Showcasing Optimization in Hyperconnected Networks

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Foreword

- This presentation introduces the concept of showcasing, and presents its application in guiding dealership product portfolio.

- Fast (immediate) and reliable delivery in large scale across the network as in a hyperconnected network is required to successfully implement the model in practice.

  - Able to adopt it as the sole mode across the dealer network

  Through smartly integrating product showcasing and product availability, retailers can take full advantage of the fast replenishment from hyperconnected networks in the Physical Internet world and better meet customers' expectations.

Showcasing

- **Each dealership displays a portfolio of vehicles in its showroom for customers to see and to help them make better purchase choices**
- **Once a customer decides on a vehicle he/she wants, it is shipped from another location to the dealership for pickup or directly to the customer**

Which vehicles should a dealership display? How to decide?

Let us take a look at a dealer (13) for illustrative purposes
Assuming its current inventory is its showcasing portfolio

	Alpha2	Beta2	Beta11	Gamma 6
Color	Red	Blue	Black	Red
Engine	1000 Twin Cylinder	1000 Twin Cylinder	Turbo	Pro 101
Platform	A2	A2	A2	A3
Passenger	2	2	2	3
Segment Industry	Recreational	Sport-1	Sport-2	Utility

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Measuring Showcasing Portfolio Value

Define the key categories of product features that
customers want to physically touch and feel on a product in the dealership
in order to differentiate correctly between products
and to gain sufficient confidence that an ordered product
will satisfy their needs and meet their expectations

Illustrative Feature Categories

- Product Segment
- Seating Capacity
- Platform
- Engine
- Color

Illustrative Features in a Category: Seating Capacity

2 **3** **4** **6**

Measuring Showcasing Portfolio Value

Showcasing value $\Gamma = \sum_{c \in \mathcal{C}} \alpha_c w_c^s \sum_{f \in \mathcal{F}_c} d_f y_f^T + \sum_{c \in \mathcal{C} \setminus \bar{\mathcal{C}}^t} \beta_c w_c^t \sum_{f \in \mathcal{F}_c} d_f y_f^t$

w_c: Showcasing Weight of a Feature Category

$d_{f:}$ Demand Share for a feature

Feature Category	Weight
Segment Industry	0.455
Passenger (Seat Capacity)	0.136
Platform	0.182
Engine	0.091
Color	0.136
Sum	1

Feature	2	3	4	6	Sum
Demand Share	36.0%	23.9%	11.8%	28.4%	100%

Measuring Showcasing Portfolio Value

$$\text{Showcasing value} \quad \Gamma = \sum_{c \in \mathcal{C}} \alpha_c w_c^s \sum_{f \in \mathcal{F}_c} d_f y_f^T + \sum_{c \in \mathcal{C} \setminus \bar{\mathcal{C}}^t} \beta_c w_c^t \sum_{f \in \mathcal{F}_c} d_f y_f^t$$

Y_f : showcase representation in the portfolio of feature f

- **1 if the exact feature is showcased by a product in the dealership portfolio**
- **Between 0 and 1 if a similar feature is showcased by a product in the dealership portfolio**
- **0 otherwise**

Illustrative Example

Assume only engine ROTAX 1000R is showcased in products currently in the dealership portfolio

- $y_{ROTAX1000R} = 1$
- **Since seeing and touching a ROTAX 1000R is a partial surrogate for do so on a ROTAX 850**

  $y_{ROTAX\ 850} = .75$

NEW ROTAX 570

NEW ROTAX 850

NEW ROTAX 1000R

Measuring Showcasing Portfolio Value

$$\text{Showcasing value} \qquad \Gamma = \sum_{c \in \mathcal{C}} \alpha_c w_c^s \sum_{f \in \mathcal{F}_c} d_f y_f^T + \sum_{c \in \mathcal{C} \setminus \bar{\mathcal{C}}^t} \beta_c w_c^t \sum_{f \in \mathcal{F}_c} d_f y_f^t$$

- **For some categories such as color, customers will always want to see the exact feature**

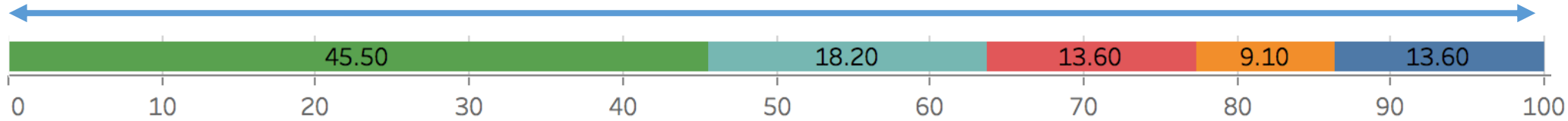 - **Thus, $y_{f \text{ in category "color"}}$ will be 1 if and only if that color is showcased**

Note:

- **Definitions of categories and feature scoring method in this presentation were selected to illustrate the concept; More precise definitions and methods need to be developed by the experts, and might be different from shown here**
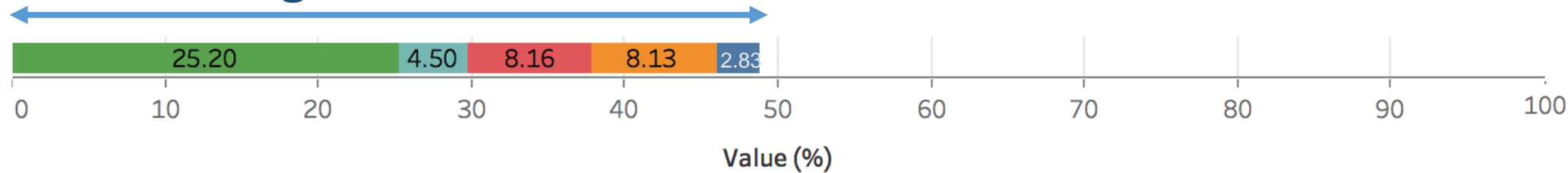
Current Showcasing Value of Example Dealer Portfolio

Max Potential Showcasing value = 100%

| 45.50 | 18.20 | 13.60 | 9.10 | 13.60 |

Value scale: 0 10 20 30 40 50 60 70 80 90 100

Showcasing value = **48.8%**

| 25.20 | 4.50 | 8.16 | 8.13 | 2.83 |

Value scale: 0 10 20 30 40 50 60 70 80 90 100
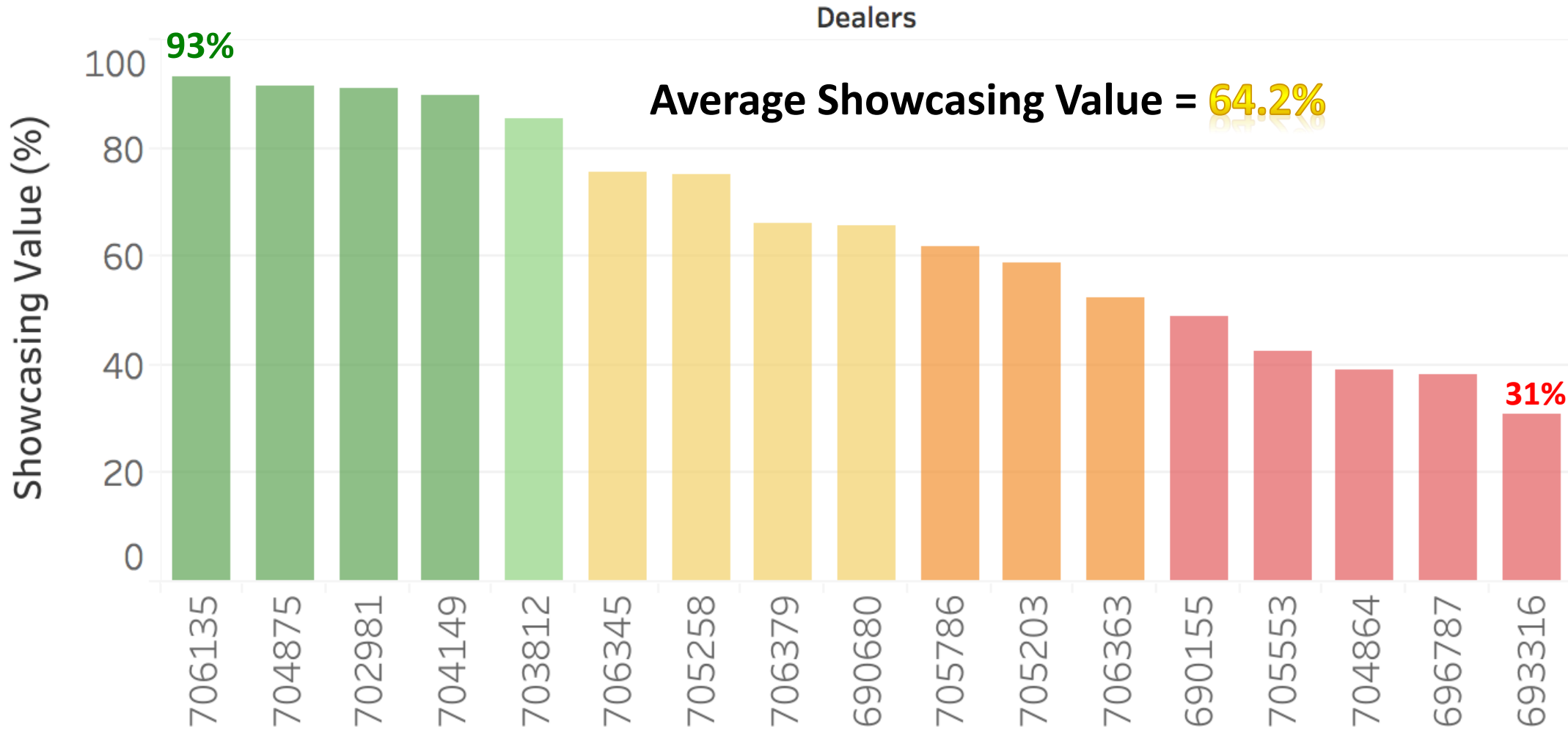
Value (%)

Legend:
- Color
- Engine
- Passenger
- Platform
- Segment Industry

Is it possible to get a better showcasing value with a different portfolio?

Current Showcasing Values

Average Showcasing Value = 64.2%

Optimization Model Output : Current Showcase

- Shows the SSV models initially showcased for each dealer in Oklahoma

- Current showcasing value and budget also shown for each dealer

	Legend
0	Product not showcased for this dealership
1	One unit of the product showcased for this dealership
2	Two units of the product showcased for this dealership
3	Three units of the product showcased for this dealership
4	Four units of the product showcased for this dealership
5	Five or more units of the product showcased for this dealership

Several dealers have multiple copies of the same product, which adds nothing to the showcasing value

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Showcasing Value Optimization

- **Goal is to maximize showcasing value for a dealer through deciding which products to showcase given physical and budgetary constraints**

- **Higher showcasing value means lower chance of a customer not purchasing the product because desired features were not showcased**

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Showcasing Portfolio Value Optimization Model

$$\max \quad \Gamma = \boxed{\sum_{c\in\mathcal{C}} \alpha_c w_c^s \sum_{f\in\mathcal{F}_c} d_f y_f^T} + \sum_{c\in\mathcal{C}\backslash\bar{\mathcal{C}}^t} \beta_c w_c^t \sum_{f\in\mathcal{F}_c} d_f y_f^t \tag{1}$$

$$s.t. \quad y_f^s \geq \delta_{fp}^i x_p^i, \qquad\qquad\qquad \forall c\in\mathcal{C}, f\in\mathcal{F}_c, p\in\mathcal{P}, i\in\{s,t\} \tag{2}$$

$$y_f^s \leq \sum_{i\in\{s,t\}}\sum_{p\in\mathcal{P}} \delta_{fp}^i x_p^i, \qquad\qquad \forall c\in\mathcal{C}, f\in\mathcal{F}_c, i\in\{s,t\} \tag{3}$$

$$v_{fp}^i \leq 1-(y_f^s - \delta_{fp}^i x_p^i), \qquad\qquad \forall c\in\mathcal{C}, f\in\mathcal{F}_c, p\in\mathcal{P}, i\in\{s,t\} \tag{4}$$

$$\sum_{i\in\{s,t\}}\sum_{p\in\mathcal{P}} v_{fp}^i \leq 1, \qquad\qquad\qquad \forall c\in\mathcal{C}, f\in\mathcal{F}_c \tag{5}$$

$$y_f^m \geq \mu\delta_{f,f'}^m x_{f'}^m, \qquad\qquad\qquad \forall c\in\mathcal{C}, f, f'\in\mathcal{F}_c \tag{6}$$

$$y_f^m \leq \mu\sum_{f'\in\mathcal{F}_c} \delta_{f,f'}^m x_{f'}^m, \qquad\qquad \forall c\in\mathcal{C}, f\in\mathcal{F}_c \tag{7}$$

$$u_{f,f'}^m \leq 1-(y_f^m - \mu\delta_{f,f'}^m x_{f'}^m), \qquad \forall c\in\mathcal{C}, f, f'\in\mathcal{F}_c \tag{8}$$

$$\sum_{f'\in\mathcal{F}_c} u_{f,f'}^m \leq 1, \qquad\qquad\qquad \forall c\in\mathcal{C} \tag{9}$$

$$y_f^t \geq \delta_{fp}^t x_p^t, \qquad\qquad\qquad \forall c\in\mathcal{C}, f\in\mathcal{F}_c, p\in\mathcal{P} \tag{10}$$

$$y_f^t \leq \sum_{p\in\mathcal{P}} \delta_{fp}^t x_p^t, \qquad\qquad\qquad \forall c\in\mathcal{C}, f\in\mathcal{F}_c \tag{11}$$

$$u_{fp}^t \leq 1-(y_f^t - \delta_{fp}^t x_p^t), \qquad\qquad \forall c\in\mathcal{C}, f\in\mathcal{F}_c, p\in\mathcal{P} \tag{12}$$

Showcasing Portfolio Value Optimization Model

$$y_f^T \geq y_f^i, \qquad\qquad\qquad \forall c \in \mathcal{C}, f \in \mathcal{F}_c, i \in \{s,m\} \qquad (13)$$

$$y_f^T \leq y_f^s + u_f^T, \qquad\qquad\qquad \forall c \in \mathcal{C}, f \in \mathcal{F}_c, i \in \{s,m\} \qquad (14)$$

$$y_f^T \leq y_f^t + (1 - u_f^T), \qquad\qquad \forall c \in \mathcal{C}, f \in \mathcal{F}_c, i \in \{s,m\} \qquad (15)$$

$$\sum_p x_p^t \leq m^t, \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (16)$$

$$\sum_{c \in \mathcal{C}} \sum_{f \in \mathcal{F}_c} \lambda_f x_f^m + \sum_{p \in \mathcal{P}} x_p^s \leq m^s \qquad\qquad\qquad\qquad\qquad (17)$$

$$\sum_{p \in \mathcal{P}} c_p^s x_p^s + \sum_{c \in \mathcal{C}} \sum_{f \in \mathcal{F}_c} c_f^m x_f^m + \sum_{p \in \mathcal{P}} c_p^t x_p^t \leq B \qquad\qquad\qquad (18)$$

$$v_{fp}^i \in \{0,1\}, \qquad\qquad\qquad \forall c \in \mathcal{C}, f \in \mathcal{F}_c, i \in \{s,t\} \qquad (19)$$

$$u_{fp}^i \in \{0,1\}, \qquad\qquad\qquad \forall c \in \mathcal{C}, f \in \mathcal{F}_c, i \in \{t,T\} \qquad (20)$$

$$u_{f,f'}^m \in \{0,1\}, \qquad\qquad\qquad \forall c \in \mathcal{C}, f \in \mathcal{F}_c \qquad\qquad (21)$$

$$x_p^i \in \{0,1\}, \qquad\qquad\qquad \forall p \in \mathcal{P}, i \in \{s,t\} \qquad\qquad (22)$$

$$x_f^m \in \{0,1\}, \qquad\qquad\qquad \forall c \in \mathcal{C}, f \in \mathcal{F}_c \qquad\qquad (23)$$

$$y_f^i \geq 0, \qquad\qquad\qquad \forall c \in \mathcal{C}, f \in \mathcal{F}_c, i \in \{s,m,t,T\}. \qquad (24)$$

Optimized Portfolio of the Same Dealer
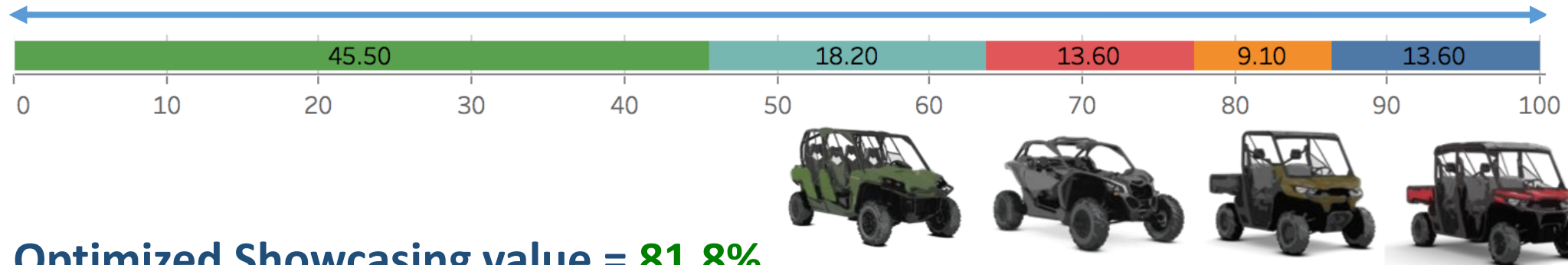## Maximizing Showcasing Value

	Alpha 12	Beta 10	Gamma 9	Gamma 20
Color	Green	Grey	Brown	Red
Engine	1000 -Twin Cylinder	Turbo	Pro 8	Pro 100
Seating	4	2	3	6
Platform	Alpha 6	D38	B5	B15
Segment	Muti	Sport-1	Utility	Utility Multi
Showcasing Value		**81.8%**		

Optimized Showcasing Value

Max Potential Showcasing value = 100%
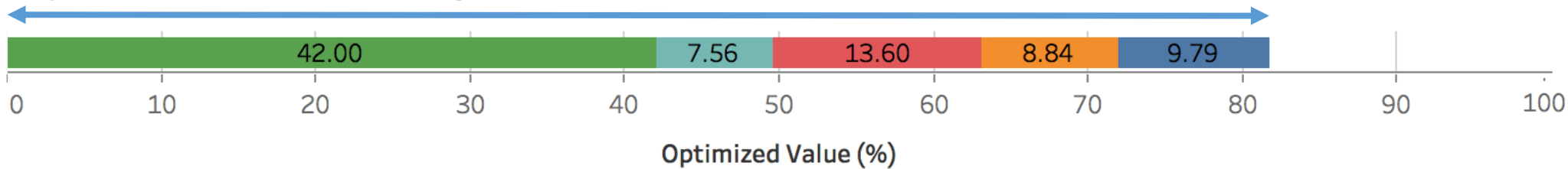
45.50	18.20	13.60	9.10	13.60

0   10   20   30   40   50   60   70   80   90   100

Optimized Showcasing value = 81.8%

42.00	7.56	13.60	8.84	9.79

0   10   20   30   40   50   60   70   80   90   100

Optimized Value (%)

Current Showcasing value = 48.8%

25.20	4.50	8.16	8.13	

0   10   20   30   40   50   60   70   80   90   100

- ■ Color
- ■ Engine
- ■ Passenger
- ■ Platform
- ■ Segment Industry

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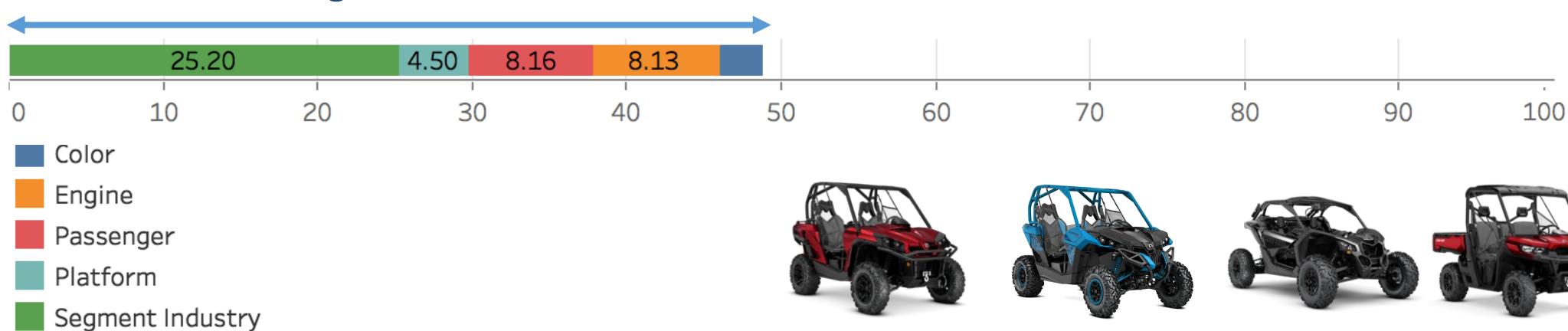
Showcasing Value Optimization
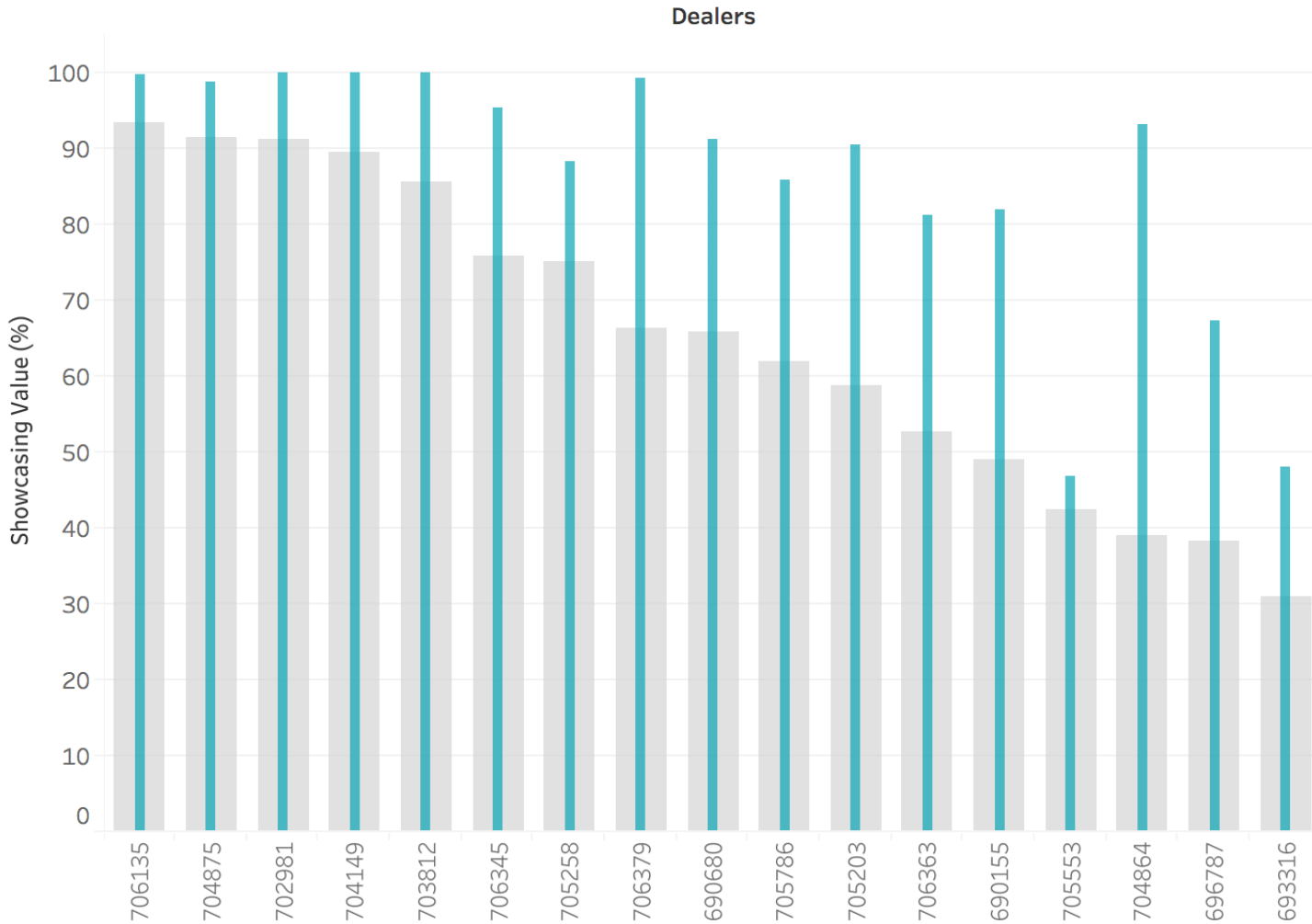
- **Optimized with the same portfolio size and budget for each dealer**

- **Average Showcasing Value = 86.2%**

- **Max Showcasing Value Increase: 140%**

- **Average Showcasing Value Increase: 40.7%**
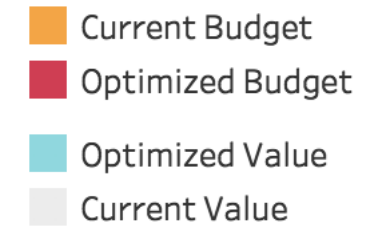
- **Min Showcasing Value Increase: 7%**

Max Achievable Showcasing Value with no portfolio size constraint= 100%

Showcasing Value Optimization

- **For some dealers, the new budget decreased**

- **The total budget for all dealers decreased by 18%**

Legend:
- Current Budget
- Optimized Budget
- Optimized Value
- Current Value

Showcasing Value Optimization: Optimized Dealer Portfolios

0 — Product not showcased for this dealership

1 — One unit of the product showcased for this dealership

- **Shows the models the showcase for optimal showcasing value within the current budget of each dealer**

- **The optimization model takes only showcasing value in to account**

  so only one unit of the same model is selected to be showcased, making it easier to stay within the budget

Future Work

- **Field work with experts and testing with consumers**

  - **Feature category definition**

  - **Feature weighing and representation**

- **Field work with dealers**

  - **Showcasing portfolio optimization**

- **Integrating Virtual, Parts and Product Showcasing**

- **Modeling Dealer Portfolio and Inventory Optimization**

  - **Merging the Showcasing and Product Availability concepts**

Questions, comments and ideas are most welcome!