IL RUOLO CHIAVE DEGLI ADVANCED ANALYTICS PER LA SUPPLY CHAIN

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Technology has changed the way we live, and we look at things.

This change must also impact the decision-making process inside our companies.
AN EXITING TIME

It's NOT only the data availability to **make the difference** but **how data lead to the best actions and decisions**, to a higher risk resilience.
APPLICATION IN SCM

THE CFC WILL PROCESS OVER 65,000 CUSTOMER ORDERS A WEEK

AN AIR TRAFFIC-CONTROL SYSTEM CO-ORDINATES THE 700 ROBOTS...

A unique Core Business
- forecast & data science
- dynamic simulators
- math-Optimization
- artificial intelligence

ACTOR is a math-technology company founded in 1996 with a strong engineering and business domain background.
We strongly believe that our math-technology with the right mix of competences in:

- Business processes
- Advanced analytics skills
- Computer science skills

Gives us the competitive advantage to offer to our Customers Business Solutions that generate immediate VALUE.
ESTABLISHED IN THE 1996 AS MATH-COMPANY

BACKGROUND
Engineering and Mathematics

MARKET POSITION
in between research & the “operations world”

SOLUTIONS
Decision Support Systems & Services

USA
• Charlotte

UK
• London

Italy
• Rome
• Varese

ENABLING SUPERIOR BUSINESS PROCESSES GOVERNANCE
ACT OR is also Spin-off of the Sapienza University (Rome) – specifically of the DIAG department having a significant reputation on Operations Research.

We generate Value to our customers by using significant **R&D knowledge** and business expertise in a unique and innovative approach

- Business processes knowledge
- Constant research & updated methodologies
- Highly skilled engineers (Phd)
- Support Customer’s strategic research projects
- EU Public founded projects
ACT OR and the partner Europcar (HQ Paris - FR) have been selected as finalists by the Institute for Operations Research and Management Science (INFORMS) for Franz Edelman Award, the world’s most prestigious international award for achievement in the practice of Operations Research.

INFORMS is the leading international association for professionals in Operations Research and Analytics.
During the recent years, the **awareness** about Advanced Analytics is growing fast.

Managers recognize their **potentiality**

Utilization **trend** is dramatically increasing
Operations Research – the market of two of its main applications is expected to grow at a CAGR of 18-20%.

Machine Learning – the projected value depends on the approaches, but surely it is big and will grow.

B Including cognitive computing, deep learning, machine learning, predictive APIs, natural language processing, image recognition, and speech recognition.

A FLOOD OF INFORMATION, BUZZWORDS BUT ALSO SUPERFICIAL PROPHETS ABOUT ADVANCED ANALYTICS
ARE WE SURE THAT THIS FLOOD OF INFORMATION DOES NOT DISORIENTATE US?
Can we distinguish what we can obtain from different types of Advanced Analytics?

When and under which conditions has the sense to adapt, for example, Artificial Intelligence in SCM? What are the risks behind such projects?
WHAT ARE WE TALKING ABOUT

DECISION SCIENCE
The discipline that deals with the application of advanced analytical methods to help make better decisions

We are talking about Operations Research, math, statistics, Artificial Intelligence;
THE STARTING POINT TO APPLY DECISION SCIENCE:

Be aware that a specific engineering approach is required to design the decision support system correctly.
Advanced Analytics: software, but not only
THE STARTING POINT TO APPLY DECISION SCIENCE:

1. Deeply **understand** the processes and the goals;
2. Watch such processes and goals with the “**analytical glasses**”
3. Identify the **techniques and correctly apply** them coherently with the available data
4. Be ready for a change management
Optimization Problem - Input
Need to go from A to B
Lengths of all the possible routes
Traffic information
Potential constraints (e.g., “do not take that narrow street!”)
Output
From A, take street 1
Then take the second left
...
Finally you’re in B in minimum time

Output of an Optimization problem is found through Operations Research
OPERATIONS RESEARCH

Discipline that deals with the application of advanced analytical methods to help make better decisions
Introducing the Traveling Salesman Problem (TSP)

TRAVELLING SALESMAN PROBLEM

Find the shortest possible route that visits each city exactly once and returns to the origin city.

25 cities will require \((25-1)!/2\) tours: 
310,224,200,866,619,719,680,000

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If you could implement optimization anywhere in a business to deliver transformational value, where would you do it?

- Optimizing day to day operations: 32%
- A model of the entire business to support planning: 26%
- Optimizing capacity and resource use: 26%
- Informing strategy around investments and programs: 11%
- Optimizing pricing and marketing activities: 5%

SOURCE: River Logic 2015 survey, ACT OR
In computer science AI is the **study of “intelligent agents”**, that is agents able to **perceive their environment and take actions** that maximize the chances of success. Machines **mimic** the human cognitive functions.

**Machine Learning** is part of the AI and refers to the **capability of computer to learn and solve problems without being specifically programmed** to solve that problem. ML explores the study of algorithms to enable learning from data and make predictions on data.
“We say that a machine learns with respect to a particular task $T$, a performance metric $P$, and type of experience $E$, if the system reliably improves its performance $P$ at task $T$, following experience $E$”

T. Mitchell

SOURCE: ACT OR, web search
LET’S REMEMBER THE MODEL

At the core of the DECISION SCIENCE there’s always a MODEL!

A model is:

• a representation of the reality from a specific "prospective“
• a relation describing how specific outcomes are related to particular inputs
A model can be simple or complex. When the processes and systems are complex the complexity of the models needed to support decisions increases.

\[
\begin{align*}
\min f(W_{in}, W_{out}, b_{in}, b_{out}) &= \frac{1}{p} \sum_{i=1}^{p} \frac{1}{2} (\hat{y}_i - y_i)^2 = \frac{1}{2p} \sum_{i=1}^{p} (W_{out} g(W_{in}x_i + b_{in}) + b_{out} - y_i)^2 \\
\text{s.t.} \quad W_{in} &\in \mathbb{R}^{N \times n}, W_{out} \in \mathbb{R}^{m \times N}, b_{in} \in \mathbb{R}^N, b_{out} \in \mathbb{R}^m
\end{align*}
\]
LET’S REMEMBER

There are usually multiple models to represent a reality (different level of approx.);

Example modeling a picking process:
1. as a delay from $t_0$
2. Sequence of movements with certain acceleration and velocity in a space, starting from a certain state $S(t_0)$.

WE NEED

The right models coherent with the goals, with the data and their quality.
## WHAT IS NEEDED

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<th>MACHINE LEARNING</th>
<th>OPERATIONS RESEARCH</th>
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Data availability, ‘hard’ skills past experience are the must-have to fully leverage OR & ML potential.
The necessary enablers must be in place to unlock Advanced Analytics value, one of the main being the DATA.

Source:
BIG DATA ANALYTICS IN SUPPLY CHAIN MANAGEMENT - TRENDS AND RELATED RESEARCH
Ivan Varela Rozados, Benny Tjahjono
Supply Chain Research Centre, School of Management, Cranfield University
Cranfield, Bedford, UK

Figure 1. SCM Data Volume and Velocity vs. Variety
EXAMPLE OF APPLICATIONS IN SCM
The fashion and luxury industry provides a particularly challenging environment:

- High seasonality
- High uncertainty
- High complexity
- Long lead times vs short life cycle

In such an environment, the ability to:

- Make better forecasts
- Take correct decisions
- Minimize risks
- Optimize the relevant processes

is fundamental to achieve success.
FASHION SUPPLY CHAIN & DISTRIBUTION NEEDS

Design
- Ability to predict demand of goods for the new collections anticipating orders and reducing overstock

Sourcing
- Optimizing production planning based on available resources

Production
- Optimizing warehouse operations and transport costs

Logistics
- Replenish the DC&stores in order to improve sell-through levels and reduce lost sales

Marketing

Sales&Dist.
- Anticipate decisions on price and promotions during season in order to improve margins

SC Network  Design OPT.
Our solutions have been successfully applied to the most relevant processes in order to improve efficiency and service level:

- Store replenishment
- Inventory Management
- Promotion and Price Optimization
- Distribution Center Optimization and Simulation
- Transport and Warehouse Optimization
Context (slotting):
Fast-Fashion distribution
1500+ stores

Challenge:
Improve Sell through
% = units sold / (units sold + on hand inventory)

Predict the products demand at store level Optimally assign the stock of products to stores maximizing the sales under constraints.
FAST FASHION DISTRIBUTION
REAL CASE

Results:
• Distribution quality Index: +17%
• Stock-out: -79%
• Over-stock : -14%
Problem:

- N Points to Serve (PoS)
- W warehouses having, Pi Production Capacity and Si Stock Capacity
- \( C_{wi} \) Handling Cost
- \( C_{ti,j} \) Transport Cost
- \( C_{Pi,j} \) Production Cost
- SL* the service level
- HOW to assign the N PoS to the W warehouses
Context:
• Reg. Dist. Centers: 12
• Transit Points: about 200
• Served Points: 10.000+

Before the Optimization:
• Transportation costs:
  14 Mil US$ /Yr

After the Optimization:
• Transportation costs:
  11.9 Mil US$ /Yr (-15%) - same SLA
Problem:

- N Points to Serve (PoS)
- W warehouses having, Si Stock Capacity
- S Suppliers
- Define optimal orders to cover the demand limiting the stock value and avoiding stock-out
INVENTORY OPTIMIZATION
REAL CASE

Context (slotting):
35 warehouses connected to 5 Distribution Centers
More than 5,000 suppliers managed

Goal: eliminate stock-out

Results
• Stock-out near to zero
• Inventory costs reduced by 30%
• Process centralized in a unique center.
Context (slotting): Grocery, dairy and frozen food Distribution Center

Challenge:
Increase productivity that was also affected by a not-optimal shelving.

- Decide the best (math-optimal) position for each SKU
- Evaluate impact on productivity & traffic
- Optimize the design of the racks
Results:

- Productivity improvement 21%
- Service level improvement 20%
- Reduction of travel distances for picking activities 30%
Context (slotting): Supervised RX Control of products

Challenge: Dramatically reduce the costs of an intensive quality control process

Automatic identification of defects
TIPS FOR A STRUCTURAL USE OF ADVANCED ANALYTICS IN SUPPLY CHAIN
SCM BY ADV. ANALYTICS

- Prediction first
- Measure culture: we cannot control what you do not measure in the right manner
- Data culture
- Exploit opportunity by the what-if (you need reliable models)
HOW DO WE SUPPORT SCM?
By connectors the specialized analytical modules of the platform empower existing IT applications like ERP, WMS, TMS, Real Time Execution system. By a web user interface decision-makers work in a high-quality collaborative virtual environment. All the generated data are available to others IT Systems.
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