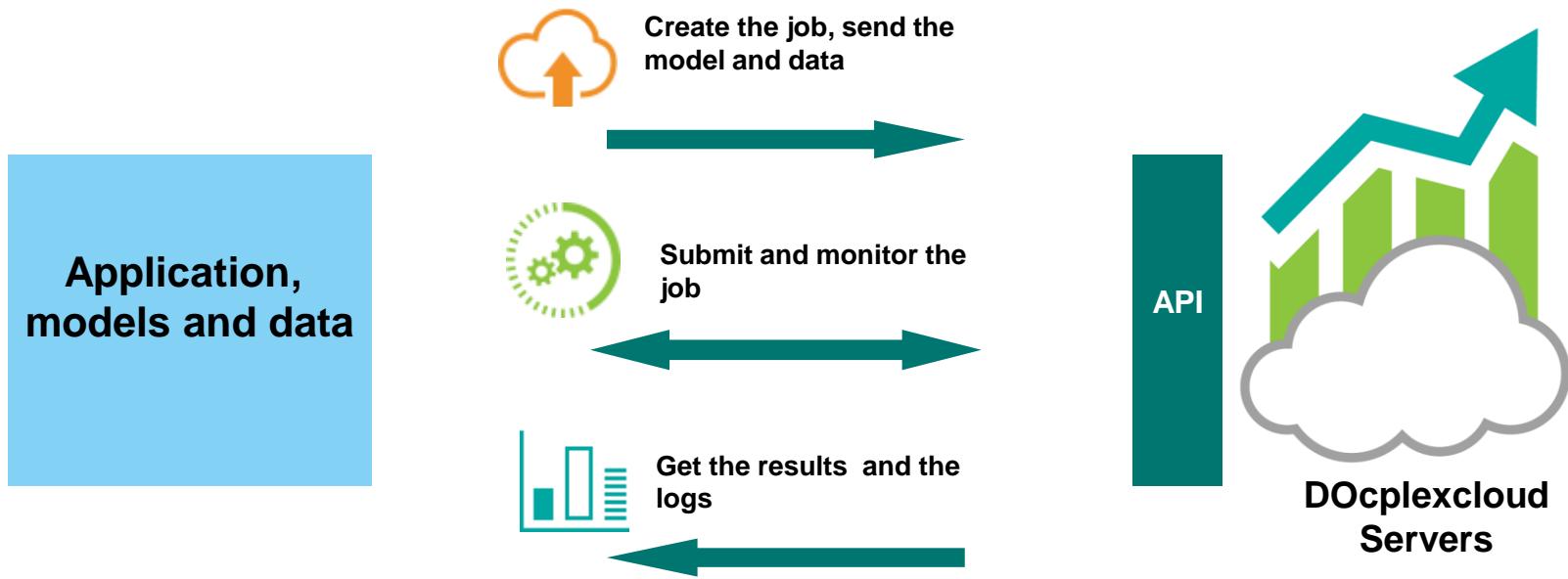


Get Support

Questions? Issues? We are here to help.

DOplexCloud – Enabling Optimization Solutions

Understanding the Integration Principles



▪ Benefits:

- Automate the execution of your optimization problems (OPL and CPLEX) without deploying and maintaining any of the optimization libraries
- Free up application resources and get solutions asynchronously
- Solve more demanding problems by using large configurations



Decision Optimization on Cloud (DOcplexCloud)

There are many ways to solve optimization problems
with Decision Optimization on Cloud



You call a solver from your
Bluemix application using a
DOcplexcloud API.



You call a solver from
your application using a
DOcplexcloud API



You drop an
optimization problem
in the [DropSolve](#)
Website.



You configure
access in your
[optimization](#)
[modeling](#) tool

You have a **Bluemix account** and
use the [Decision Optimization for](#)
Bluemix service.



You subscribe
to a Decision Optimization on Cloud [Pricing](#) plan or Free Trial
via the IBM Market place.

DO cloud solve: modeling and solve options



CPLEX Solver
On-Prem
The CPLEX logo consists of the word "CPLEX" in a bold, pink, sans-serif font, enclosed in a dark grey rectangular box with a thin white border.

Modelling Options

- Optimization Programming Language (OPL)
- Python
- C, C++
- JAVA



**Decision
Optimization on
Cloud
(DOcplexCloud)**

Modelling Options

- Python (full modelling API)
- Optimization Programming Language (OPL)
- JAVA concert – requires model export to .lp, or .sav file

API – to access/control

- JAVA
- Python
- REST
- Node.js
- R



Create the job

Initialize a new job and upload the associated model and data files.



Submit the job

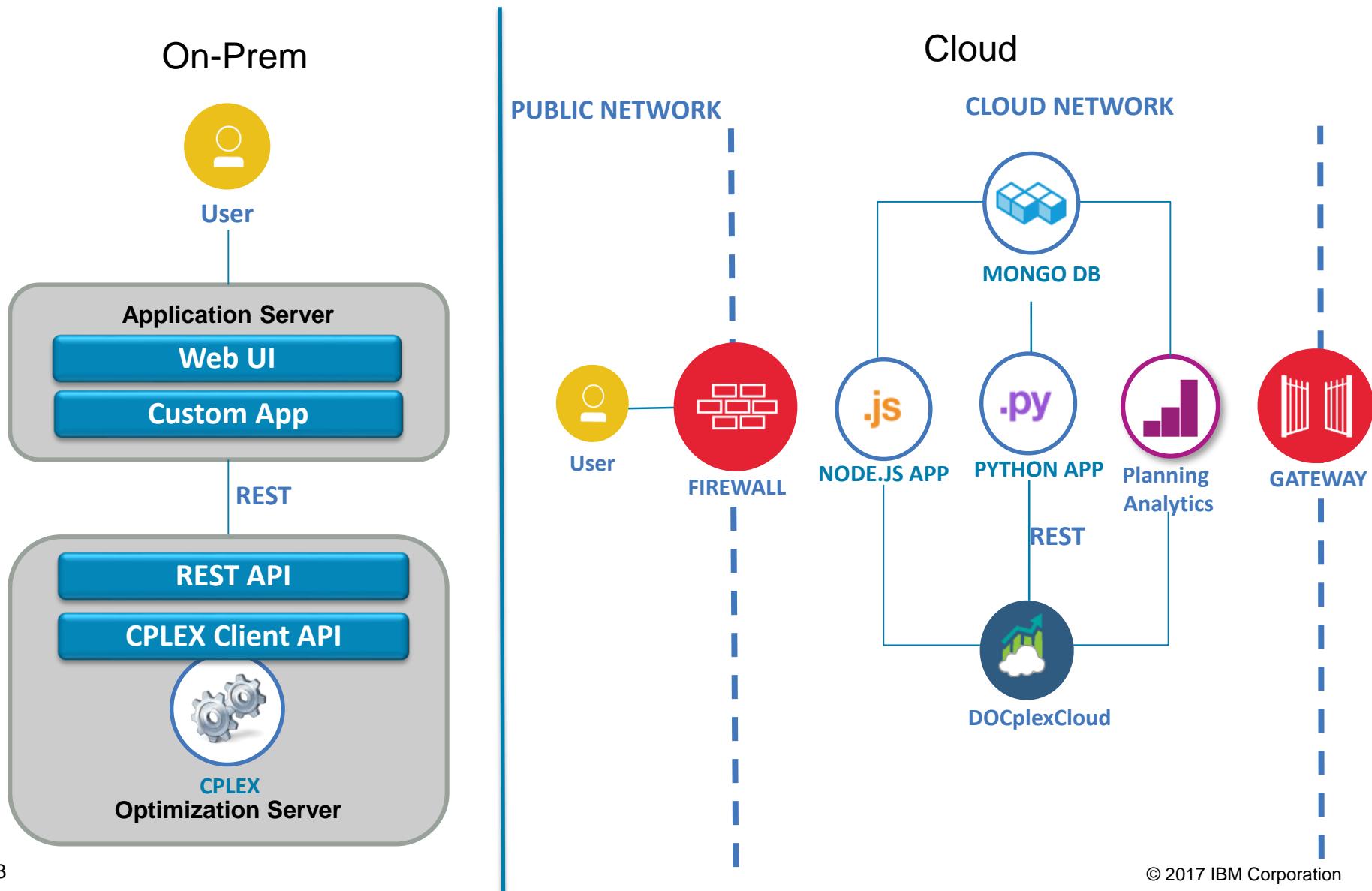
Submit the job to execute and monitor its status.



Get results

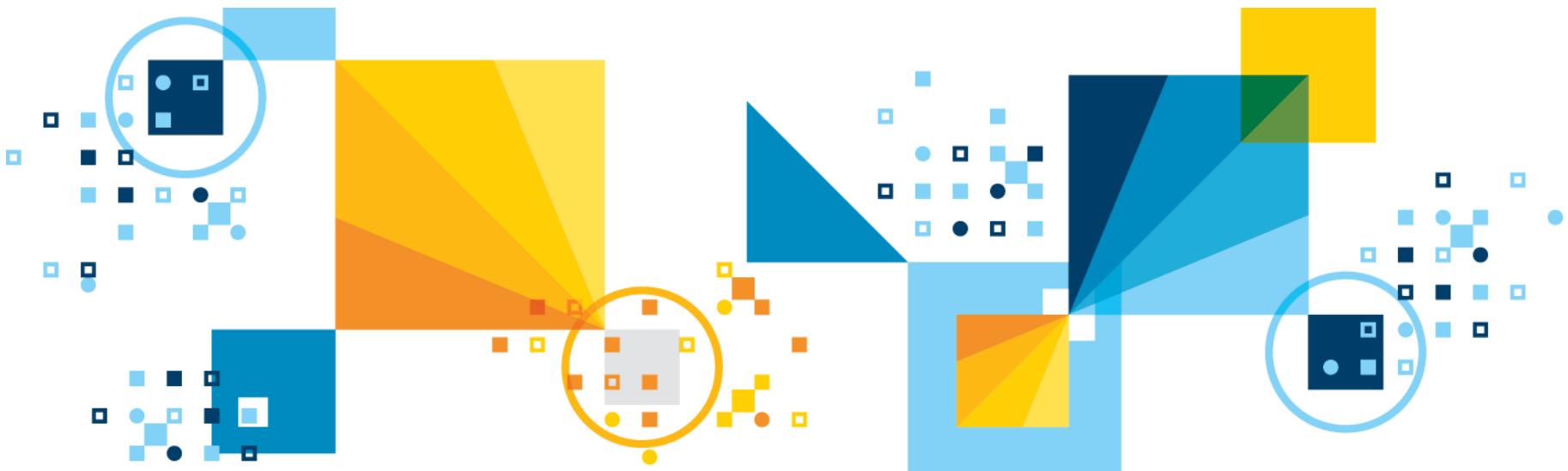
Access results and download them to your application.

CPLEX Deployment – Basic architecture



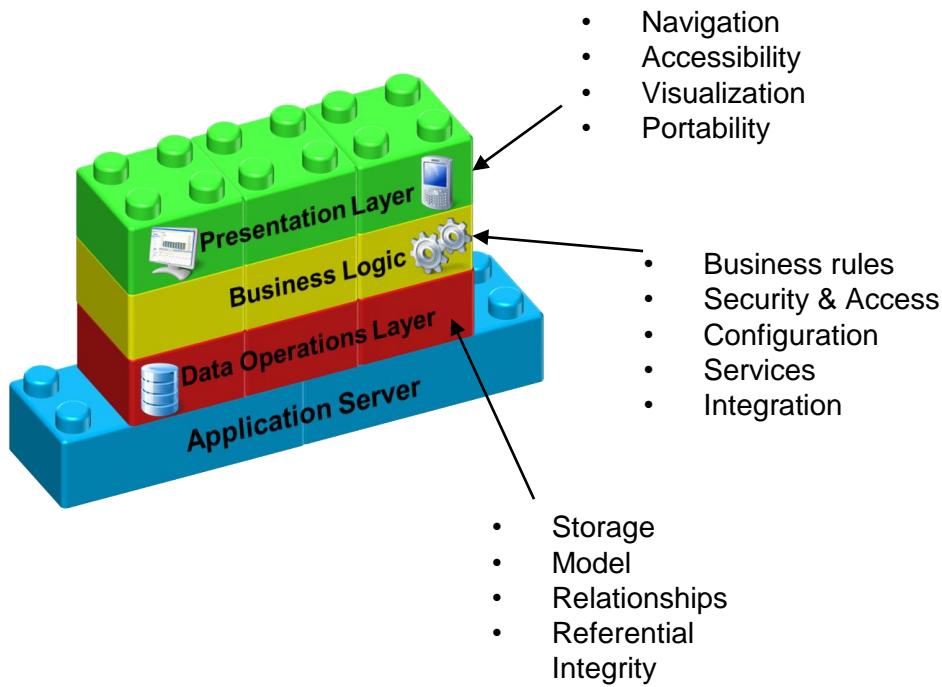
Product Details

Decision Optimization Center (DOC)



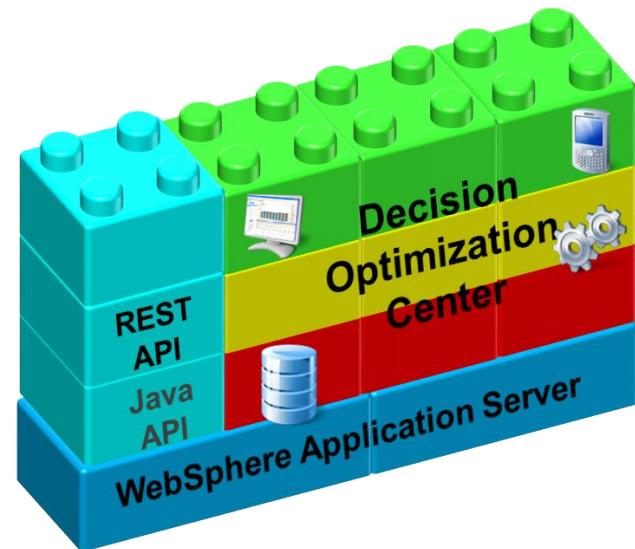
IBM Decision Optimization Center (DOC)

Framework: Software with prebuilt components



DOC: Framework for building Optimization applications

- Configurable Data and UI elements
- Custom UI option

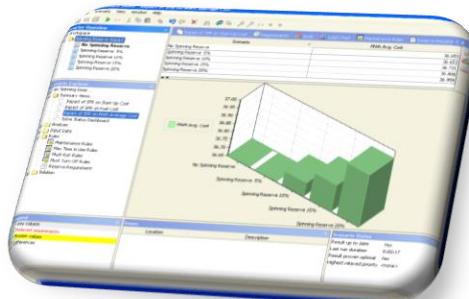


DOC Client

- **Windows native application**
- **Extensible through APIs and Hooks in Java**
- **Optional component**
 - can be replaced by Web Services architecture with REST API
- **Out-of-the-box:**
 - Prioritization of constraints
 - Weighing objectives
 - What-if analysis
 - Scenario management.
 - Multi-scenario comparison.
 - Tables and charts.



Graphs



Charts

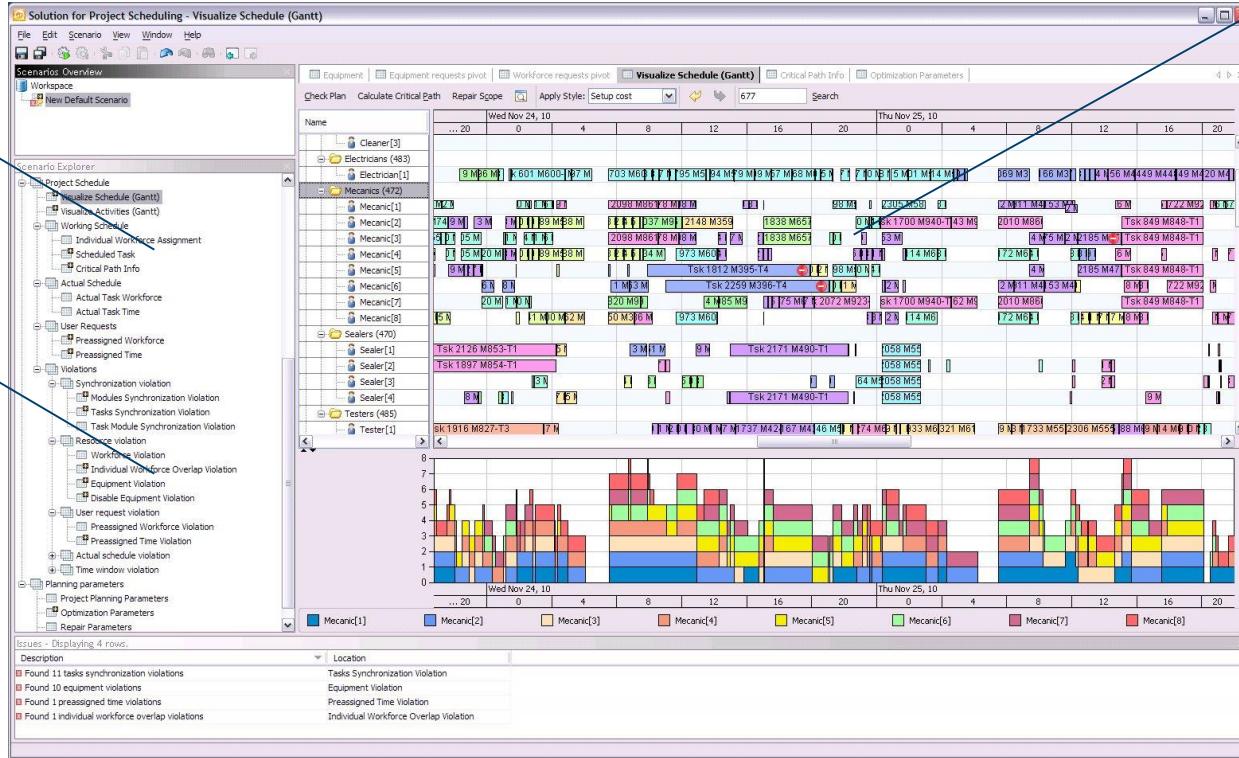


Pivot Tables

DOC for Complex Project Scheduling (CPS)

- Compare multiple scenarios
 - Run What-If Analysis

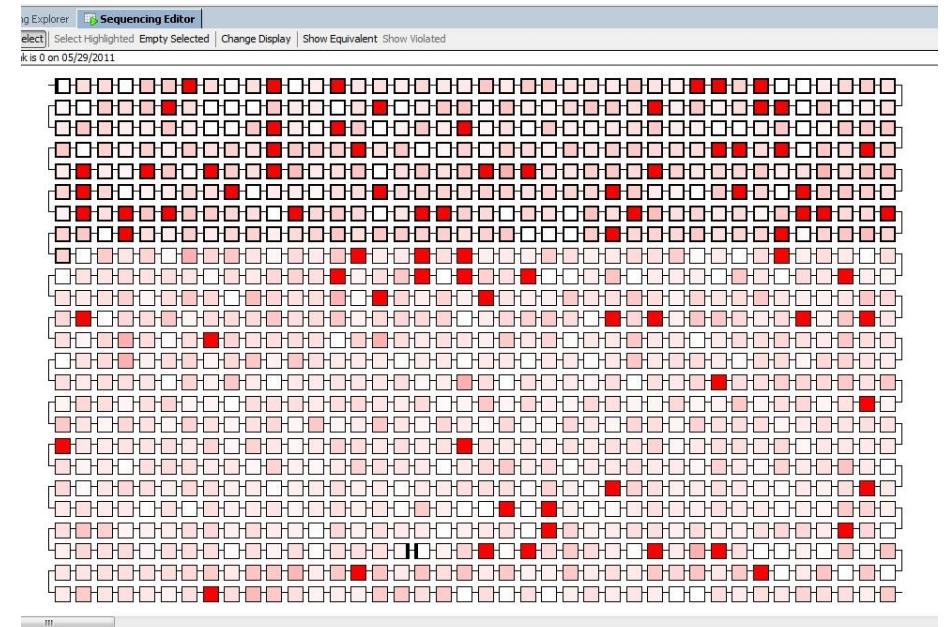
- Master Data: Workers Skills Machines Capacity Zones Time Periods Etc.



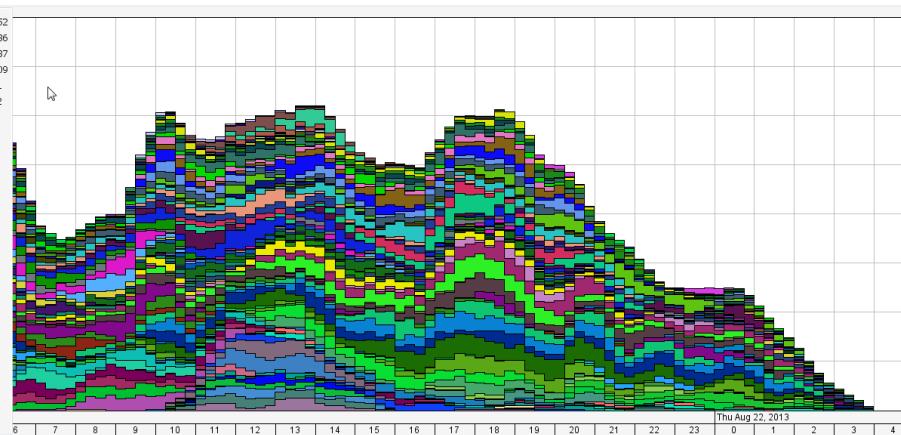
- Drag and Drop
- Dynamic Rescheduling
- Address constraint violations in real time

- Adapt to different quality measures for different industries
 - Multi-Criteria Optimization and KPIs
 - Performance and Scalability to manage hundreds of thousands of tasks

DOC Custom Data Visualizations



10A	18G	22G	4L	55Z
10B	18H	22H	4L	73E
10C	19A	22I	4L	137
10D	19B	23A	5A	V09
10F	19C	23B	25B	5C
10G	19D	23C	25C	5E
10H	19E	23D	25D	5G
12A	19F	23E	25E	5J
12B	19G	23F	25F	5M
12C	19H	23G	25G	6J
12D	20A	23H	25H	7A
12H	20B	23I	25I	7B
13A	20C	23J	25J	7C
13B	20D	23K	25K	7E
13C	20E	23L	25L	7G
13D	20F	23M	25M	7I
13E	20G	24A	3D	7K
13F	20H	24B	3D	8A
13G	21I	24C	3F	8B
13H	21J	24D	3G	8C
18A	22A	24E	3H	8D
18B	22B	24F	3I	8H
18C	22C	24G	3J	C8
18D	22D	24H	3Q	144
18E	22E	24I	4J	P12
18F	22F	24J	4K	S51



DOC Application example

Vehicle Routing with map view

Tank Level Chart - Trip Parts

Tank Level Monitoring

Geo Map

Mapnik **OsmFileCacheTileLoader** **Global Fit** **Autofit**

Trips

- 01-Feb
- 02-Feb
- 03-Feb
- 04-Feb
- 05-Feb
- 06-Feb
- 07-Feb
- 08-Feb
- 10-Feb

This is the 6th of February. A plan has been produced and is being executed. It covers an horizon of 5 days.

To review the produced plan, the planner is using the "Tank Level Monitoring" layout.

The geographical view shows

- Vendor Managed Inventory tanks (in orange)
- Order only tanks (in green)
- Production Area (green triangle)
- Depot Area (in black)

Tank Level Chart

Trip Viewer

Tanks

KPIs

Level Alerts

Tanks

1000010

Major In future

Status	Tank	Period	Date	Details
Major	100003	212	Sun Feb 10 00:00:00 CET 2013	TANK_LEVEL_MRP Below MRP in 5 days
Major	100004	239	Mon Feb 11 03:00:00 CET 2013	TANK_LEVEL_MRP Below MRP in 6 days
Major	100004	239	Mon Feb 11 03:00:00 CET 2013	TANK_LEVEL_MRP Below MRP in 6 days
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Major	1000014	172	Fri Feb 08 08:00:00 CET 2013	TANK_LEVEL_MRP Below MRP in 3 days
Major	1000014	219	Sun Feb 10 07:00:00 CET 2013	TANK_LEVEL_MRP Below MRP in 5 days
Major	1000016	141	Thu Feb 07 01:00:00 CET 2013	TANK_LEVEL_MRP Below MRP in 2 days

Consumed Received Fixed Reorder Point Past

Min Reorder Point Tank level Max level

25,000
20,000
15,000
10,000
5,000
0

1 2 3 4 5 6 7 8 9 10 11

Tank Level Monitoring

Task: Perform Routing Runs Result not up to date Run duration: 0:01:52

DOC Application Example

Explaining The Results: Scenario Comparison

Scenarios Overview

Workspace

Production Tests

Baseline [Reference]

New packing station on LAX1

Forecast Tests

New Forecast for Q1 [Current]

Test for Pacific Region Carriers

Marketing Campaigns

Marketing Campaign for 05L Bottles

Production Plan Pivot

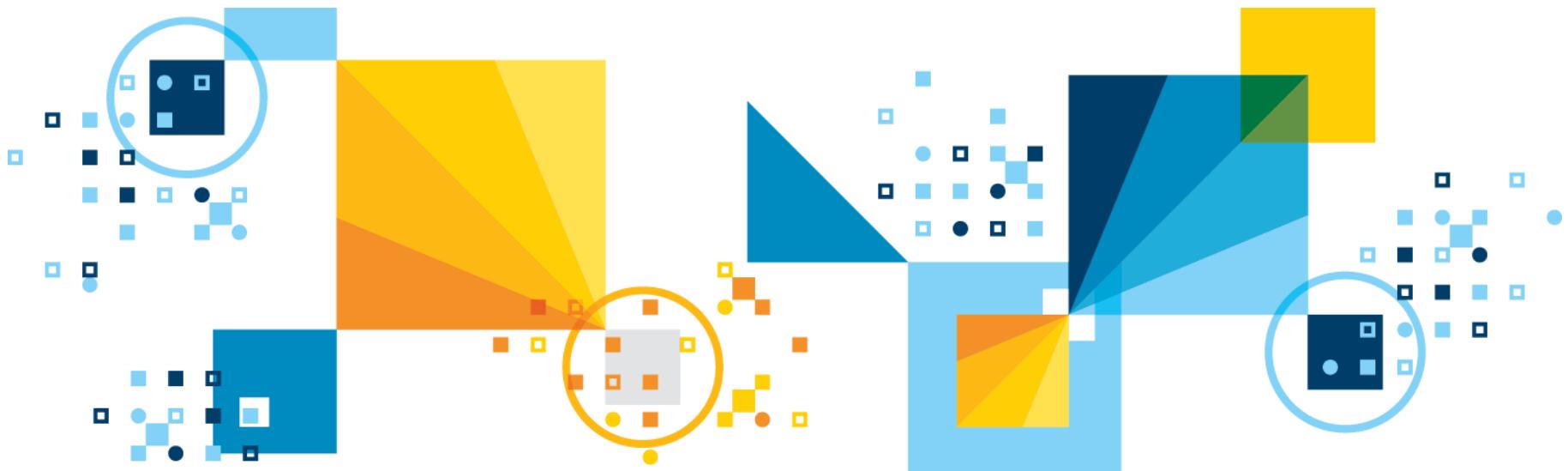
Filter is not active. Displaying 12 rows.

Drop Filter Fields Here

Forecast Month ↑ ▾

Region	05L	Nov-12	Dec-12	Jan-13
MID-ATLANTIC	05L	4,738	5,210	
MIDWEST	05L	10,272	11,197	
NORTHEAST	05L	8,446	13,626	
PACIFIC	05L	9,824,038	13,336,881	
	10L	252,388	310,047	
	15L	1,990	7,239	
	1GP	228,049 (684,147)	257,775 (773,325)	335,182
	80Z	257,650	315,715	
SOUTHEAST	05L	5,781	8,726	
	80Z			
SOUTHWEST	05L	2,746	4,667	
Grand Total		10,596,098 (11,052,196)	14,271,083 (14,786,633)	16,020,227 (

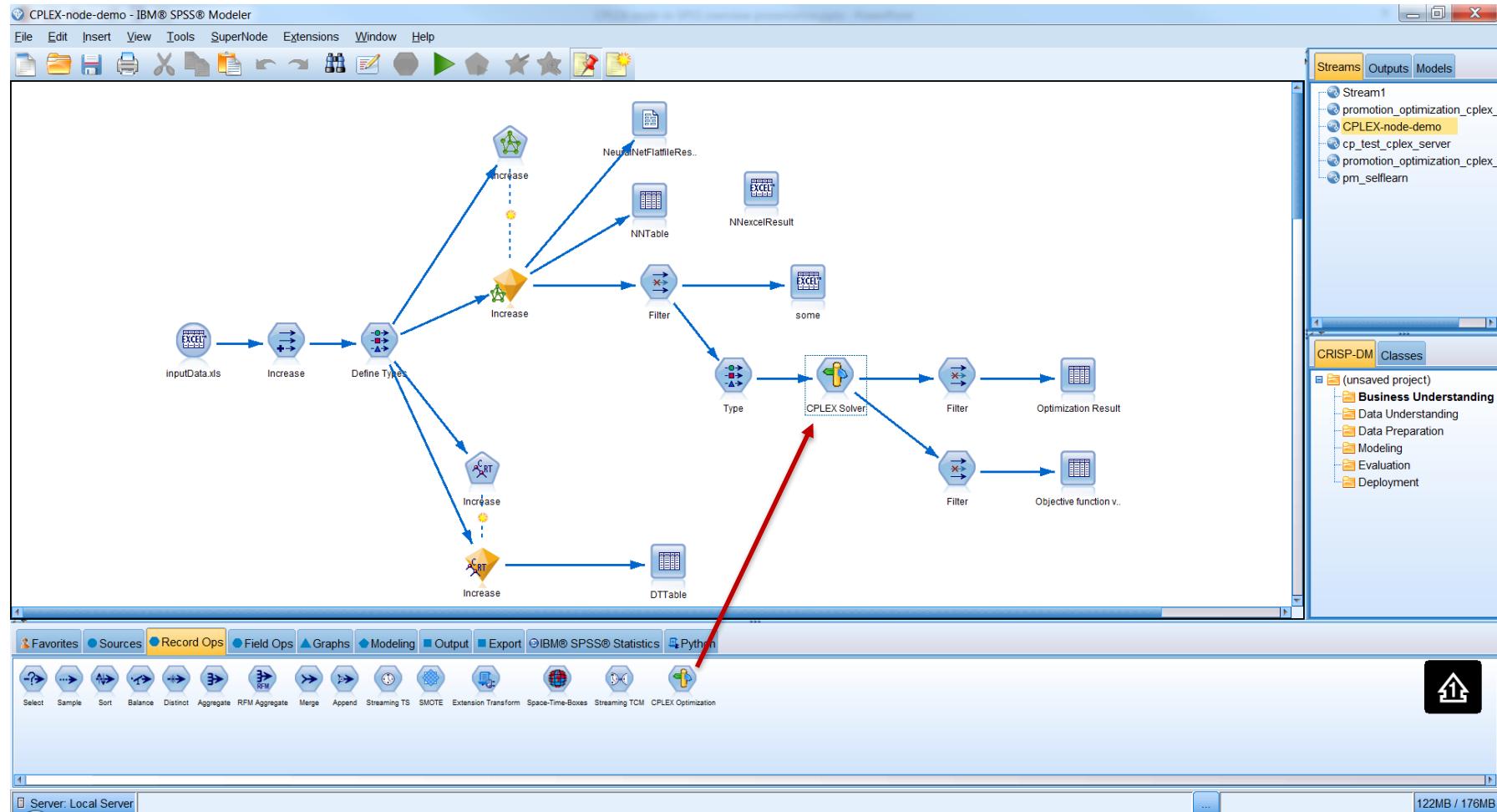
CPLEX node in SPSS



CPLEX node in SPSS - Overview



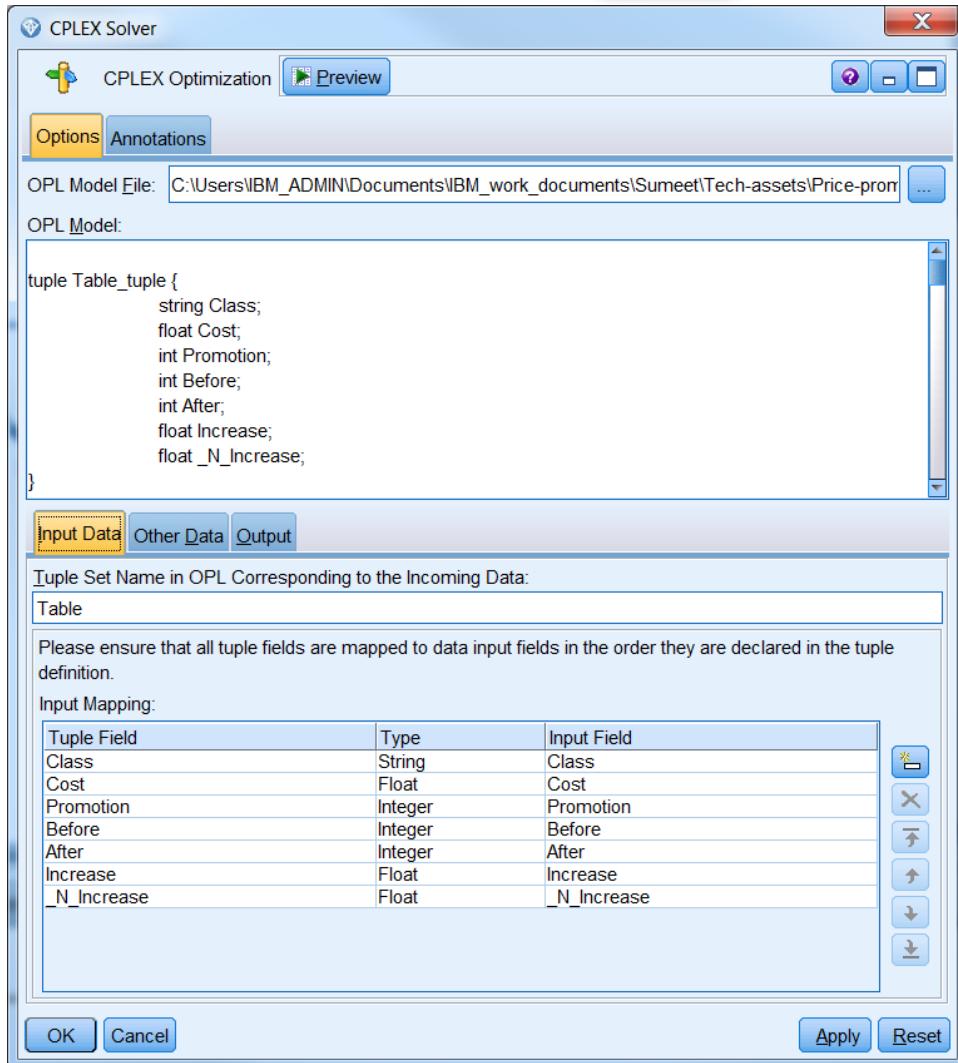
- Modeler 18.1 comes packaged with CPLEX Community edition (model limited to 1000 variables, 1000 constraints)



CPLEX node in SPSS - Overview



- Run Optimization Programming Language (OPL) models
- Run OPL script
- Input Data:
 - Input data to OPL model Tuple
 - Additional data option
- Output Data:
 - Objective function value
 - Decision Variable values



The screenshot shows the 'CPLEX Solver' dialog box. At the top, there are tabs for 'CPLEX Optimization' (selected), 'Preview', 'Options' (highlighted in yellow), and 'Annotations'. The 'OPL Model File' field contains the path: C:\Users\IBM_ADMIN\Documents\IBM_work_documents\Sumeet\Tech-assets\Price-prom... . Below it, the 'OPL Model:' section displays the following OPL code:

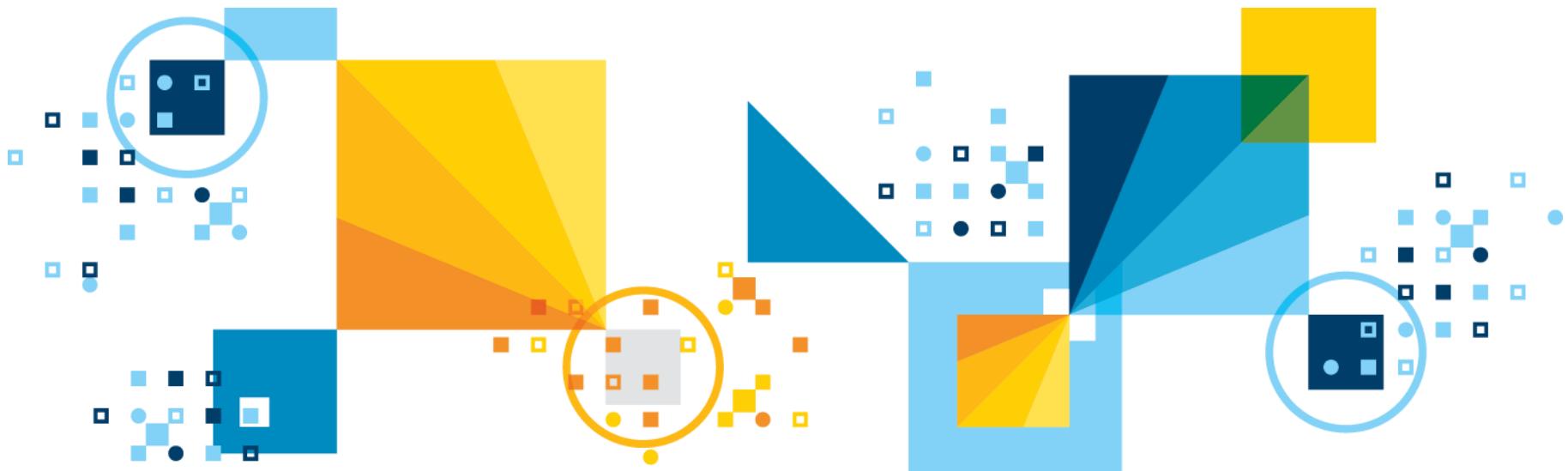
```
tuple Table_tuple {  
    string Class;  
    float Cost;  
    int Promotion;  
    int Before;  
    int After;  
    float Increase;  
    float _N_Increase;  
}
```

Below the code, there are three tabs: 'Input Data' (selected), 'Other Data', and 'Output'. Under 'Input Data', it says: 'Tuple Set Name in OPL Corresponding to the Incoming Data: Table'. A note below states: 'Please ensure that all tuple fields are mapped to data input fields in the order they are declared in the tuple definition.' The 'Input Mapping:' table lists the fields and their corresponding types and input fields:

Tuple Field	Type	Input Field
Class	String	Class
Cost	Float	Cost
Promotion	Integer	Promotion
Before	Integer	Before
After	Integer	After
Increase	Float	Increase
_N_Increase	Float	_N_Increase

At the bottom of the dialog box are 'OK', 'Cancel', 'Apply', and 'Reset' buttons.

DO in DSX



IBM Data Science Experience (DSX)

IBM Data Science Experience



Community

- Find tutorials and datasets
- Connect with Data Scientists
- Ask questions
- Read articles and papers
- Fork and share projects

Open Source

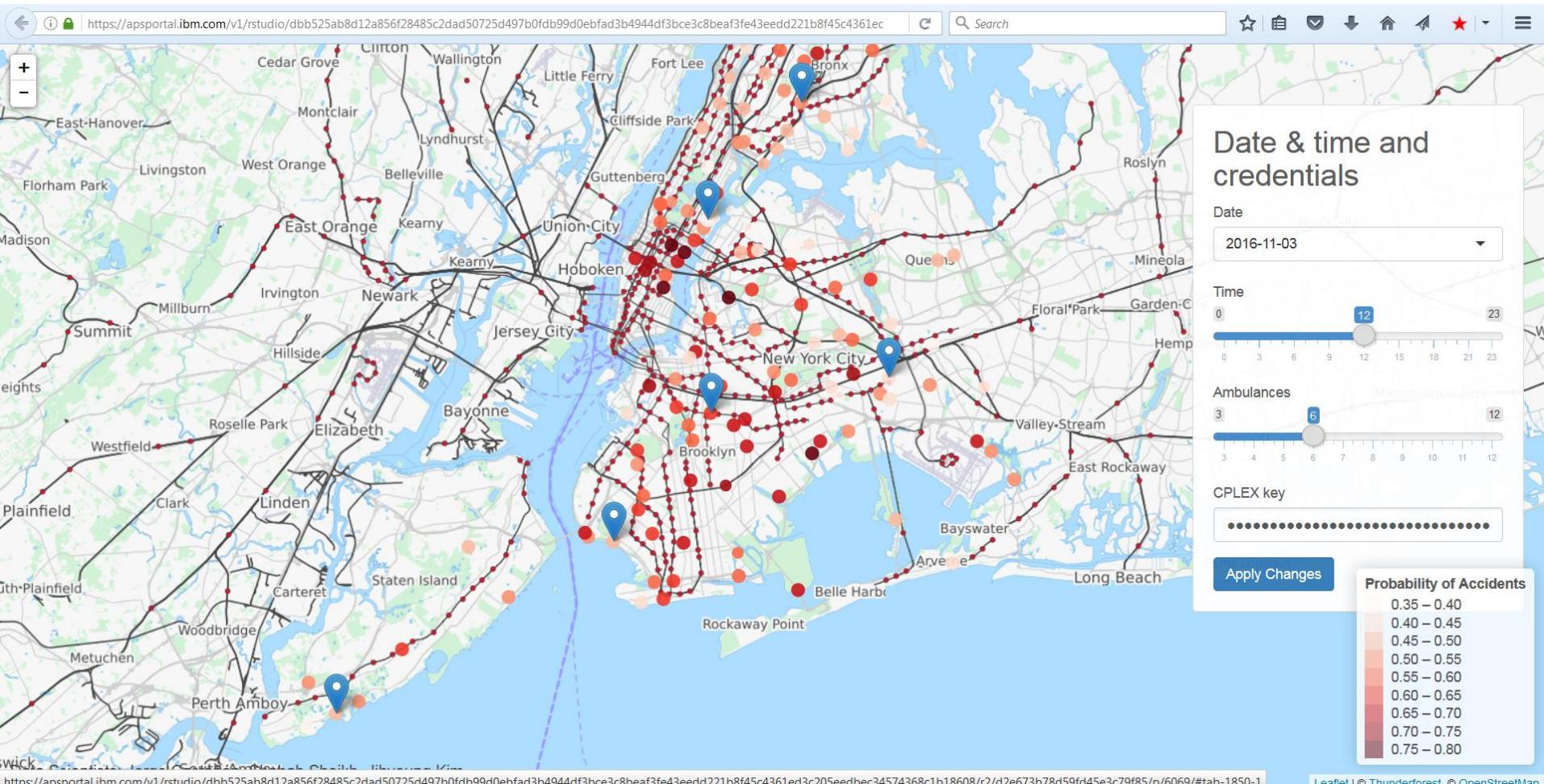
- Code in [Scala/Python/R/SQL](#)
- Jupyter Notebooks
- RStudio IDE and Shiny
- [Spark ML](#)
- Your favorite libraries

IBM Added Value

- IBM Machine Learning
- SPSS Modeler Canvas
- [Prescriptive Analytics – Decision Optimization \(CPLEX\)](#)
- Projects and Version Control
- Managed Spark Service

Powered by IBM [Watson Data Platform](#)

Positioning ambulances based on accident predictions



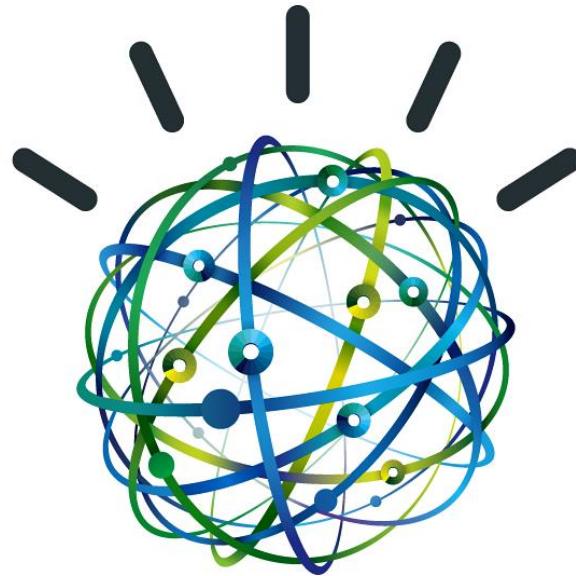
Summary: What Can Optimization Do?

Optimization helps businesses make complex decisions and trade-offs about limited resources:

- **Drive business process using high level KPIs**
 - Compliance with business policies and regulations
 - Free up planners and operations managers so that they can leverage their expertise across a wider set of challenges
- **Better Decisions Faster**
 - Automatically evaluate millions of choices
 - Trade off value against limited resources
- **Explore more scenarios and alternatives**
 - Understand trade-offs and sensitivities to various changes
 - Gain insights into input data
 - View results in new ways

THANK YOU !!

Questions ?



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Backup

Prescriptive Analytics: History & Brand Names

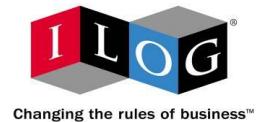
- **CPLEX**

- Acquired by ILOG in 1997



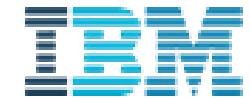
- **ILOG**

- Acquired by IBM in 2009 (founded in 1987)



- **IBM Decision Optimization**

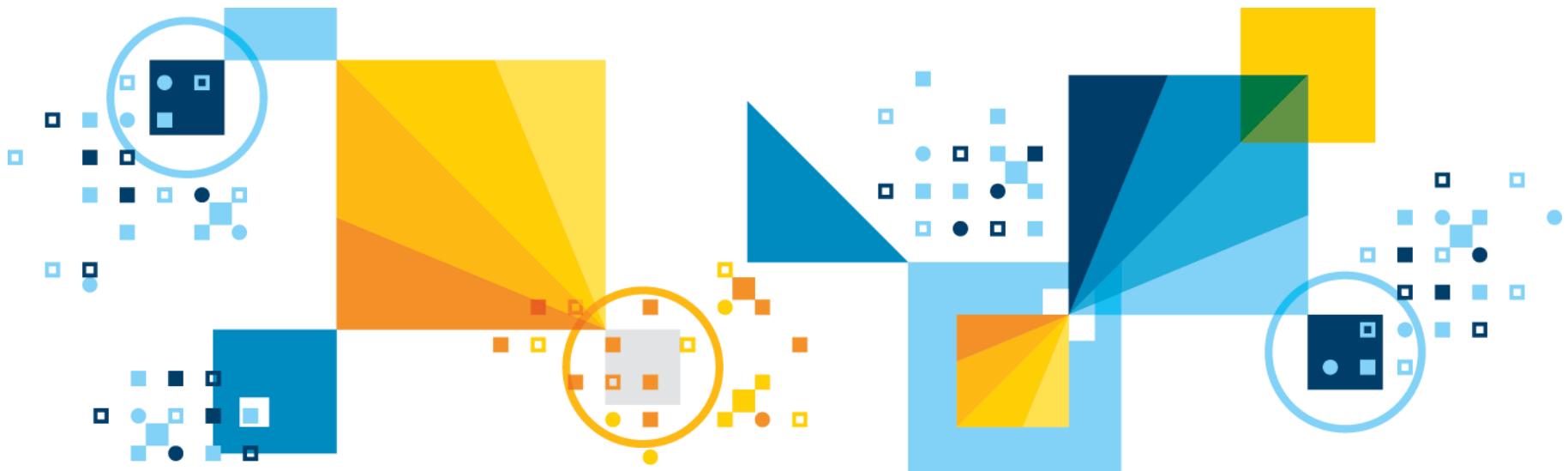
- Part of IBM Analytics in 2015



- **IBM Decision Optimization Product Names**

- IBM CPLEX Optimization Studio (COS)
 - IBM Decision Optimization Center (DOC)
 - IBM Decision Optimization on Cloud (Docplexcloud)

Applications / Use cases



Re-allocation of Paramedic Units (City of Ottawa)

- Paramedic units re-allocation to different posts for maintaining coverage while minimizing travel times; overtime and taking into account human factors like meal-breaks
 - Minimize max-travel time
 - Minimize number of moves
 - Minimize travel times to individual posts (higher priority posts getting more preference)
 - Minimize re-routings
- Constraints
 - Tactical units cannot be positioned at Low Density (population) posts
 - Certain units having preference at higher priority posts
 - Low Density units preference to be assigned to their base post
 - Human factor constraints around eating periods
 - Incentivize relocation of an unit from mobile post (if there for too long)

Vehicle Routing Replenishment Optimization demo

Tank Level Chart

The geographical view shows:

- Vendor Managed Inventory tanks (in orange)
- Order only tanks (in green)
- Production Area (green triangle)
- Depot Area (in black)

Trips

- 01-Feb
- 02-Feb
- 03-Feb
- 04-Feb
- 05-Feb
- 06-Feb
- 07-Feb
- 08-Feb
- 10-Feb

This is the 6th of February. A plan has been produced and is being executed. It covers an horizon of 5 days.

To review the produced plan, the planner is using the "Tank Level Monitoring" layout.

Tank Level Chart

Legend:

- Consumed
- Received
- Fixed Reorder Point
- Min Reorder Point
- Past
- Tank level
- Max level

Graph Y-axis: 0, 5,000, 10,000, 15,000, 20,000, 25,000. X-axis: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11.

Level Alerts

Status	Tank	Period	Date	Details
Major	100003	212	Sun Feb 10 00:00:00 CET 2013	TANK_LEVEL_MRP Below MRP in 5 days
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Nissan UK drives down costs with production planning and scheduling optimization



Key Challenges:

- Production of a new model for the European market was awarded.
- Meeting production requirements within very tight deadline without disrupting the production for existing models.
- To deliver this third model, the plant had to increase output efficiency, making optimal use of existing facilities which in time required tighter and more accurate planning.



Business benefits:

30% throughput

increase without an investment in a new production line

85%

Schedule adherence after the new solution went into production (up from 3%)

Minutes

To create new plans down from days with the old process

Nissan UK

Production of a 3rd car model alongside the previous 2 models on the same 2 production lines.

Produces around 334,000 cars each year at its plant in northern England. The plant is recognized as the most efficient in Europe and the eleventh most efficient in the world.
- 2001

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