

The Intersection of OR and Data Science Opportunities, Challenges, and Innovation

LNMB - 2018.01.18



AIMMS

Gertjan de Lange

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Gertjan de Lange



Member of the leadership team of AIMMS. Worked with many different customers and partners in distinct roles to enable the successful use of the AIMMS optimization technology. In addition, actively promoting the use of analytics, and specifically the use of optimization to potential users and research analysts in and outside the Operations Research community. Recently took up the role as Product Owner AIMMS

Gertjan works in the Seattle (WA, USA) office and holds MSc degree in Applied Mathematics (OR) of University of Twente.

AIMMSian since 1995



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About AIMMS

- > Is a Software Technology Company
- > Founded in 1989 by Johannes Bisschop, a math professor
- > Employs over 50 highly skilled people
- > Enables to rapidly build, configure and roll-out business apps
- > Provides built-in prescriptive analytics engines

A Purpose Driven Company



Vision

‘Software is eating the world’



Mission

Bring the benefits of **optimization** to society



Brand Promise

We will support you to get the best out of your business



Selection of our Customers

Air Liquide

Anadarko

ArcelorMittal

G.S.R. de nederlandse verzekeringsmaatschappij voor alle verzekeringen

BR PETROBRAS

POLITIE

Remia

xerox

POST

BASF
The Chemical Company

BNP PARIBAS

BOON EDAM

REWE

ROLLS ROYCE

SANOFI

van hessen

bp

Cargill

Chevron

DEPARTMENT OF ENERGY

SASOL

Shell

SK energy

DEPARTMENT OF ENERGY

DEPARTMENT OF TRANSPORTATION UNITED STATES OF AMERICA

DOW

easyJet

SynCrude

TNT

Unilever

FMC Technologies

GE

Geisinger Health Plan

GM

REPSOL

zalando

HEINEKEN

HÖGH AUTOLINERS

JBS

jo

n

sapa

M&S
EST. 1884

linksbridge

MARATHON

M&S MODE

Nampak

SUZANO
PAPEL E CELULOSE

Itaú

nielsen

North Star Alliance

Ontario
NATURAL RESOURCES

PAPYRUS

YARA

LIBERTY GLOBAL

Nike

ExxonMobil

agrifirm

ASML

AIMMS

AIMMS Academic Community

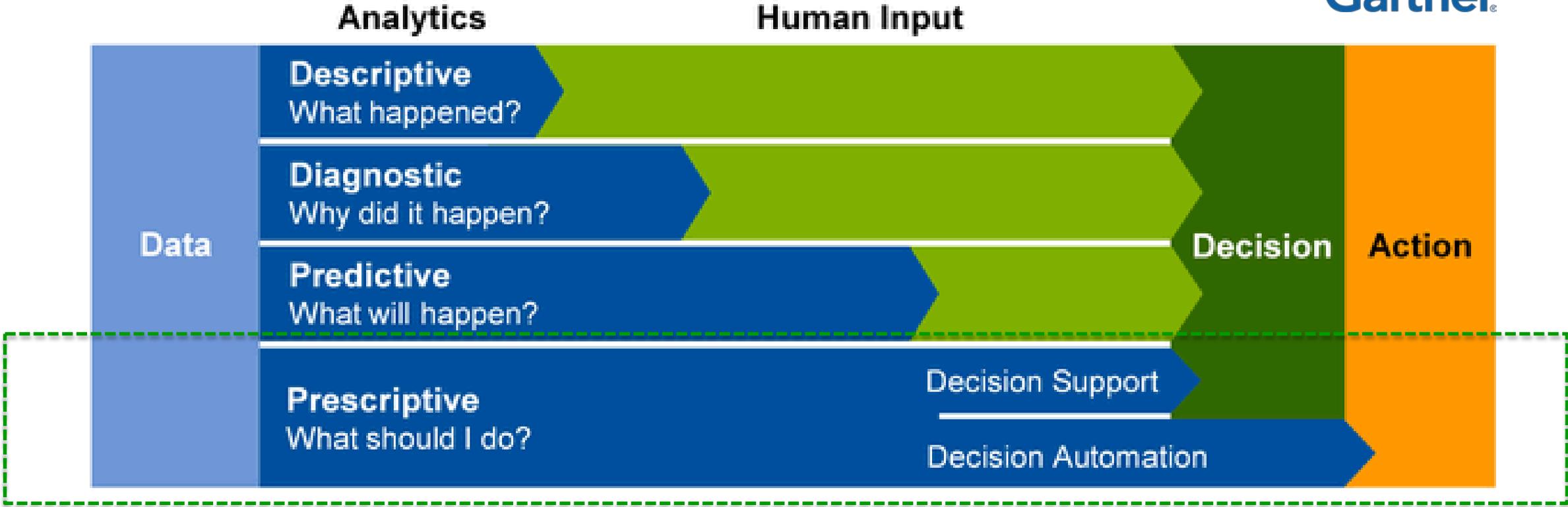
 Budapest University of Technology and Economics	 Carnegie Mellon University	 香港城市大學 City University of Hong Kong	 TU Delft Delft University of Technology	 GEORGE MASON UNIVERSITY	 HARVARD UNIVERSITY
 HUMBOLDT-UNIVERSITÄT ZU BERLIN	 LSU LOUISIANA STATE UNIVERSITY	 MIT Massachusetts Institute of Technology	 Stanford University	 LSE THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE	 THE UNIVERSITY OF EDINBURGH
 清华大学 TSINGHUA UNIVERSITY	 UTS UNIVERSITY OF TECHNOLOGY, SYDNEY	 UNIVERSITY OF WASHINGTON 1861	 THE UNIVERSITY OF WISCONSIN MADISON	 VirginiaTech	

> 6,500 Registered Academic
Individuals in December 2017
at > 700 Universities

Quick Product Overview

Positioning in field of Analytics

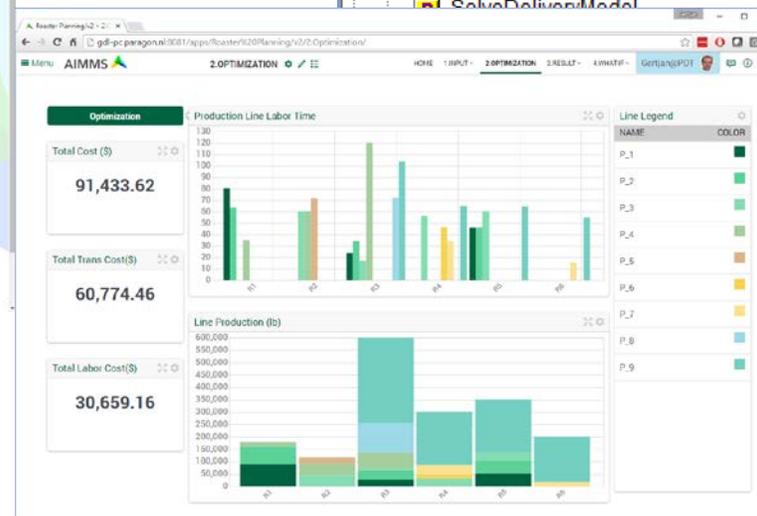
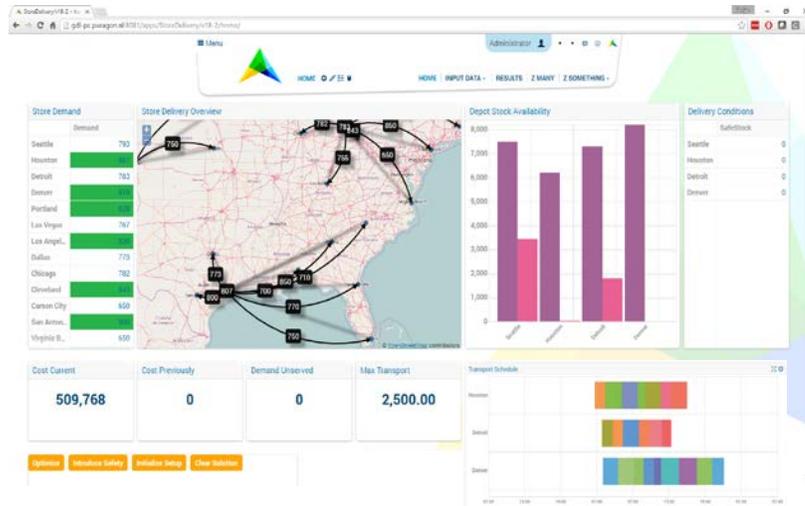
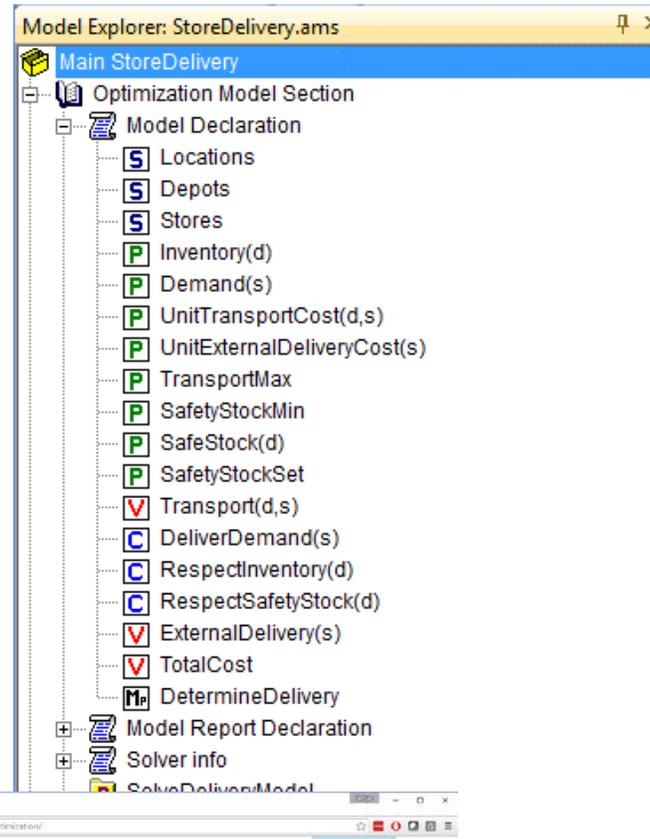
Gartner



The advantage over regular analytics is the output of a **recommended action**.

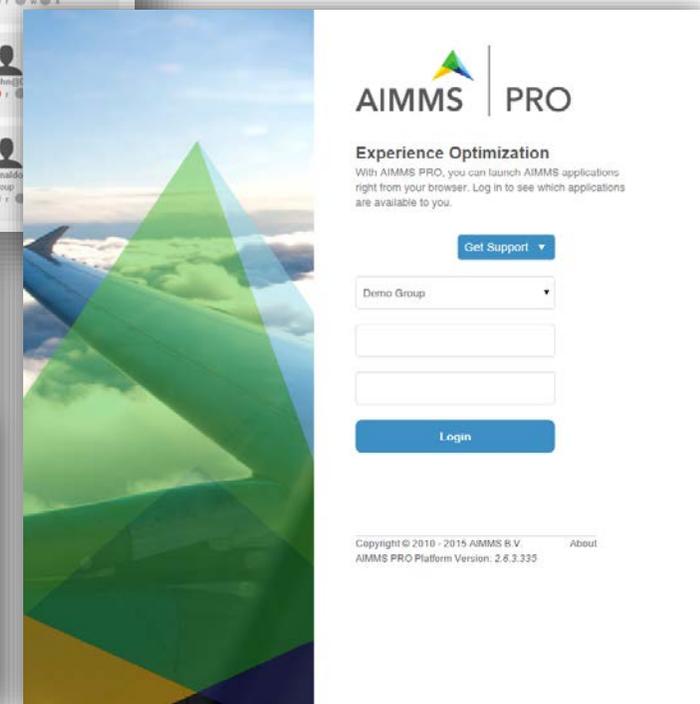
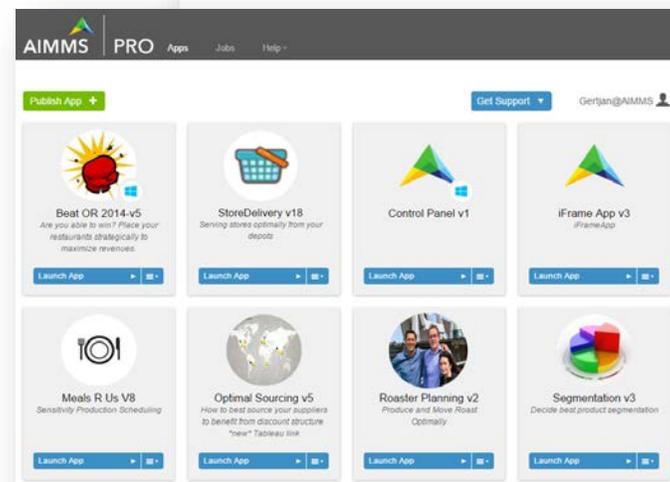
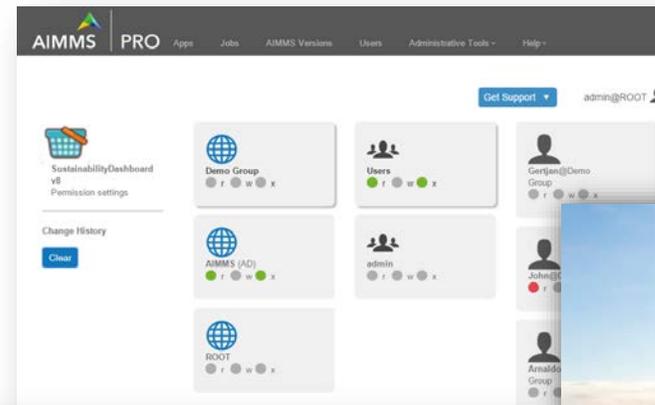
AIMMS Toolset characteristics

- Easy to model
- Flexible & Fit for purpose {‘glass box’}
- Gain direct insights of results
- Attractive & Easy to use



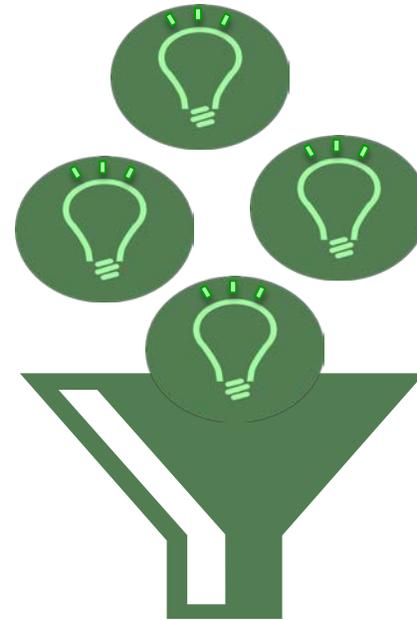
AIMMS Toolset characteristics

- Easy to model
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- Scalable
- Easy to integrate
- Easy to deploy



AIMMS Toolset characteristics

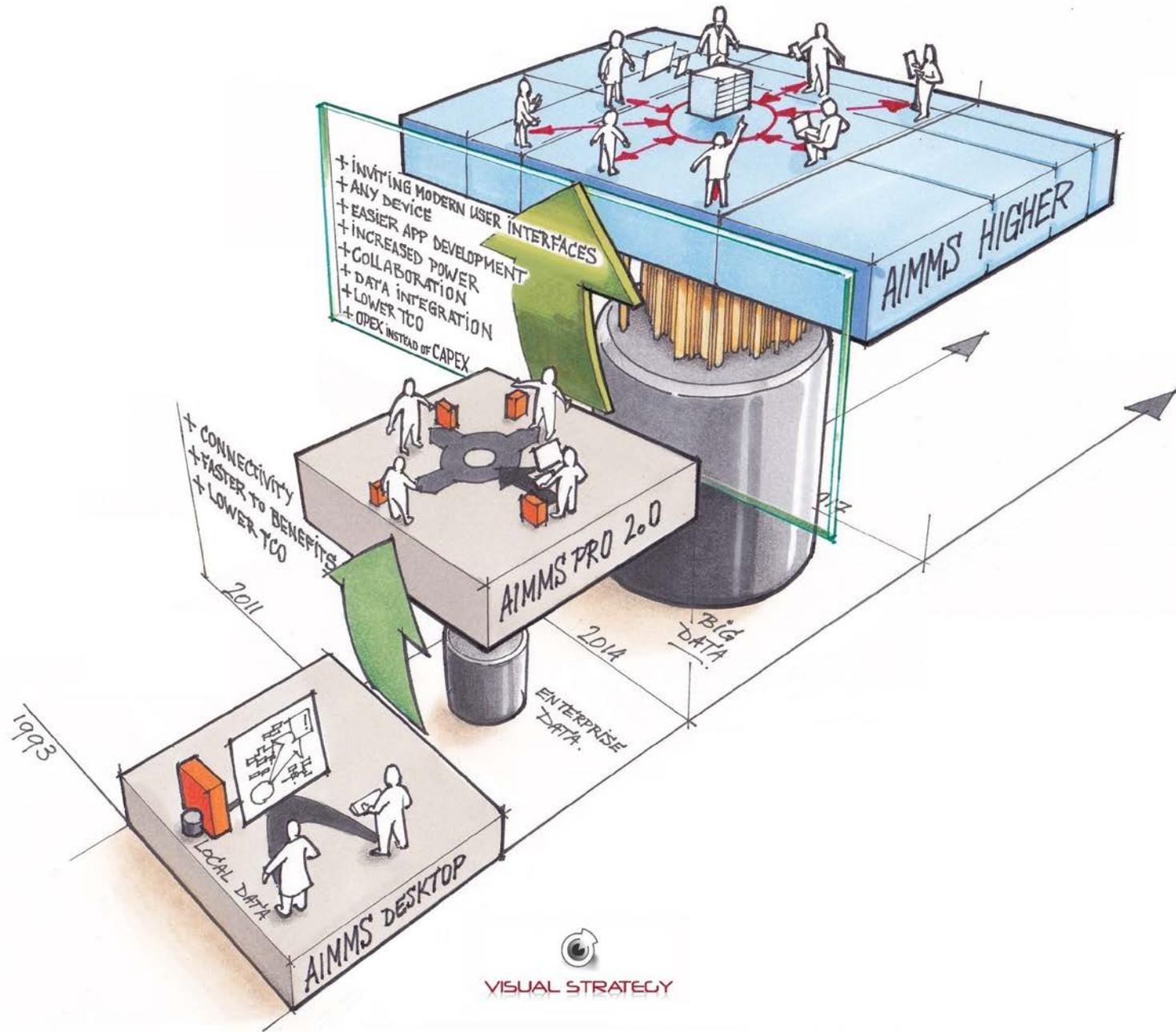
- Easy to model
- Flexible & Fit for purpose {'glass box'}
- Gain direct insights of results
- Attractive, Interactive & Easy to use
- Collaborative
- Scalable
- Easy to integrate
- Easy to deploy
- Stimulate innovation
- Deliver Value



Simple
Fast
Secure
Reliable



AIMMS
Cloud
Platform



1982

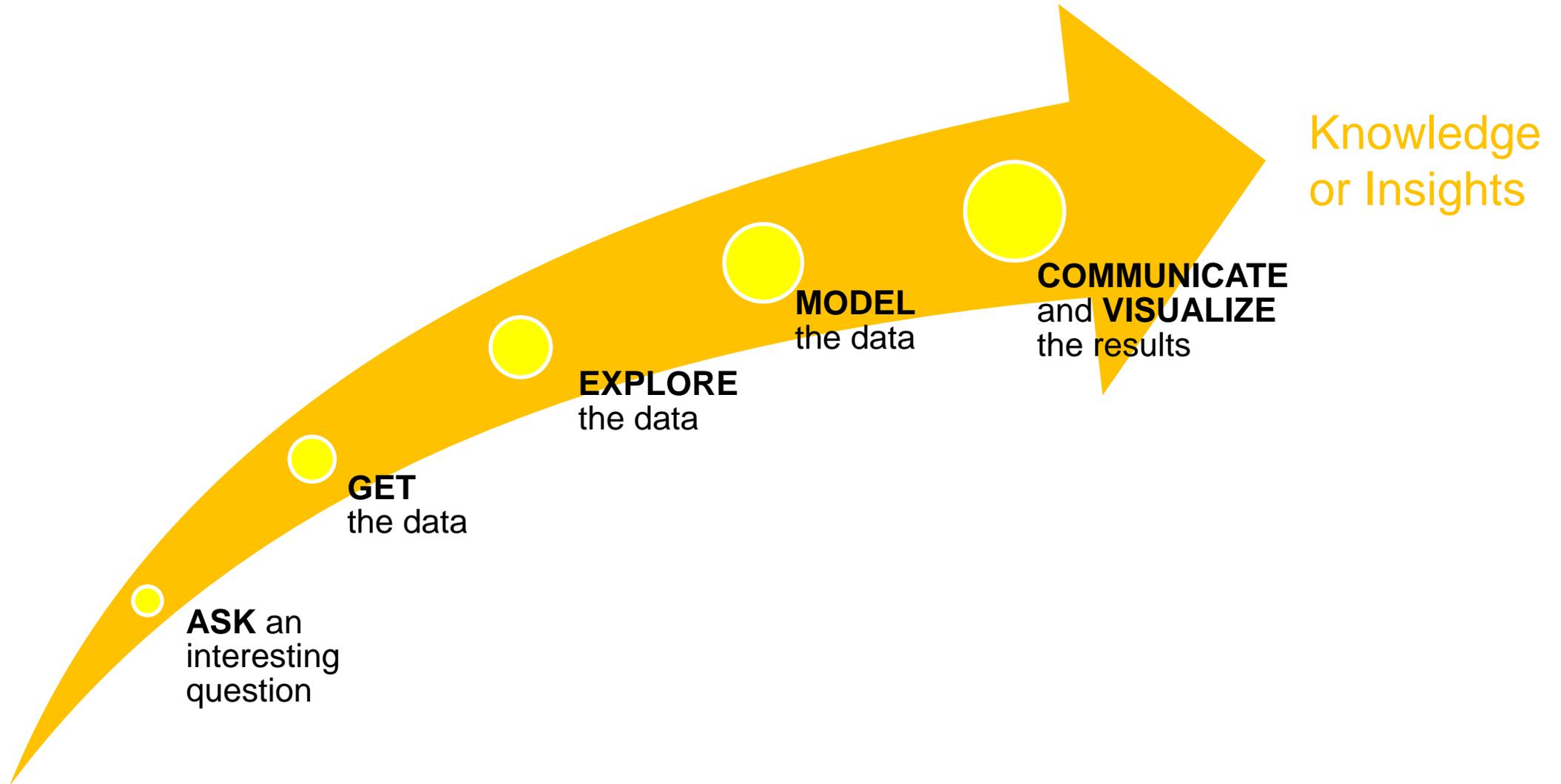
ment of a General Algebraic Modeling System (GAMS). The aim of this system is to provide one representation of a model which is easily understood by both humans and machines. We have chosen a rigorous algebraic representation of both data and equations, coupled with relational database-type facilities. With such a notation, the information content of the model representation is such that a machine can not only check for algebraic correctness and completeness, but also interface automatically with solution algorithms and report writers. In

J. Bisschop and A. Meeraus / A general algebraic modeling system

Source: "On the development of a general algebraic modeling system in a strategic planning environment". Mathematical Programming Study 20 (1982) 1-29

So far so good, how does Data Science make us better?

A Typical Data Science Workflow



From Source: <https://medium.freecodecamp.org/i-ranked-all-the-best-data-science-intro-courses-based-on-thousands-of-data-points-db5dc7e3eb8e>

A Typical Data Science Workflow: Challenges

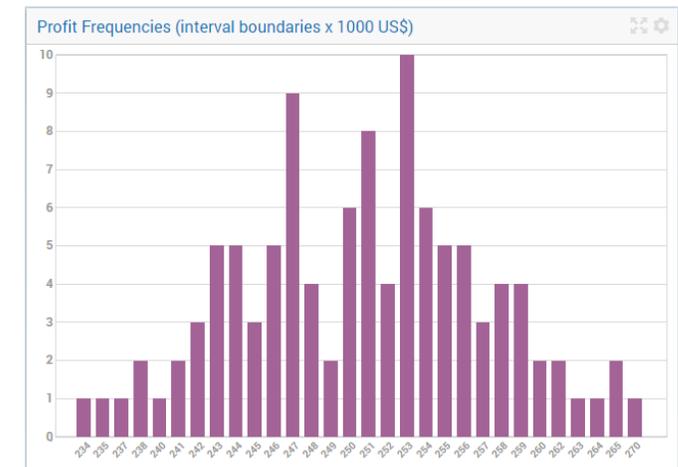
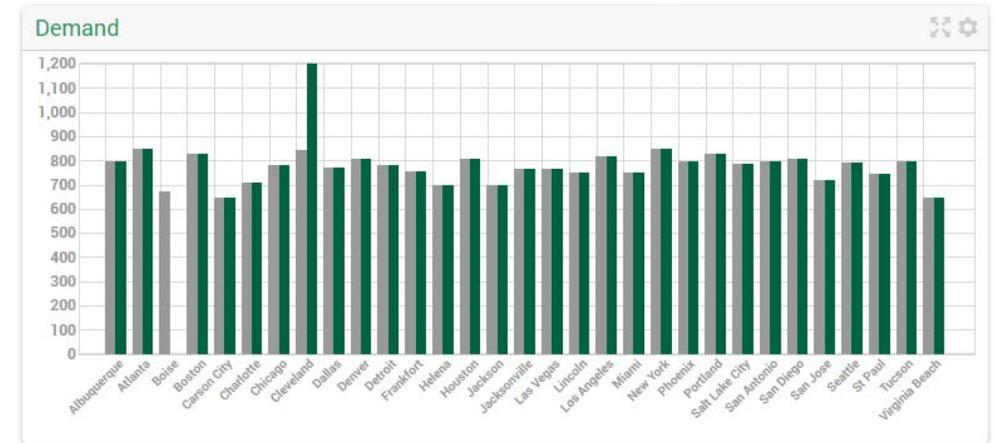
- > Data 1st mentality, everybody is an analyst
- > No business logic included in data
- > Error handling or data issues can be troublesome
- > “Analysis Paralysis”
- > Understanding of the results (Trends, Correlation, ML, Statistics)
- > Assuring Deterministic interpretation of results
- > No validated recommended actions

A Typical Data Science Workflow: Opportunities

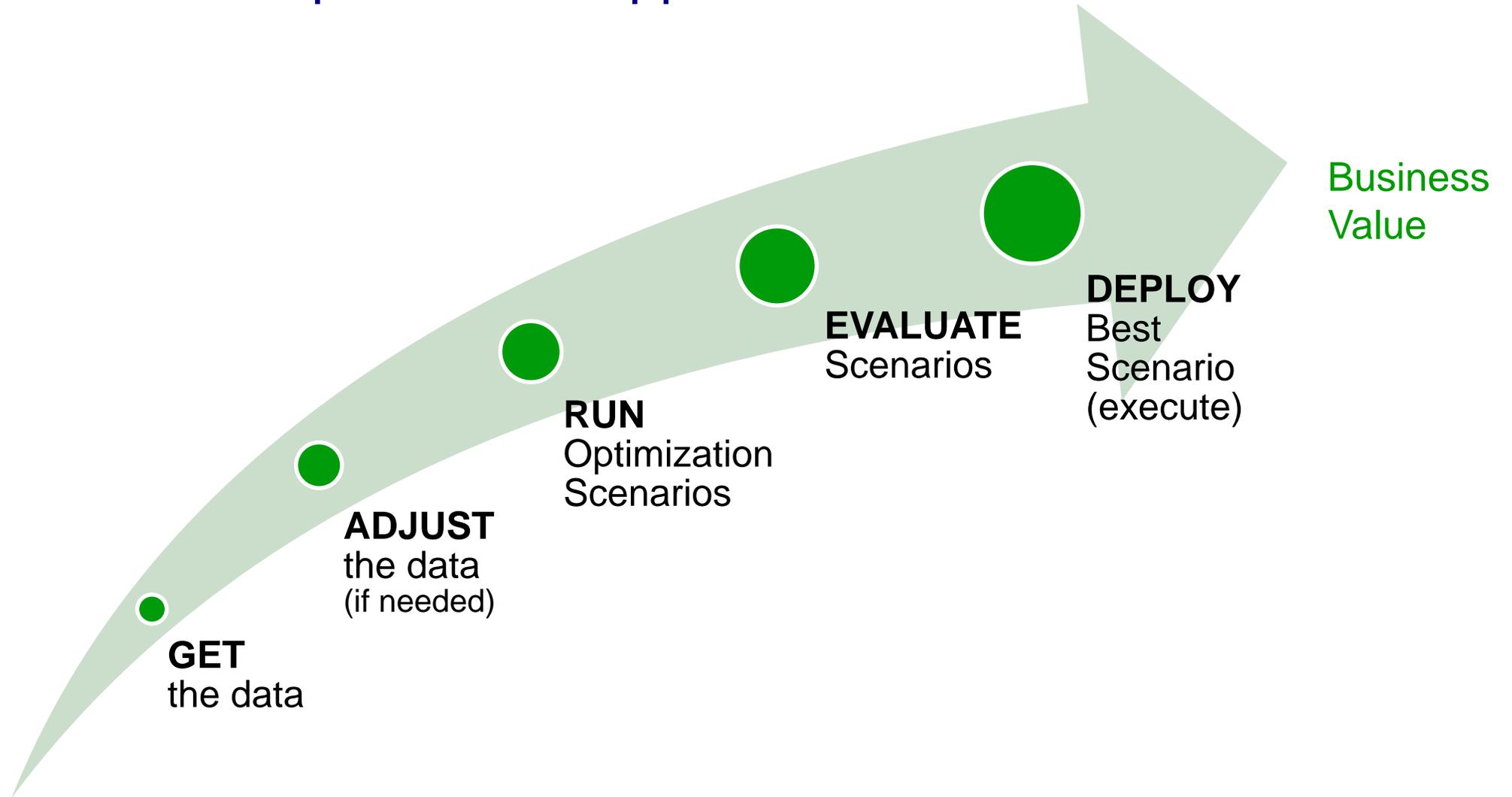
- > Current Tools & Methods are very powerful
- > Data 1st mentality, anybody can analyze
- > Lots of examples of how it can improve quality of data
- > Machine Learning can generate new insights else overlooked
- > Data Science and Visualization go hand in hand
- > Business accepts Data Science as a necessity
- > Data Science \neq Operations Research

What about Data Science in AIMMS?

- > Visual & Procedural data analysis and comparison
- > Distribution functions, Statistical operators
- > Histogram functions
- > Forecasting library
- > Data Link (databases, csv, xls, txt, tde, ...)
- > R-link
 - Machine Learning options
 - More statistical options (any...)
 - Matrix Manipulationsetc.
- > ..

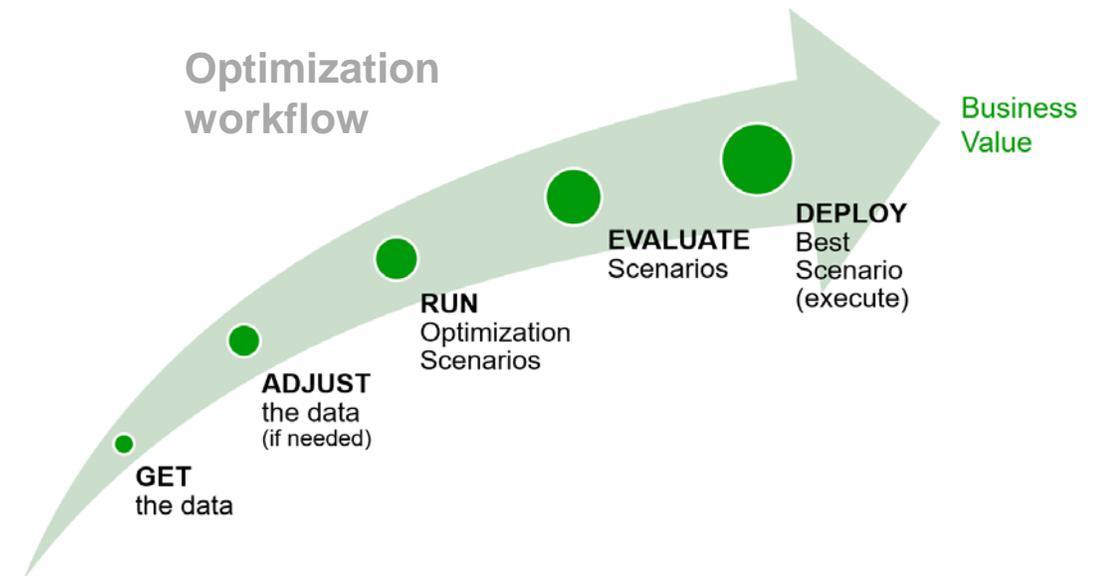


A Typical AIMMS Optimization App User Workflow

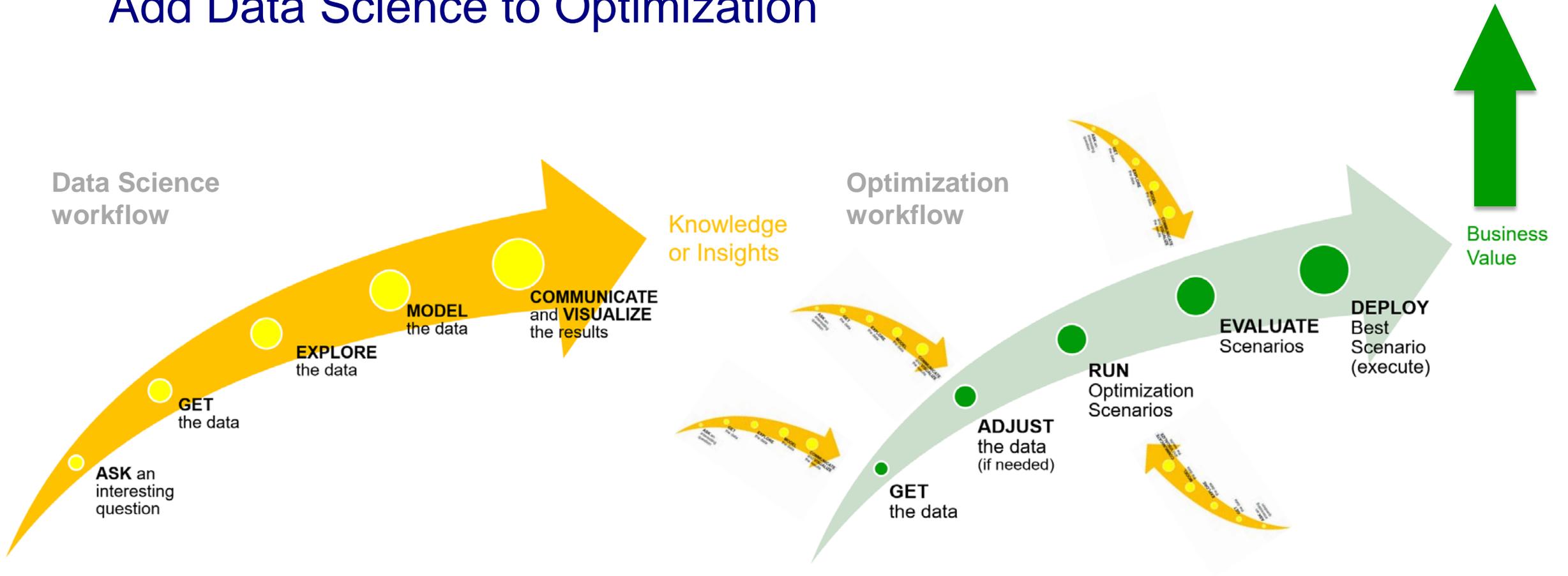


A Typical AIMMS Optimization App User Workflow: Characteristics

- > Model based, includes business logic
- > Done by a **non-optimization** expert (business user)
- > Need for special optimization training
- > Standard (manual) process
 - be compliant
 - be repeatable
 - feel comfortable
- > Could contain lots of iterations
- > Becomes more complex over time
- > Focus and needs will shift when more experienced



Add Data Science to Optimization



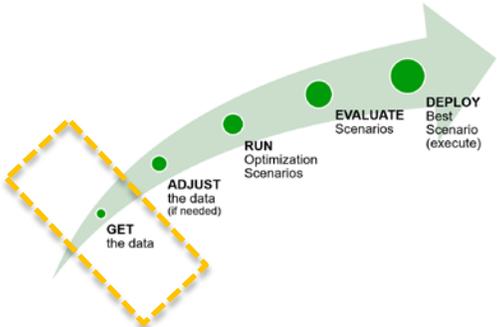
Example DS+O "Get Data"

- > Use trigger to get data ahead of time (prepare)
- > Learn what is 'crucial data' and what is not
- > Analyze data to complete data
- > Be smart about the user
- > ...



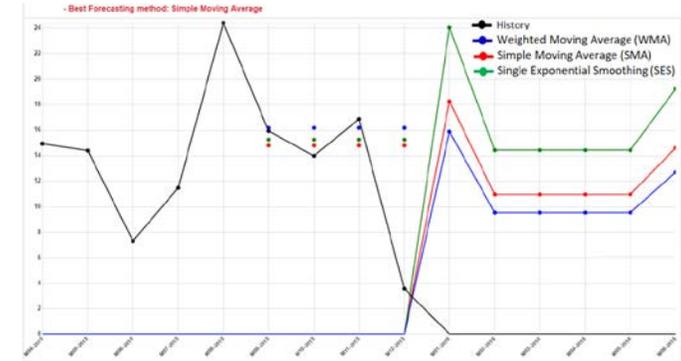
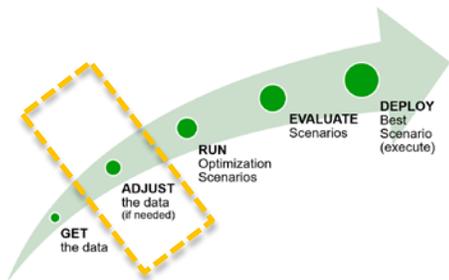
January 12, 2018

		FRIDAY
AMS	SEA	
4 PM	7 AM	
5	8	Make Plan



Example DS+O "Adjust Data"

- > Show dynamic comparisons to norms (history, seasonal, market data, etc.)
- > Use learnings of previous adjustments to suggest new adjustments to user, or share "okay"
- > Detect anomalies and bring those forward (e.g. based on set of rules)
- > Take out obvious mistakes
- > ...



Examples DS+O "Run Optimization Scenarios"

- > Generate more scenarios based on certain conditions
- > Store Solutions and analyze to support future decisions
- > Understand behavior of planner and become pro-active
- > Avoid (full) optimization if you can
 - Develop surrogate/sub models that are good enough;
 - tune it regularly with full optimization
- > ..

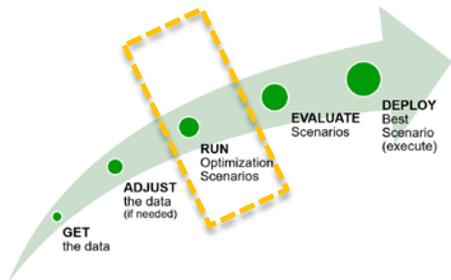


Frequently bought together

Total price: \$13.62

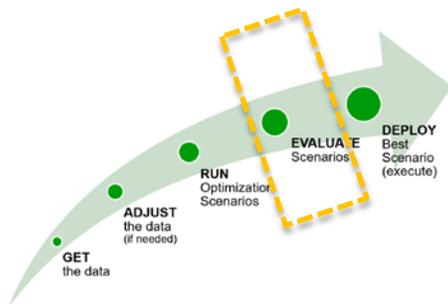
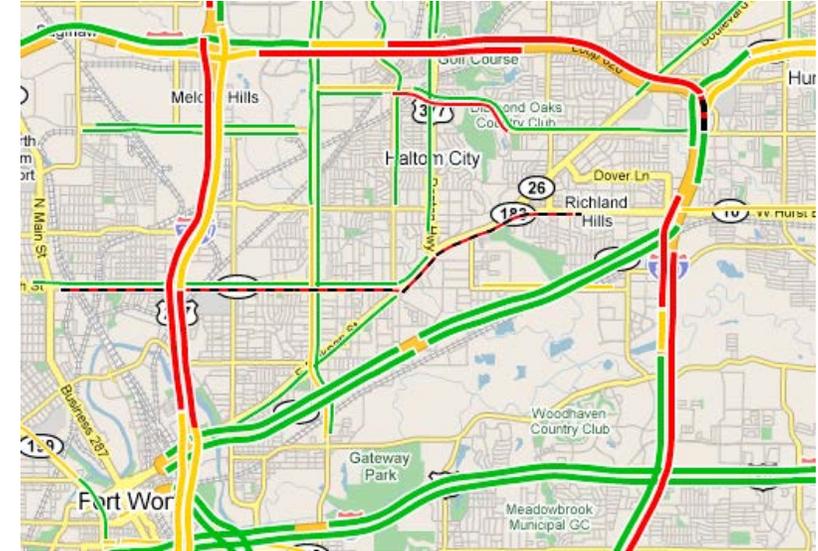
Add all three to Cart

Add all three to List

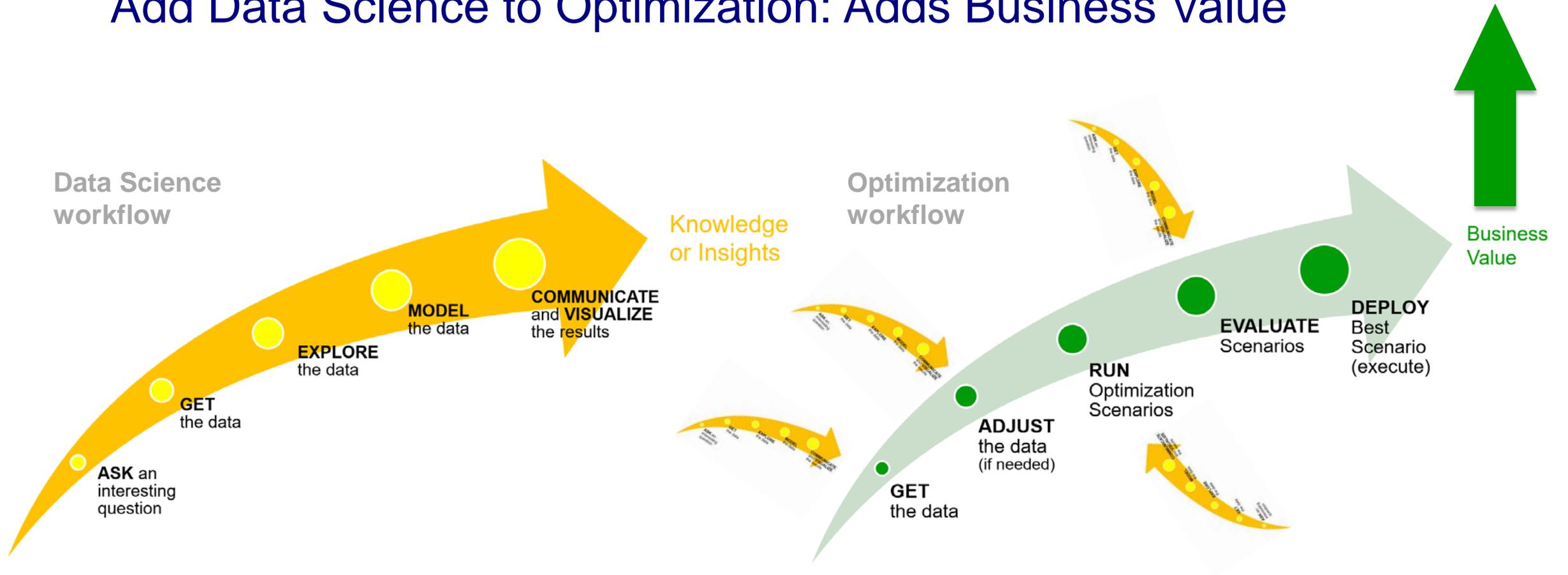


Examples DS+O "Evaluate Scenarios"

- > Use e.g. ML algorithm to learn from past experiences
- > Analyze unmodeled Scenario Effects
- > Use Augmented data (unmodeled) to support evaluation
- > Detect outliers and filter those as unrealistic
- > Determine 'Likable' or 'Practical' solutions
- > ..



Add Data Science to Optimization: Adds Business Value



Package it well!

Hide the smartness; make it a cool driving optimization experience



Keep extending user base, find new 'markets'



DS+O+AI+... Move to ALWAYS ON



Source: <http://fortune.com/2015/03/11/target-walmart>

Thank you



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