ADVANCED ANALYTICS AT VOLVO CARS

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Volvo Cars was an early adopter of IT technology. In the 70’s, KDP, Memo (e-mail), CAD, etc. was introduced. The KDP enabled customer specified car orders through sequential assembly.

Some of these systems are still operational and vital to run production and to order cars.

Most systems added were used to solve specific business problems, and has led to an increased efficiency and quality.

The end result, however, is a structure with gaps, lack of holistic view on data in the company and data quality issues.

In 2006 a decision was made to start consolidation of the data and gather all data in a data warehouse.
OUR CARS

Since model year 1999 Volvo Cars started to equip cars with Diagnostic Read Out (DRO) functionality, where data can be downloaded at service through a workshop station.

Now car starts to be connected through the cloud, and create vast amounts of data to the company. This will enable direct communication with the end customers with new offers and business opportunities as a result.
Understanding the customer is crucial to strengthen brand perception, make attractive cars and services that appeals to the end customers.

Data in the whole customer life cycle, provides an opportunity to optimise all stages and attain improvements in the customer experience, as well as offer individuals specific attention to their needs.
Volvo Cars Lean Six Sigma program has been active for 13 years, and has instilled a consciousness of the benefits of being data driven.

Combining data sources leads to new knowledge and understanding of the business and customers, thus providing opportunities that were formerly unknown.

The statistical challenges encountered with the combined and increased amount of data is beyond the ordinary Six Sigma level, requiring further competence development and recruitment.
CONNECTED VEHICLES AMPLIFIES THE DATA CHALLENGE

“The Car becomes integrated in an all communicating world. The Sensus Cloud links the Car to Your services and needs”
THE BUSINESS OPPORTUNITIES

New areas, as e-commerce, digital marketing and social media challenges the company’s old ways of doing business on one hand, on the other hand a great opportunity to make new business.

Understanding the customers, also proves difficult, as social science becomes increasingly important, underlining the need of statistical methods used in operations research, econometrics, behavioural science and psychometrics.
DATA = INFORMATION + NOISE

DATA COLLECTION & EXPERIMENT
- Product
- Customer
- Warranty
- Dealer
- Sales
- Economics
- Employees

STORE
- Extract/Transform/Load
- Volvo Data Warehouse
- Data Quality
- Master Data Management

STRUCTURE
- Extract/Transform/Load
- Pre process data for analytics
- Relevance
- Outliers

ANALYTICS
- Statistics
- Exploration
- Models

REPORT
- Insights
- Visualisation

DECISION
- Business
- Question

GENERAL PROCESS
VCC PROCESS

Business  IT  Business

Advanced Analytics at Volvo Cars

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### Examples of Areas where Analytics is/can be used

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<td>• Machine learning when repairing cars</td>
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<td>• <strong>Residual Value optimisation</strong></td>
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<td>Generic</td>
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<td>• Key Performance Indicator (KPI) generation in complex environments</td>
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VOICE OF THE CUSTOMER ANALYTICS

What properties drives customer satisfaction?
• Car segments
• Markets
• Customer segments
WARRANTY ANALYTICS

Correlation with other repairs

Geographical differences

Seasonal effects

Manufacturing dates

Dealer repair cost performance
Meet John Smith

John lives in Gattonside on the Scottish Border. John owns a 2009 XC60 with 78,690 miles.
JOHN’S RECENT VISIT TO VOLVOCARS.COM/UK

User visited volvocars.com/uk from an iPad. User didn’t follow any campaigns into the site.

First, user looks at V60 offers.

Then moves to the virtual tour

Then visits the request-a-brochure page.

User reviews the privacy policy.

Then requests a brochure, stopping at both the e-brochure and brochure pages.
In general visitors look at one specific car model and the car configurator before they request a brochure.
ACTIVE SAFETY RESEARCH

Enabled by fusion of sensor data from: radar, laser, camera, velocity, etc

- Pedestrian protection
- City safety
- Collision mitigation
- Blind spot detection

Further enhanced by connected vehicles:
- Car to Car communication
- Car to infrastructure communication
EARLY WARNING SYSTEM - DIAGNOSTIC READ OUT

Analysis/prediction engine

Car configurations

500 000 analyses

Event types

Top concerns

Data drilldown

Graphs and predictions

Clickable reports
Generated by standard BI-tools

• Large scale, fully automated, survival analysis
  • Kaplan-Meier estimator
  • Prediction with maximum likelihood Weibull analysis
  • Scheduled automated weekly updates

• Processed quality data directly to the engineers
• Current and predicted quality situation
• Analysis made by standard open source engineering tools

Diagnostic readouts
Repair reports

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Find controllable parameters that affects loyalty.

Customer loyalty segments

- Migrants
- Dissatisfied defectors
- Active/Deliberate switchers
- Lifestyle adapters
- Loyals
  - Inertial loyals
  - Deliberative loyals
  - Emotive loyals

- Driven away by sources of dissatisfaction
- Seek variety, susceptible to competition
- Needs change
- Low involvement
- Consider switching
- Continual reassessment stay or go based on rational decision making
- Perceive real differentiation rarely reassess purchase decision

- Social change
  - Driven away due to change in Geography or other

Data

- Dealer Management System
- Customer Satisfaction Surveys

Qualitative loyalty model

Significant predictors

Customer stock prediction vs age of cars

Market simulation

Loyalty programs

Improve customer sat.

Improvements

Data

Significant predictors

Customer stock prediction vs age of cars

Market simulation

Loyalty programs

Improve customer sat.
**REMARKETING - RESIDUAL VALUE - US MARKET**

- Maximize RV for each individual car
- 250 Variables

**Best decision!** (on average)

- **Transport**
  - Floor price: 15555 USD
  - Total cost: 315 USD
  - Profit: 240 USD

- **Wait**
  - Floor price: 15315 USD
  - Total cost: 170 USD
  - Profit: 145 USD

- **Sell now at current location**
  - Floor price: 15000 USD
  - Profit: 0 USD

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**Floor price: 15000 USD**

**Total cost: 170 USD**

**Profit: 145 USD**
CHALLENGES TO ADDRESS, GOING FORWARD

Data Quality

- Standards for naming variables and items. E.g. not having 8 different ways of naming alloy wheels, space in the end of names, different number of space characters etc.
- Inconsistent dates, i.e. 30th of February

Master Data Management

- Many systems feed each other, risking inconsistency and updating problems.
- Double storage
- Confusion about what is master or reference i.e. what feeds what

Accessibility

- Standardised ways of accessing AND understanding the data. Sometimes stored in codes that are not intuitive to understand
- Easier ways to connect data without being an SQL programmer.
- Access correct data at an appropriate level.
CHALLENGES TO ADDRESS, GOING FORWARD

Business and Analytical Competence

- Business understanding/knowledge
- Skills in applied advanced statistics/mathematics
- Skills in handling data
- IT/data management/scripting etc
- Management and business integration
- IT architecture knowledge
- Creativity/Conceptual ability

Process change=Change Management

- How we use the new insights might change processes, the way we do business, thus leading to need for change management. A challenge that should not be underestimated
Privacy aspects

• Volvo Cars applies the same strict rules to protect the integrity of the end-users in a connected car as it applies to general safety issues.

• It will always remain the end-users decision if he or she would like transmit personal data to another party.

• Volvo however believes that generalized data from the whole Volvo car fleet can be useful for our customers – and society. I.e. sharing information about road-condition, collected by the whole Volvo fleet of connected cars could be shared in the future with the road authorities.
THANK YOU!
QUESTIONS?