

# Dell's Channel Transformation:

Leveraging Operations Research to Unleash Potential across the Value Chain

## Business Overview & Problem

Phil Bryant - Vice President, Sales

## Business Strategy & Need for OR

Donna Warton - Vice President, Supply Chain

## Innovative OR Solutions & Results

Parag Chitalia - Director, Analytics

Murugan Pugalenti - Sr. Manager, Analytics

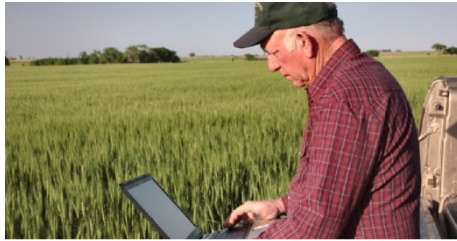
Karl Martin - Director, Sales Operations



# Dell achieved market leadership by pioneering the direct sales model

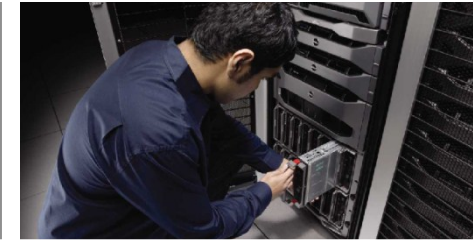
## 1996

- Dell.com launched
- \$1 million/day within 6 months



## 2000

Dell.com sales reach \$40 million/day



## 1999

# 1 in PCs in the U.S  
# 1 in Workstations worldwide



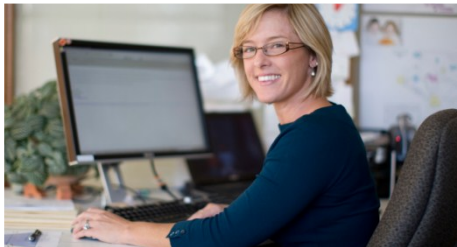
## 2004

Revenues grew from \$3.5B to \$49B in 10 years



## 1997

- 10 million<sup>th</sup> PC shipped
- 15 days of inventory levels



## 2001

# 1 computer systems provider worldwide



In 2007, Dell launched a massive channel transformation initiative to address the changing market dynamics



# Business Strategy & Need for OR

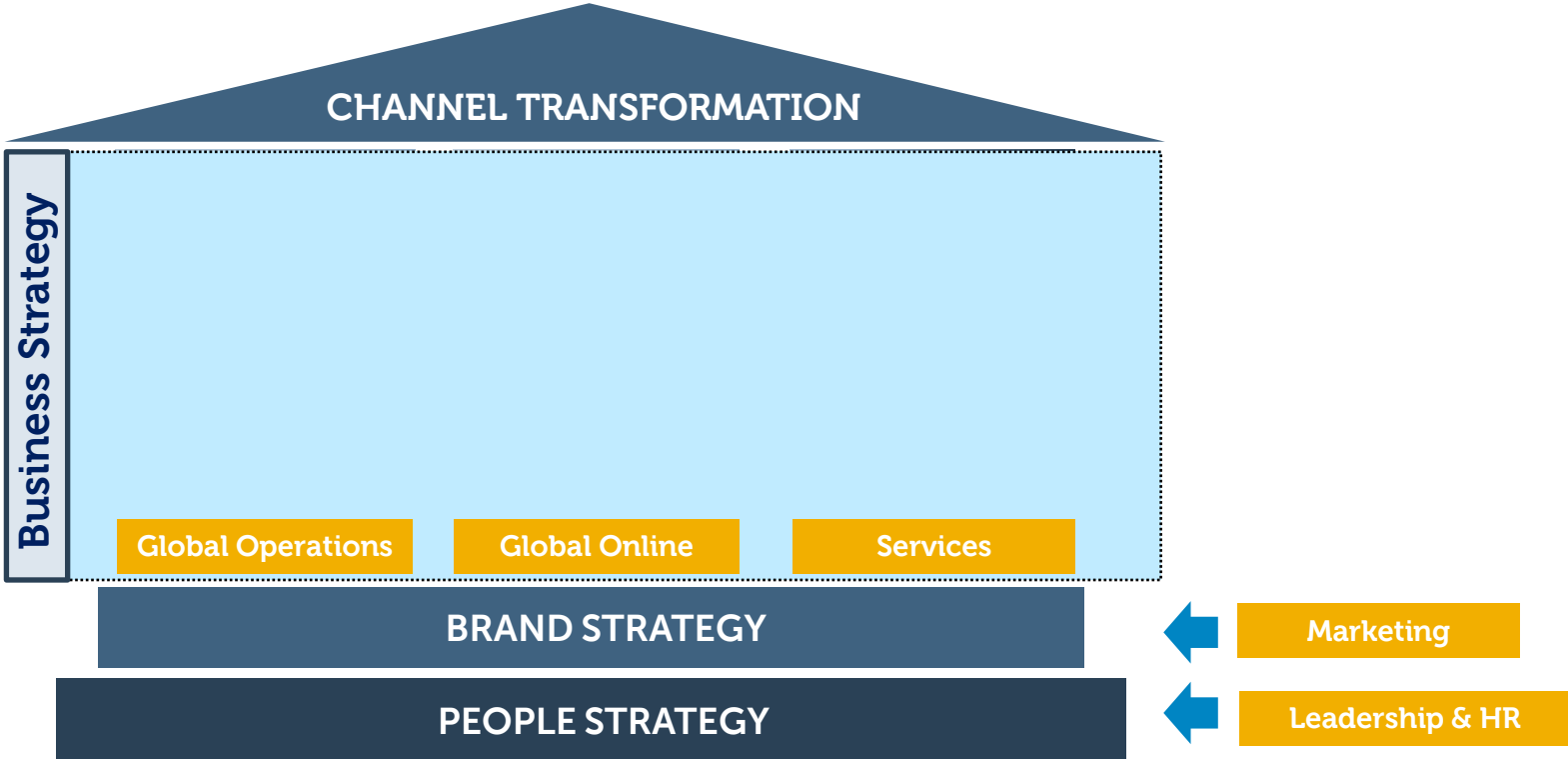
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**Donna Warton**

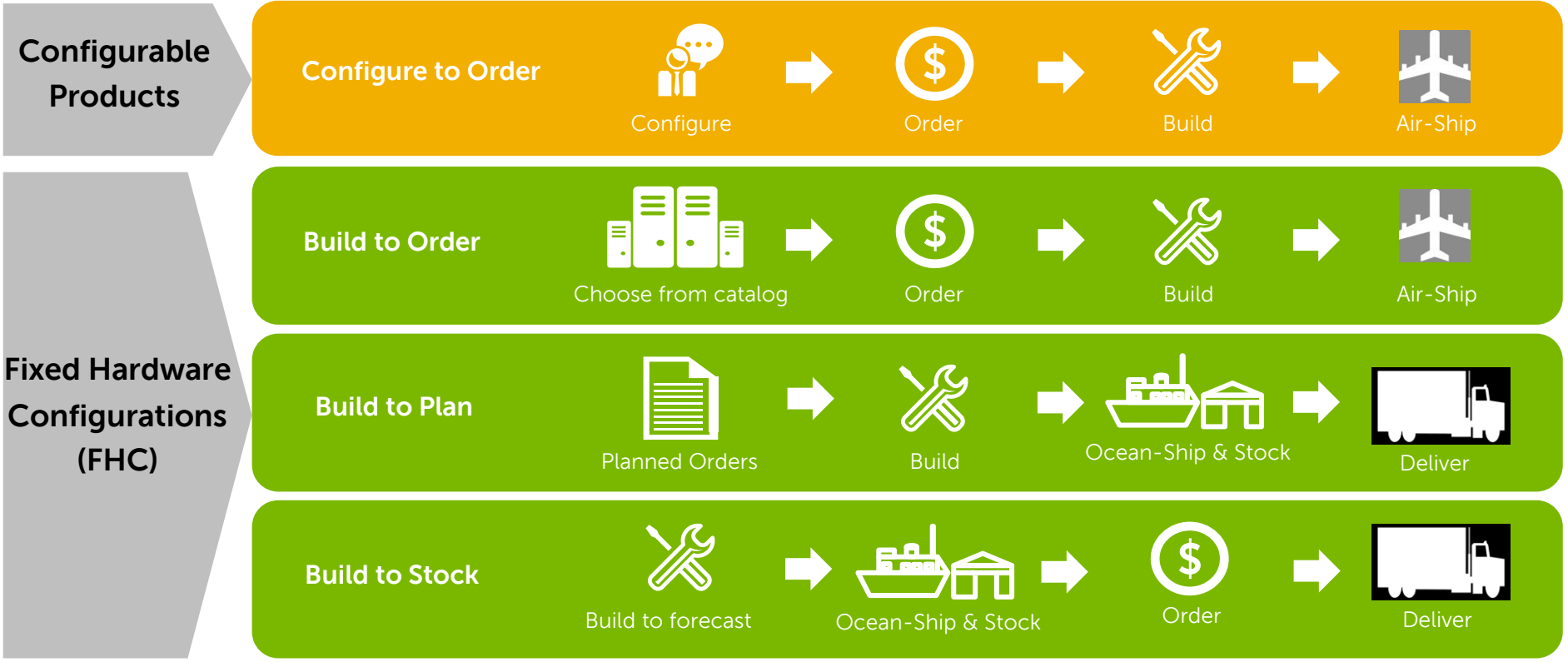
Vice President, Supply chain



# Dell's channel transformation was built on three organization-wide strategic programs



# Segmented supply chain, as part of Client Reinvention, addressed the needs of different customer segments



# Operations Research was leveraged to address the business challenges posed by channel transformation

- Deliver profitable growth in channels
- DNA of direct model
- Disruption to the ongoing business

Challenges

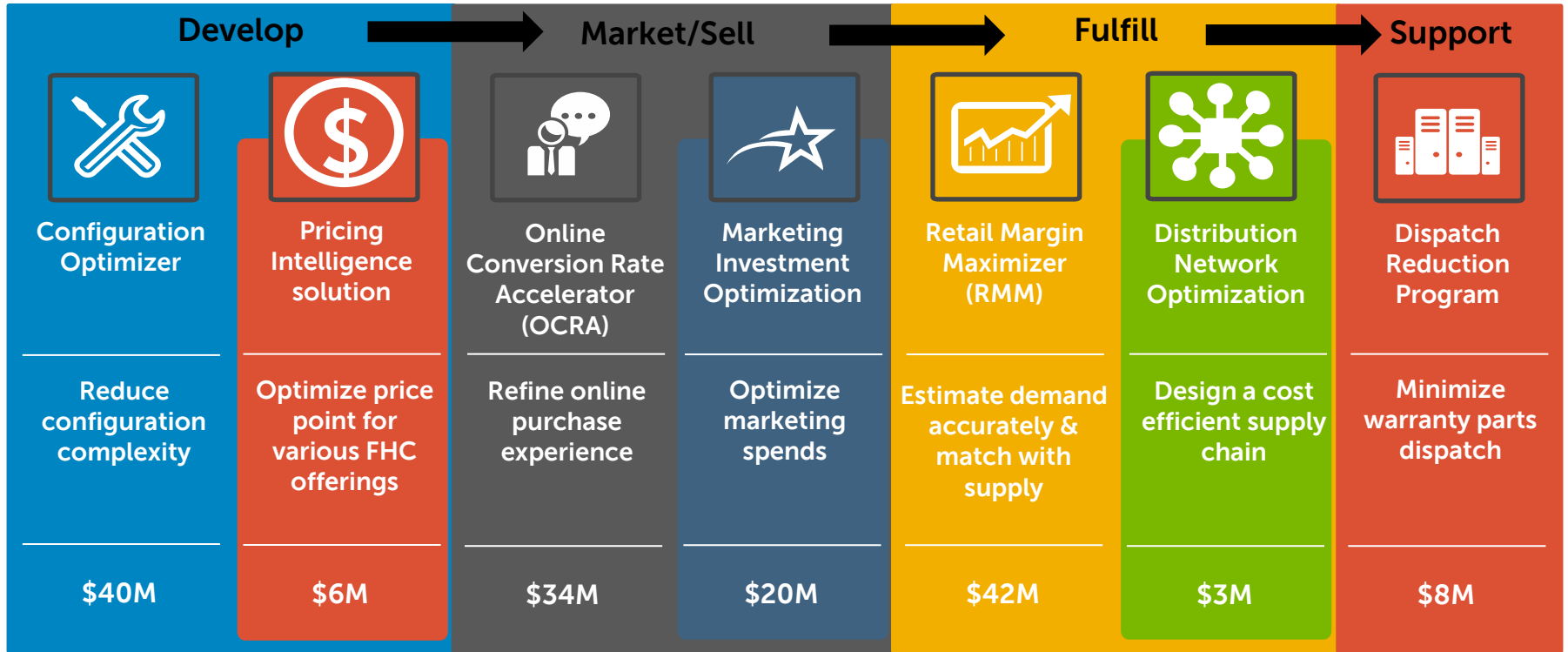
- OR based analytics
- Change management
- Pilot implementations

Responses

Dell Global Analytics (DGA), a Center of Excellence for OR and advanced analytics helped address key challenges across the value chain



# DGA delivered high-impact OR solutions to solve key business problems across Dell

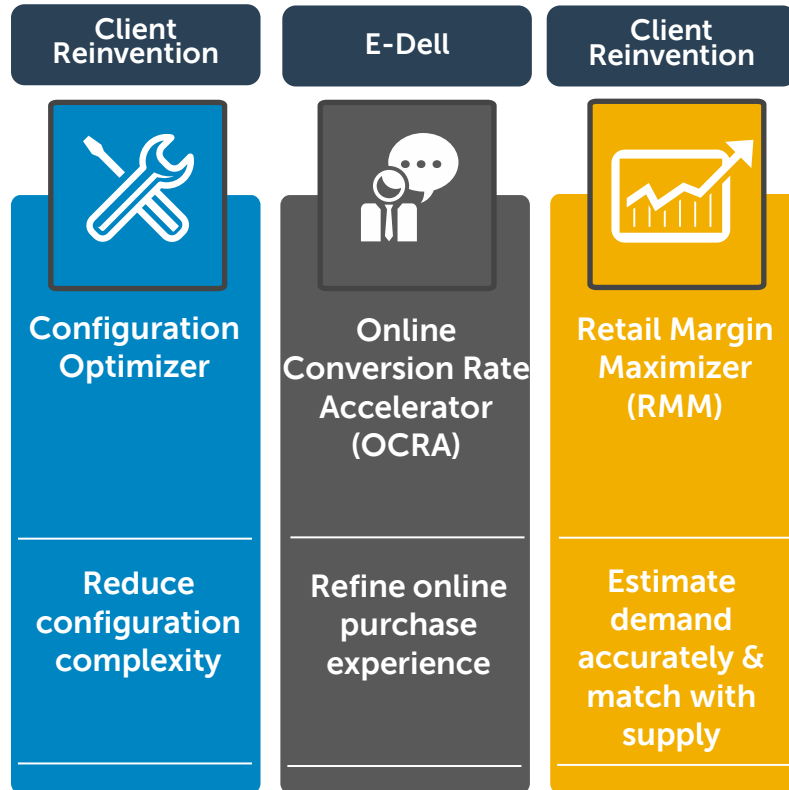


Realized margin improvement of over \$140 million in the last two years





# We will showcase three high impact OR solutions that supported our channel transformation strategy





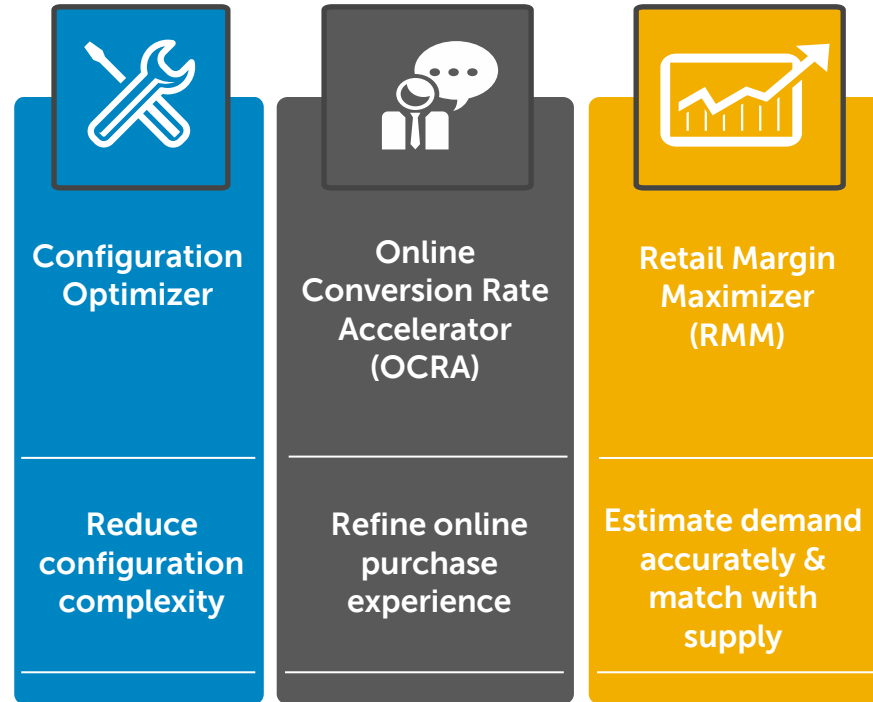
# Configuration Optimizer

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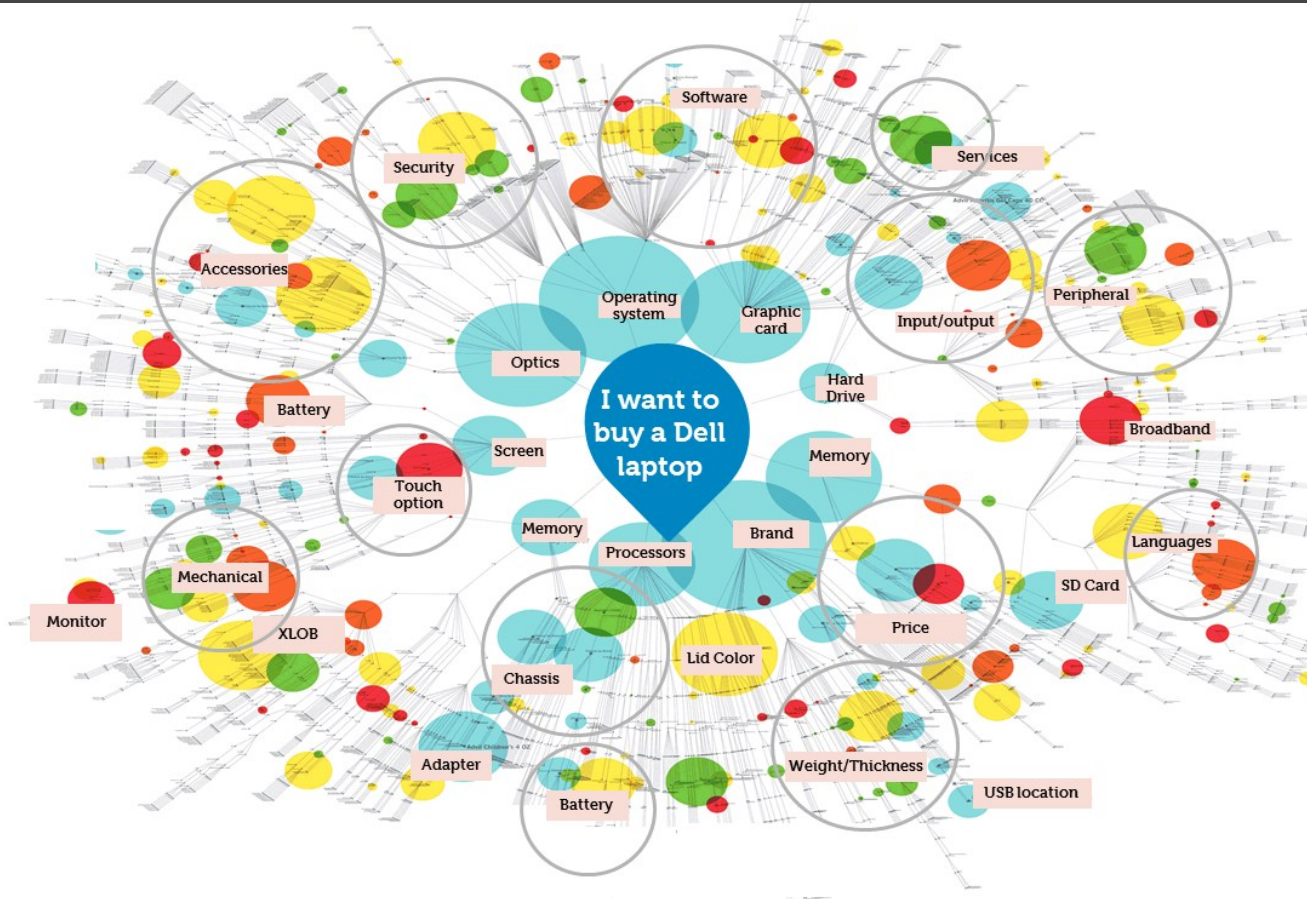
**Parag Chitalia**  
Director, Analytics



# Configuration Optimizer was aimed at reducing the configuration complexity while maximizing revenue



Configuration Optimizer is aimed at simplifying our product offers  
- to provide what customers value most



## Problem

- >60 million options in a single product
- <15% configurations driving 72% sales

## Objective

Design optimal fixed configurations to meet most customer needs



# The first step in building the Configuration Optimizer solution was to generate an initial set of potential configurations

## Commodity Selection

Identify influential commodities



*Exploratory Analysis*

## Bundles Generation

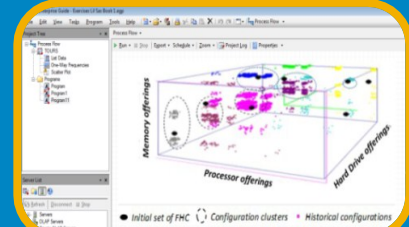
Create Performance, Security & Accessibility Bundles (correlated buying preference)



*Factor Analysis*

## Potential Set

Formulate initial configurations



*Demand Cluster Analysis*

The objective function was to maximize revenue through the design of optimal configurations by using a quadratic function

$$\text{Maximize Revenue} = \sum_{\forall i \in FHC} \{price_i - C_i - L_i\} * X_i$$

$$\text{Unit coverage } (X_i) = \sum_{\forall j \in commodity} \sum_{\forall k \in options} (OptionInfluence_{ijk} * IsOptionSelected_{ijk}) \quad \forall i \in FHC$$

$$\text{Upgrade Cost } (C_i) = \sum_{\forall j \in commodity} \sum_{\forall k \in options} (UpgradeCost_{ijk} * IsOptionSelected_{ijk}) \quad \forall i \in FHC$$

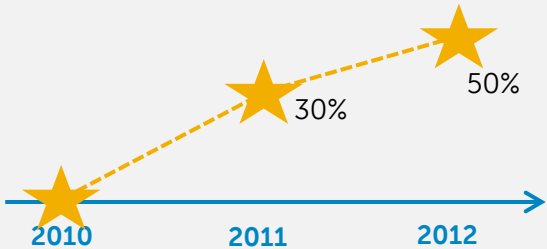
$$\text{Opportunity Loss } (L_i) = \sum_{\forall j \in commodity} \sum_{\forall k \in options} (LossDueToGap_{ijk} * IsOptionSelected_{ijk}) \quad \forall i \in FHC$$

**Bounds**

Number of FHCs, Technology Trend, Commodity Upgrades and Cost, SOS

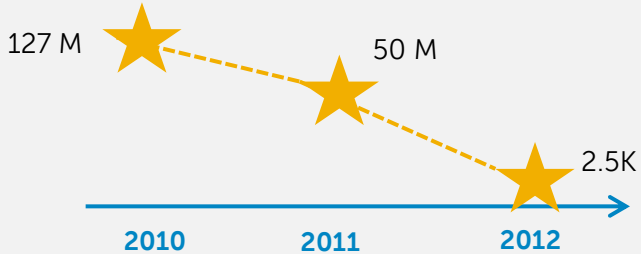
# Configuration Optimizer solution reduced the offer complexity & led to \$40M in margin improvement

FHC sales mix\*



\*America Large Enterprise

Configuration complexity



## Benefits

Commodity complexity



Margin  
(Ocean ship & Rationalization)





# Online Conversion Rate Accelerator (OCRA)

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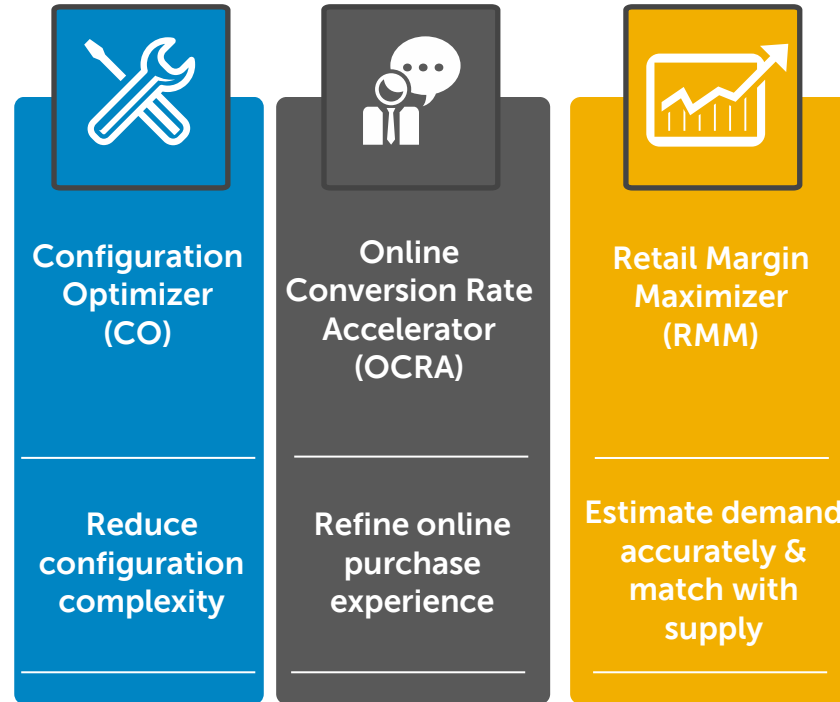
**Murugan Pugalenti**

Sr. Manager, Analytics





# OCRA aimed to refine the online purchase experience while maximizing conversion rates



# OCRA addressed the changing online customer preferences in Ships Fast channel

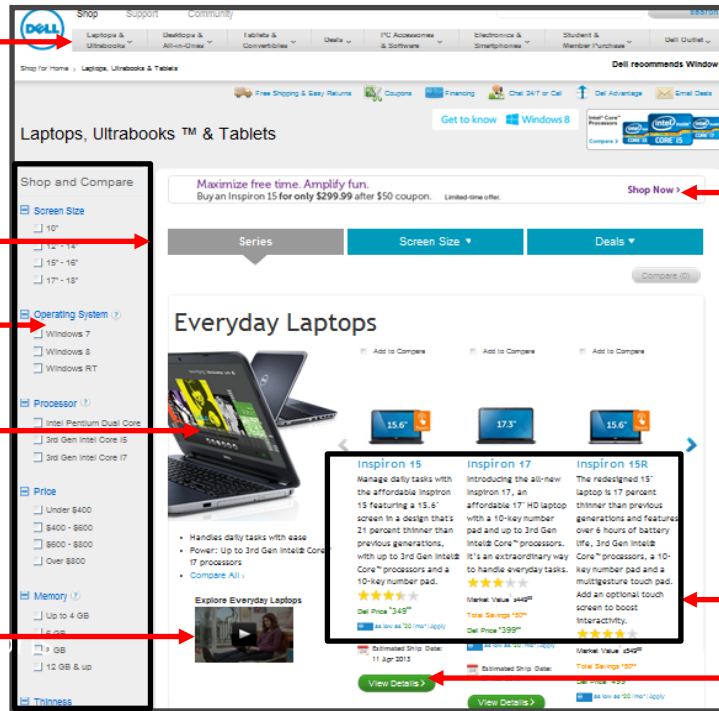
Main Menu – 10 options

Color – 20 options

Navigation – 5 options

Images – 12 options

Video – 5 options



Merchandising – 10 banners

Sub Menu – 5 options

## Problems

- Trillions of possible design combinations
- Lower conversion rates

Content – 5 options

Buttons – 5 options

Objective - Increase purchase conversion rate and customer experience



OCRA followed a multi-step approach to enhance online customer experience and maximize conversion rates

## Identify conversion influencers

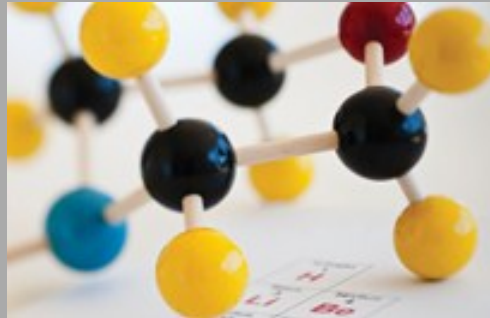
Driver  
Analysis

Text  
Mining

Pathing  
Analysis

Bench-  
marking

## Evaluate alternative designs



A/B test & Multivariate  
test

## Identify optimal design



Webpage  
Optimizer

# Online data volume & variety necessitated use of big data tools; a non-linear mixed integer program helped in maximizing conversion

$$\text{Maximize Conversion Rate} = \sum_{\substack{i \in A \\ j \in B}} a_{ij} * x_{ij} + \sum_{\substack{i_1 \in A \\ j_1 \in B}} \sum_{\substack{i_2 \in A \\ j_2 \in B}} b_{i_1 j_1 i_2 j_2} * x_{i_1 j_1} * x_{i_2 j_2}$$

Main effects
Interaction effects

$a_{ij}, b_{ij}$  : Influence factor on conversion rate  
 A : Set of components  
 B : Options

$$\text{Component combination} = \sum_{\forall i, j \in \text{Permissible Combinations}} \text{IsOptionSelected}_{i_1 j_1} + \text{IsOptionSelected}_{i_2 j_2} + \dots + \text{IsOptionSelected}_{i_n j_n} = 1$$

$$\text{Load Time (T)} = \sum_{\forall i, j \in \text{Permissible Combinations}} \text{TimeToLoad}_{ij} * \text{IsOptionSelected}_{ij} \leq \text{AcceptableLoadTime}$$

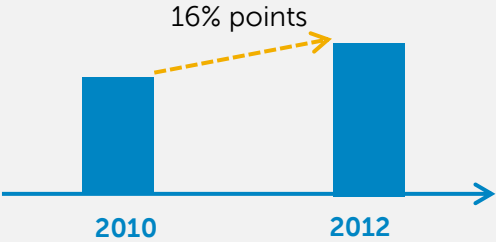
**Bound:**

Product price mix, Components per page, SOS, Products on promotion



# OCRA improved online customer satisfaction & conversion, resulting in a margin improvement of \$34M

## Revenue Per visit



## Margin (Improved conversion)

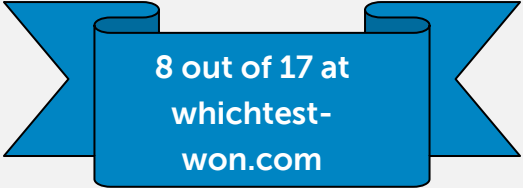


## Benefits

## Online Customer Satisfaction



## Recognition



# Retail Margin Maximizer (RMM) & Overall Impact

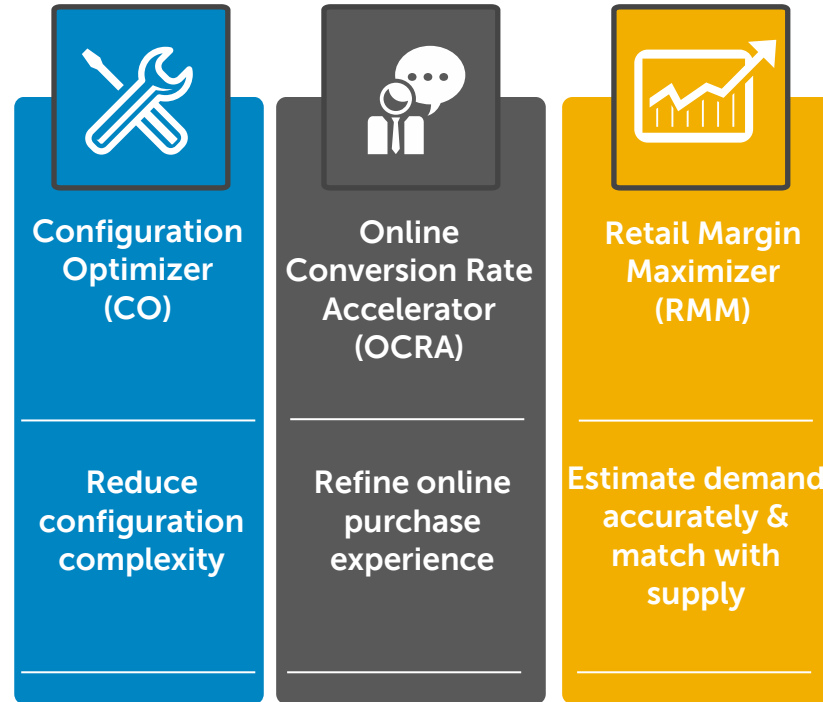
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**Karl Martin**

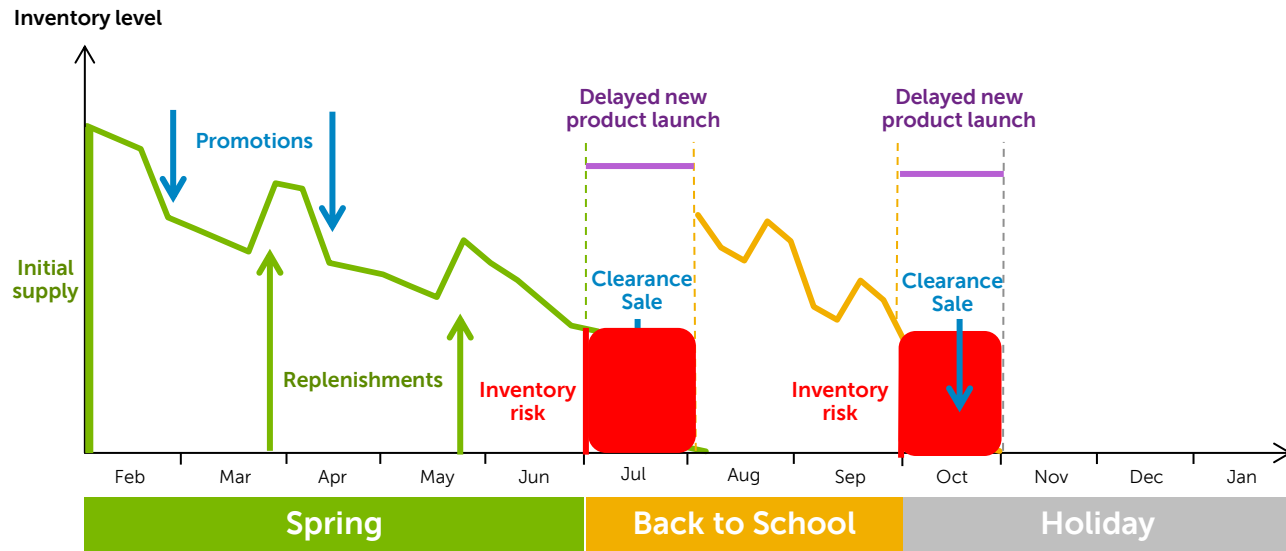
Director, Sales Operations



# Retail Margin Maximizer aimed to improve retail profitability through collaborative planning of inventory & promotions



# Retail channel posed a variety of inventory management and promotion planning challenges resulting in lower profitability



Retail business operates through 3 annual seasons

## Problem

- Inflated forecasts
- High season-end inventory
- Delayed season transition
- Low margins due to high discounting

## Objective

- Improve retail margin using
- Proactive inventory risk management
  - Effective promotions



# The first module, Demand Sensing, drove collaborative planning using advanced time series techniques

## Demand Sensing

### Like-wise FHC analysis

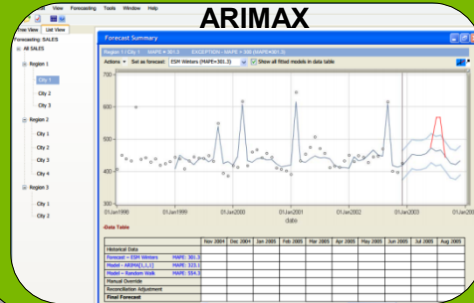


Time Series

### Other Factors

- Inventory
- Price
- Competitor actions
- Special events

### Demand Forecasting

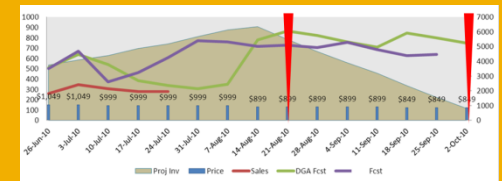


### Weekly Governance



Scenario analysis

Replenishment planning

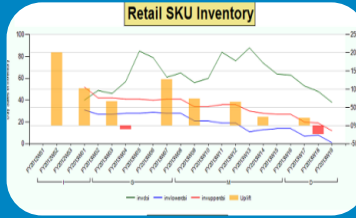


# The second module, Demand Shaping, helped systematically plan & execute promotions to improve margins

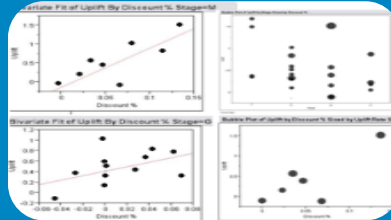
## Demand Shaping



**Inventory Optimization**  
*Identifies FHCs with high inventory risk*



**Promotion Uplift Model**  
*Identifies FHCs with high potential uplift*



Initial set of FHCs

## Optimization Engine

Which FHC to promote?

What promotion to run?

When to promote?



The objective function was to minimize the cost of excess and deficient inventory across the season

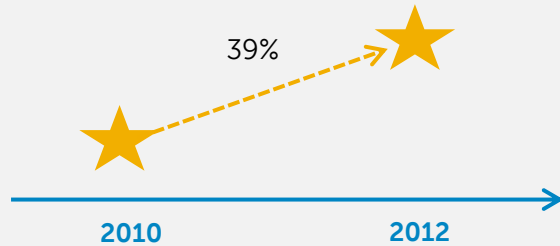
$$\begin{aligned} \text{Minimize } (C_{ei} + C_{di}) &= C_m \alpha_p I_{eT} + C_p X + C_d \left( \frac{\alpha_d I_{eT}}{R} \right) + C_o \alpha_w I_{eT} + C_e \alpha_f I_{dT} + C_l \alpha_u I_{dT} \\ &= \text{MarkdownCost} + \text{PromotionCost} + \text{DelayedLaunchCost} + \text{ObsolescenceCost} + \\ &\quad \text{ExpediteOrderCost} + \text{LostOpportunityCost} \end{aligned}$$

## Constraints

- *Inventory Balance Equation with Supply Mode and Lead Times*
- *Demand elasticity (ARIMAX)*
- *Markdown + PromotionCost ≤ Marcom budget*
- *ExpediteOrderCost ≤ Budget*
- *ExcessInventory as % of opportunity*

RMM delivered \$42M margin uplift in the retail channel & is portable across fixed configuration channels

### ROI on Promotions

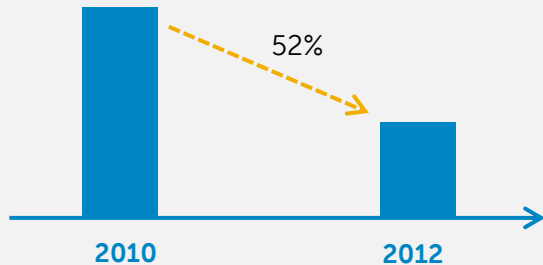


### Margin (Markdown reduction)



## Benefits

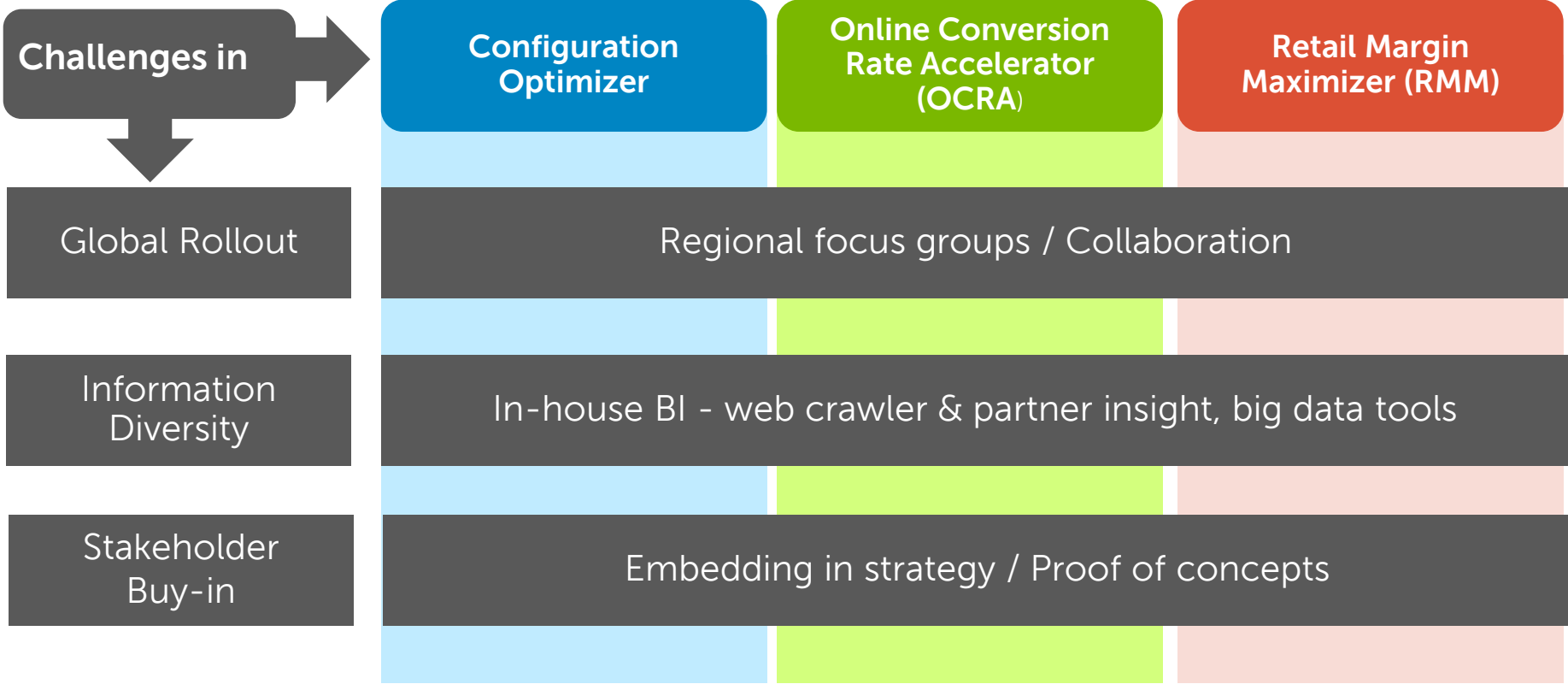
### Inventory



### Recognition

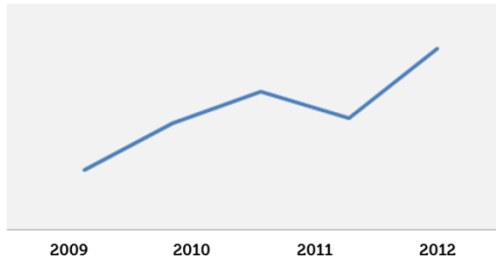


# Change management played a key role in the successful rollout of the OR solutions

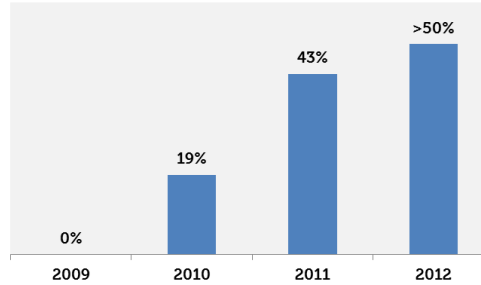


These multi-channel OR initiatives delivered a margin improvement of over \$140million between 2010-12

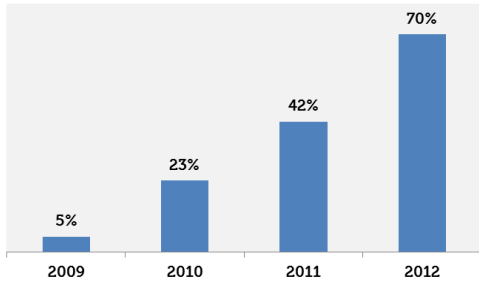
Profitability Trend - Fixed Configurations



Fixed Configuration Volume Share

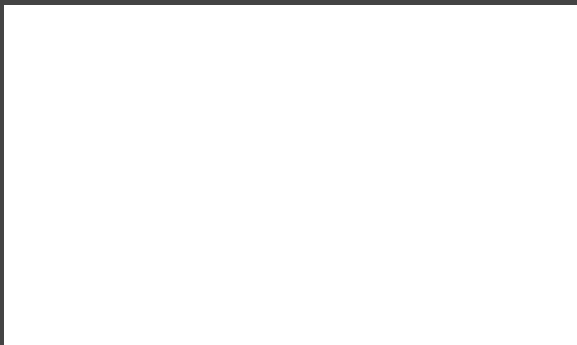


Ocean Shipment Volume (Consumer)

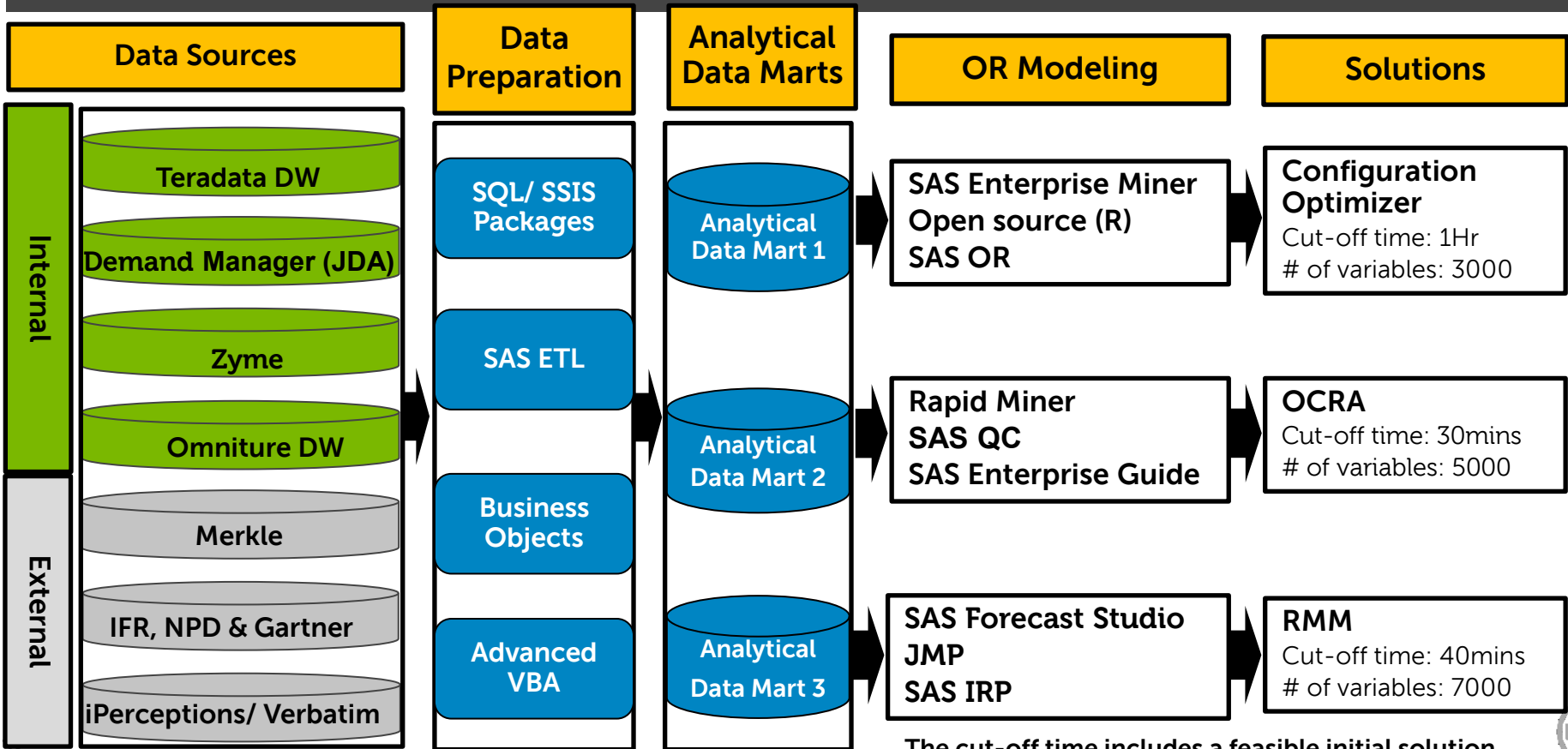


- ✓ **NPS (Customer Loyalty)**  
score more than doubled
- ✓ **Growth in services upsell**





# Solution Architecture

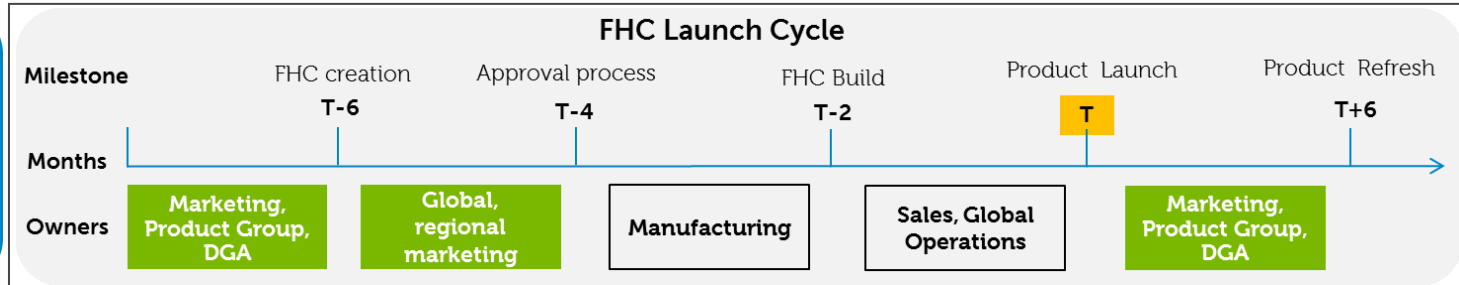




# Application of OR solutions in the business processes across functions

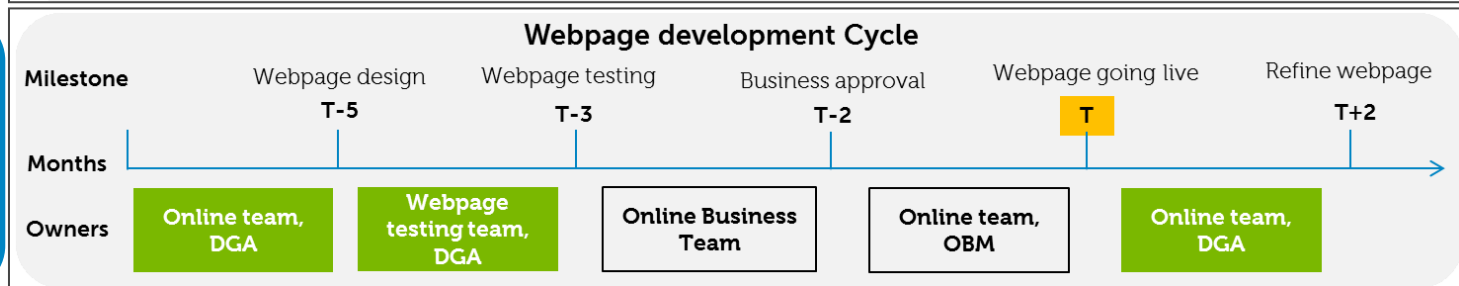
## Configuration Optimizer

- Over **100** product categories
- **20** quarters of order data
- **150+** countries



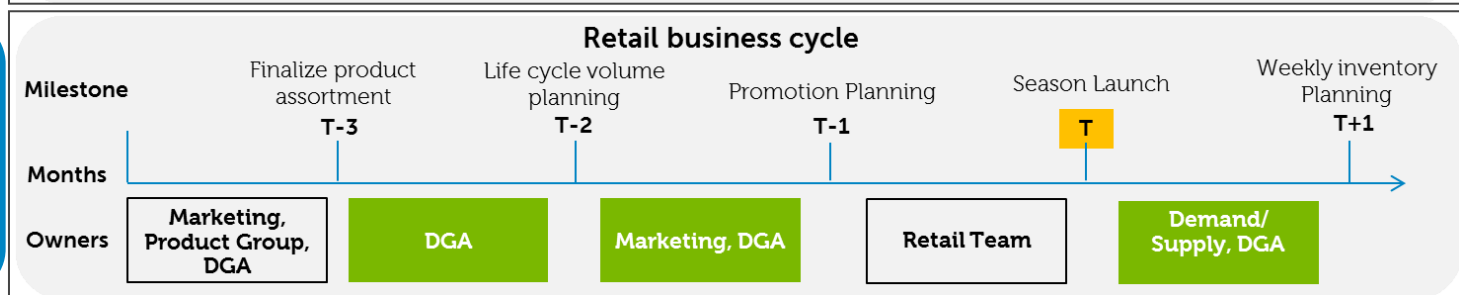
## Online Conversion Rate Accelerator

- 1.5 million unique daily visitors
- Thousands of web pages
- Websites in 15 languages



## Retail Margin Maximizer

- 40 Retailers globally
- 1200 SKUs planned annually
- 5000 promotions planned annually



# The benefits were calculated by monitoring the key metrics before and after solution implementation

	Implemented	Measure	Before	After	Margin Savings		
					2011	2012	Total
<b>Config Optimizer</b>	<ul style="list-style-type: none"> <li>US LE</li> <li>US Public</li> <li>EMEA LE</li> </ul>	# Commodities	625	327	\$ 25M	\$ 15M	\$ 40M
		# Platforms	68	50			
		Ocean Shipment	0.5M units	8M units			
<b>Online Conversion Rate Accelerator</b>	<ul style="list-style-type: none"> <li>USA &amp; Canada</li> <li>UK</li> <li>France</li> <li>China</li> <li>Japan</li> </ul>	Shipsfast RPP	\$ 4.30	\$ 5.14	\$ 20M	\$ 13.5M	\$ 33.5M
		Masthead RPP	\$ 3.30	\$ 3.65			
		Deals RPP	\$ 3.70	\$ 3.85			
<b>Retail Margin Maximizer</b>	<ul style="list-style-type: none"> <li>Best Buy</li> <li>Wal-Mart</li> <li>Sam's Club</li> <li>Microcenter</li> <li>Staples</li> </ul>	Markdown %	12%	6%	\$ 24M	\$ 18M	\$ 42M
		Season end Inventory	42 days	17 days			
		Promo uplift %	5.5 %	7%			

RPP – Revenue Per Page

