

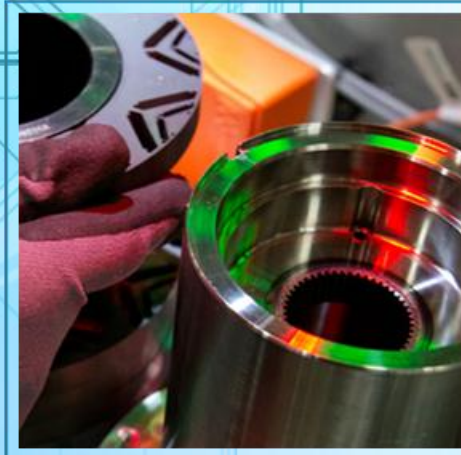
GENERAL MOTORS

TRANSFORMING AND DISRUPTING PERSONAL TRANSPORTATION ►►►

OPPORTUNITIES FOR DATA SCIENCE

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Director, Operations Research
GM Global Research & Development



TRANSPORTATION CHALLENGE DOMAIN

Enable development of
connected and automated
vehicle systems by *rapidly
processing vast amounts of data*
from thousands of individual
vehicles across an entire region

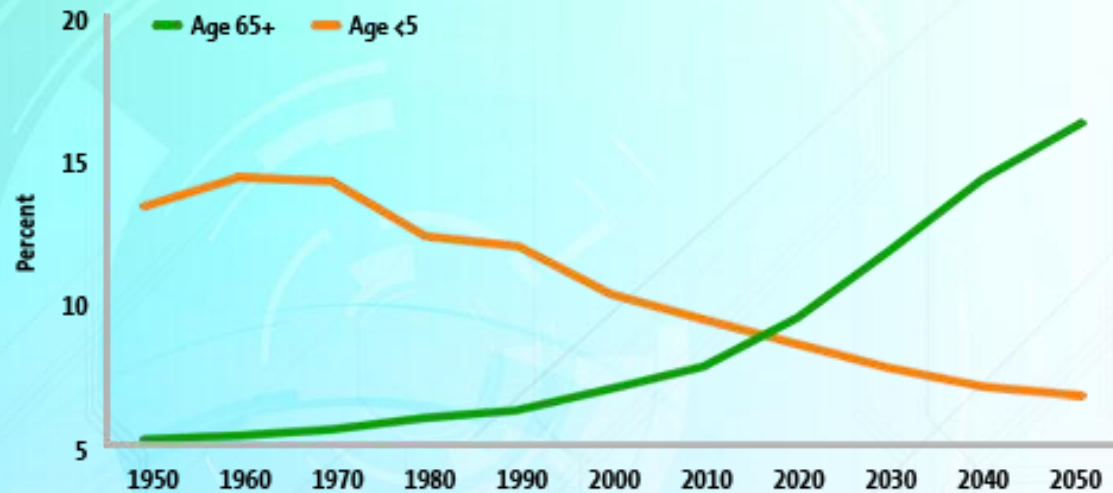


GLOBAL YOUTH



- ▶ In 2030, 37% of the world's population will be under the age of 25 (over 3.1 billion)
- ▶ Significantly lower percentage of those aged 16-30 have driver's licenses compared to 30 years ago
- ▶ A study of global youth revealed a common set of values: family, friends, money/status, education, travel, stability, and freedom

GLOBAL AGING & LIVING LONGER



► By 2030, countries with large populations ages 65+ include:

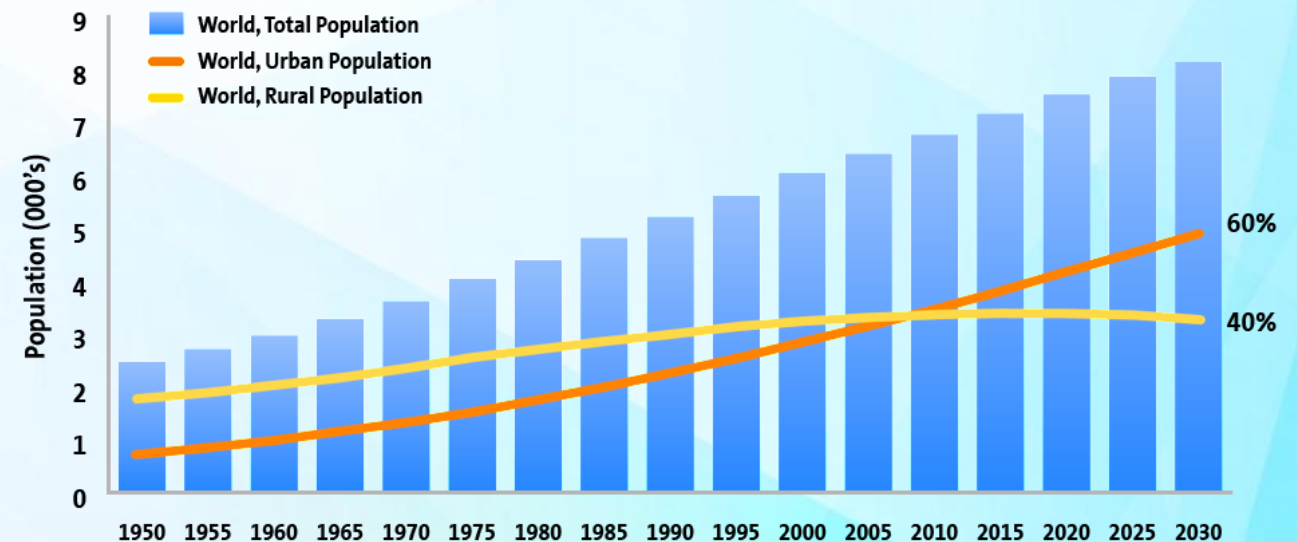
- Japan 38%
- Germany 33%
- Italy 32%
- Canada 27%
- U.K. 26%
- U.S. 24%

► Aging isn't what it used to be... “mature” citizens more active, healthier, and live longer than ever before



URBAN MOBILITY

- ▶ In 1950, two-thirds of the world's population lived in rural areas... by 2030, almost two-thirds will live in cities
- ▶ There are 28 megacities today with populations exceeding 10 million
- ▶ Hypercities: Tokyo (38M), Delhi (25M), Shanghai (23M), Mexico City, Mumbai and Sao Paulo (21M)

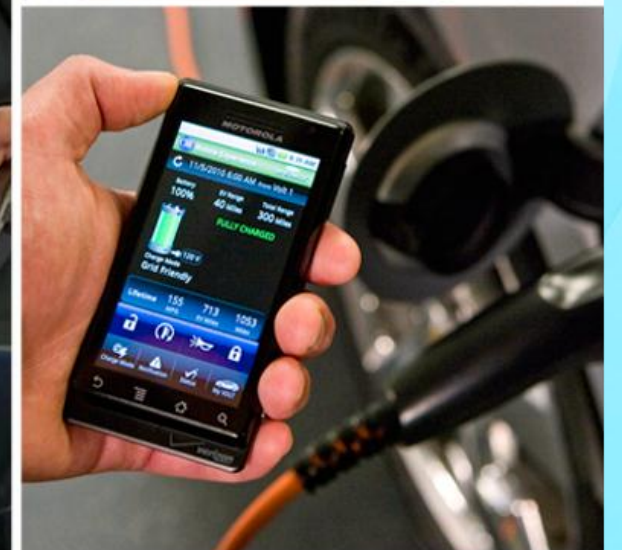


CONNECTED LIVING



- ▶ Mobile-cellular subscriptions approaching 7B, the number of people on the earth
- ▶ 3B use the Internet
- ▶ Facebook has over 1.4 billion active users globally; 85% are mobile users
- ▶ 90% of the world's data has been created in the last two years – 2.5 quintillion bytes of data created every day!

CUSTOMER EXPECTATIONS



Bring their digital life into their vehicle

Bring their vehicle into their digital life

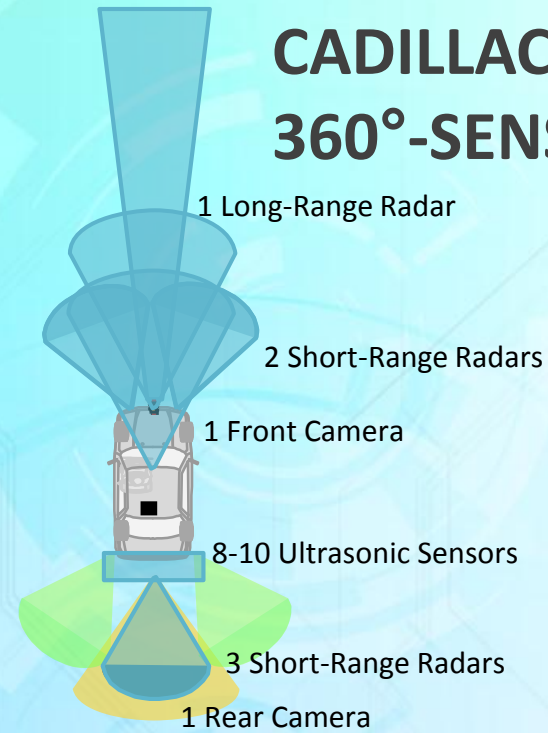
CUSTOMER EXPECTATIONS



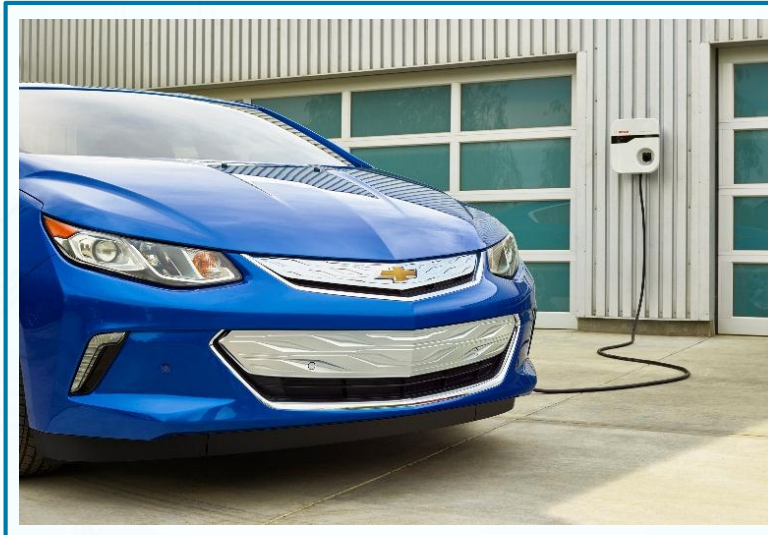
SELF-DRIVING VEHICLES

TECHNOLOGY INNOVATION

CADILLAC 360°-SENSING



ELECTRIFICATION



ROBOTIC MFG



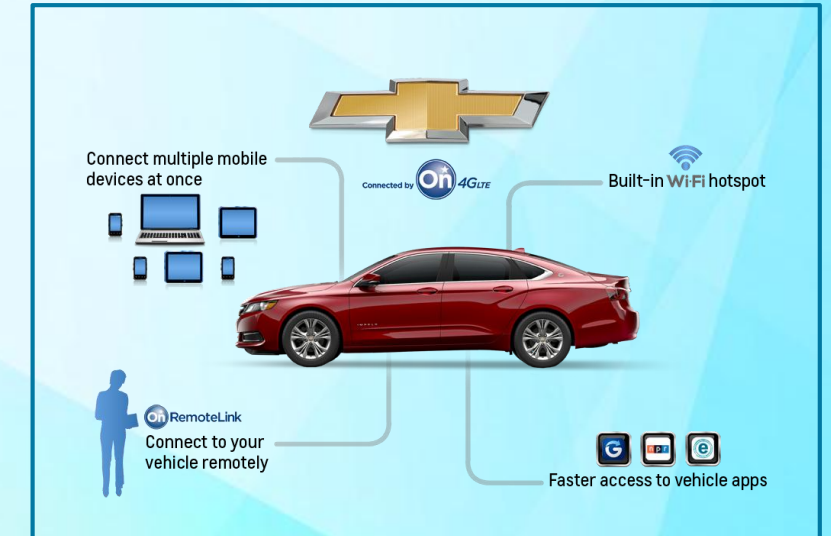
FUEL CELL VEHICLES



SUPER CRUISE



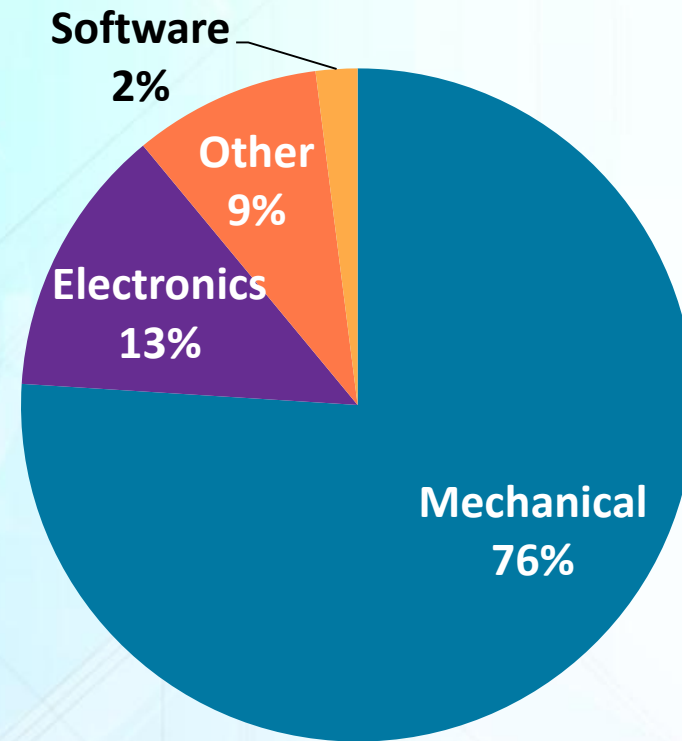
ONSTAR 4G LTE



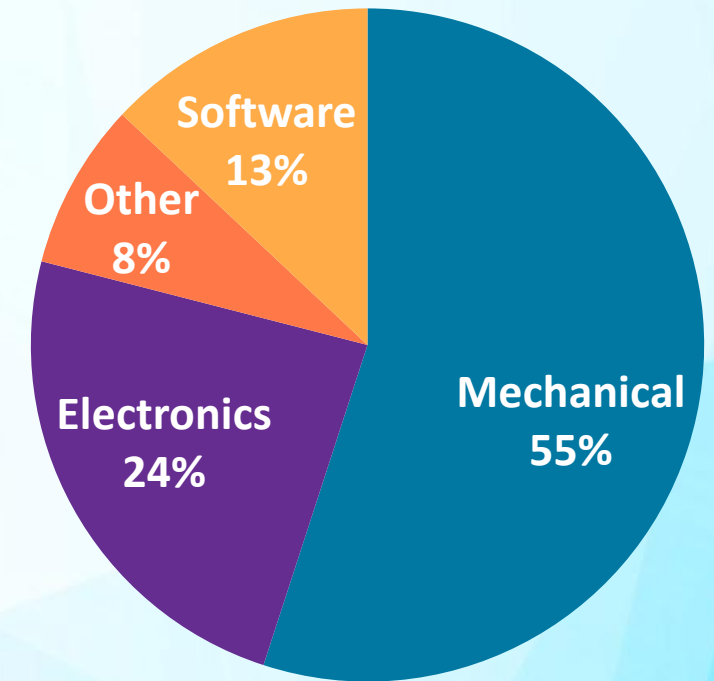
TECHNOLOGY INNOVATION

VALUE OF ELECTRONICS AND SOFTWARE

2000








Today



- ▶ \$400
- ▶ 20 ECUs
- ▶ 1M lines of code

- ▶ \$1,200
- ▶ 75 ECUs
- ▶ **100M lines of code**

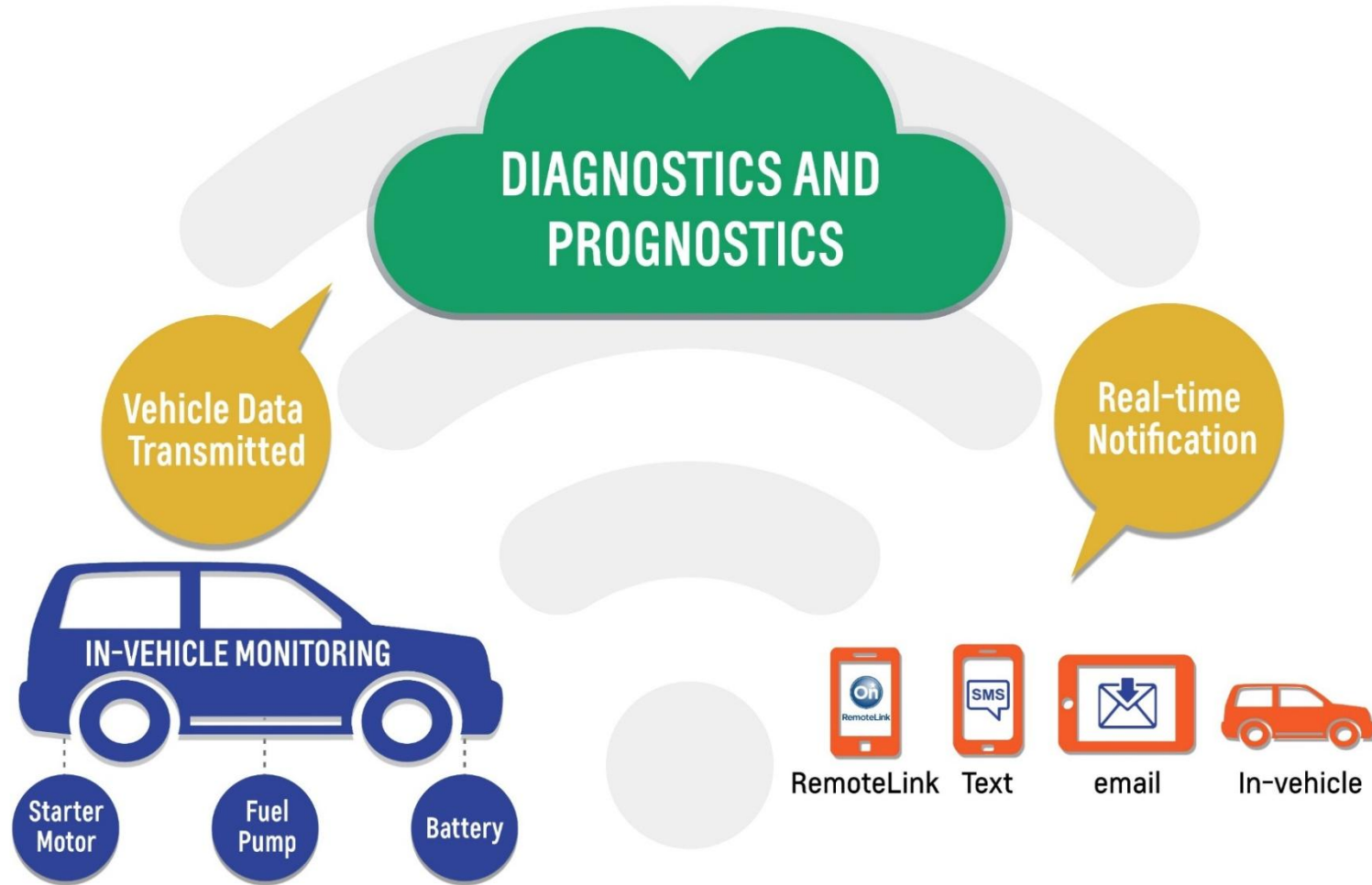
GM SPEEDS UP WITH ONSTAR 4G LTE

	Built-in Wi-Fi hotspot
	Connect multiple mobile devices at once
	Faster, more reliable connection
	Connect to vehicle remotely
	On more than 30 GM vehicle models

**NEW FOR 2016: PROGNOSTICS;
ANDROID AUTO/APPLE CAR PLAY**



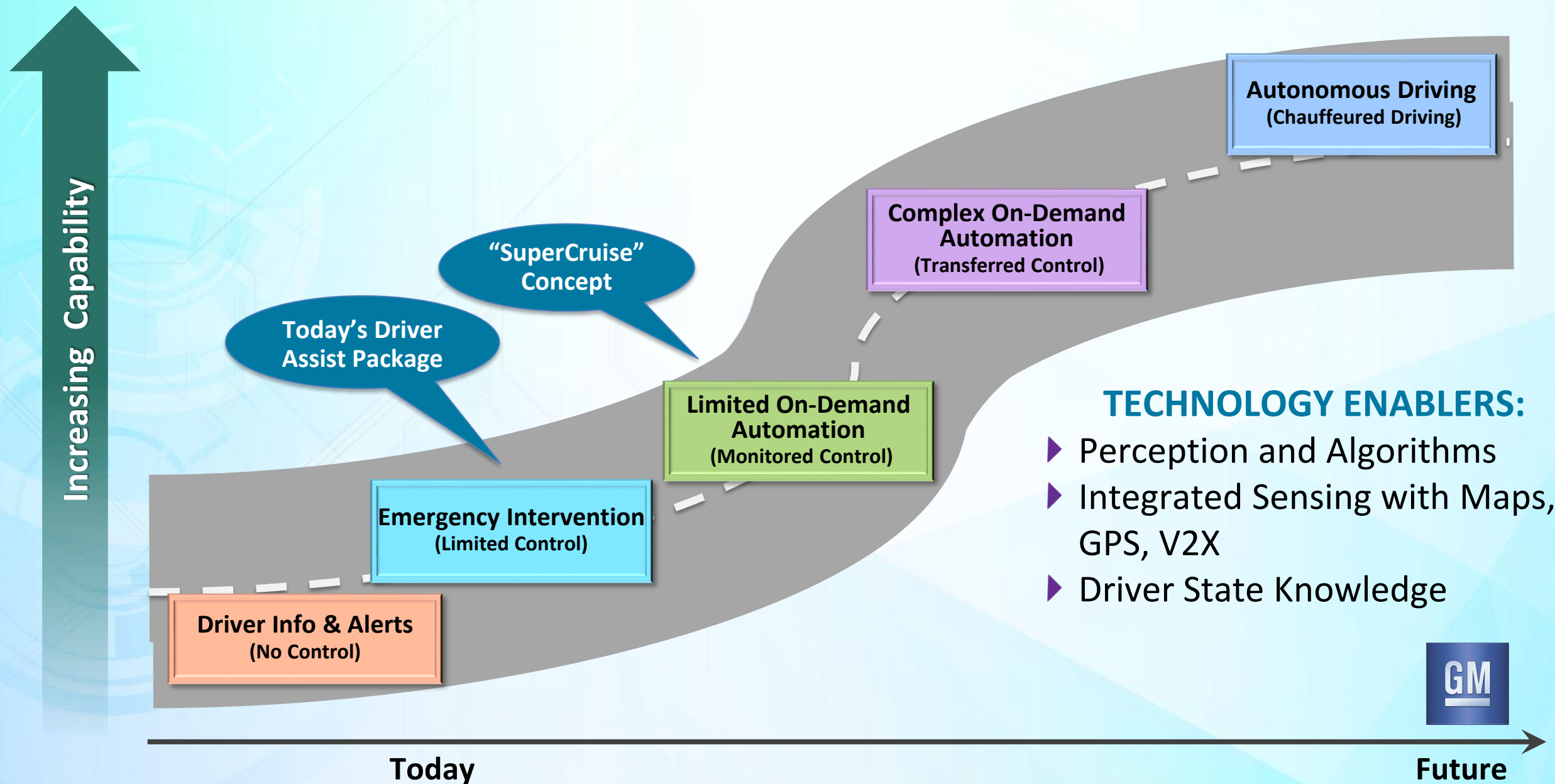
CHEVROLET PROGNOSTICS: PREDICTING WHEN CERTAIN COMPONENTS NEED ATTENTION – 2016 CHEVY MODELS



HOW IT WORKS WITH YOUR BATTERY



ROADMAP TO AUTOMATED DRIVING

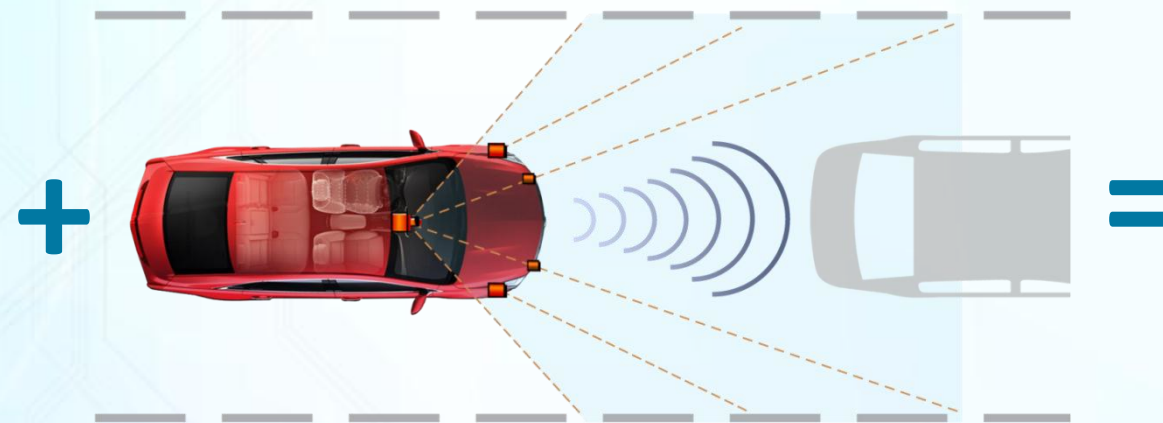


CADILLAC TO INTRODUCE SUPER CRUISE ON ALL-NEW CT6

ACTIVE SAFETY



AUTOMATED STEERING & LANE FOLLOWING



HOW IT WORKS

LANE FOLLOWING: Using a combination of GPS and optical cameras, Super Cruise watches the road ahead and adjusts steering to keep the car in the middle of its lane.

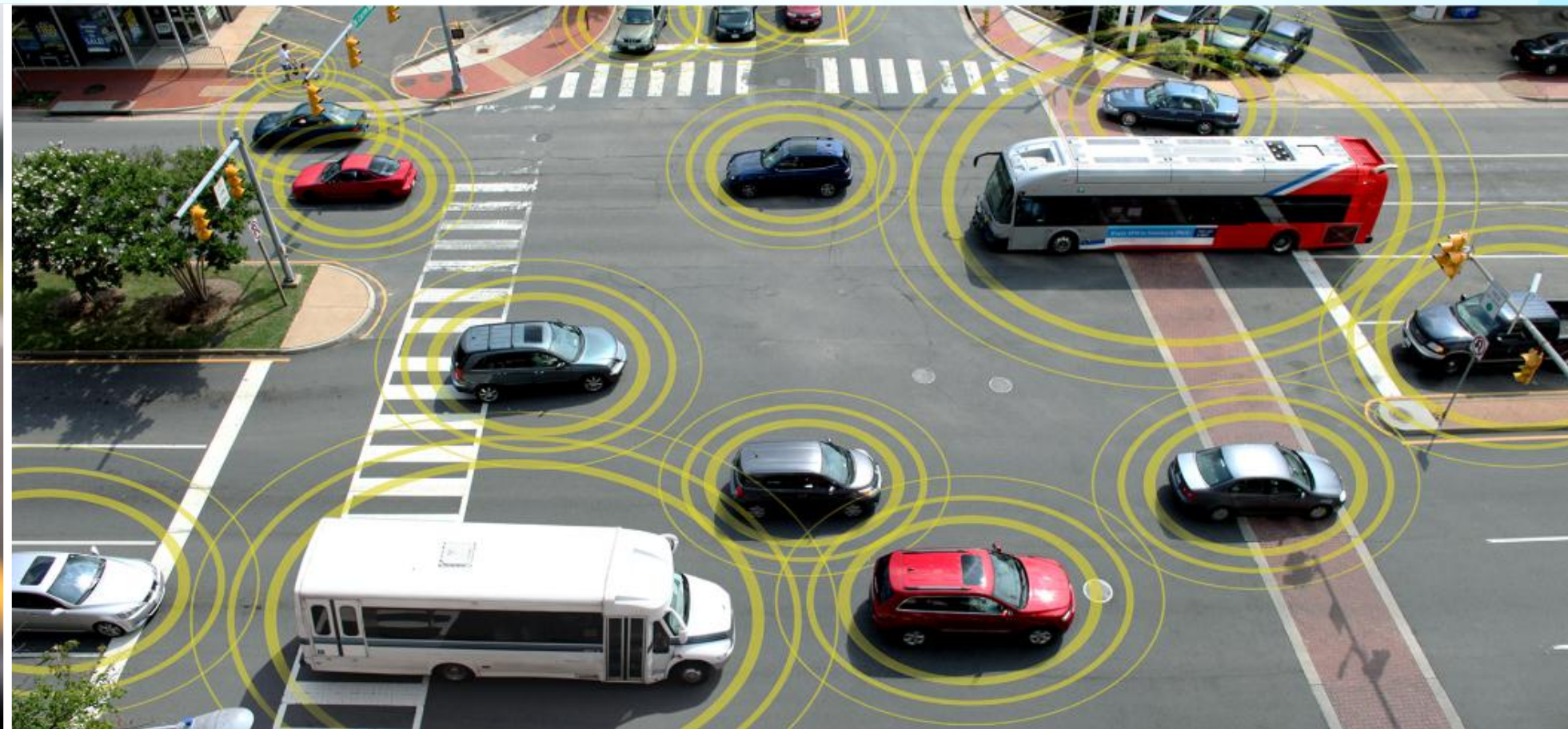
COLLISION AVOIDANCE: A long-distance radar system detects vehicles more than 300 ft. ahead. The vehicle will automatically accelerate or apply the brakes to maintain a preset following distance.

CADILLAC SUPER CRUISE



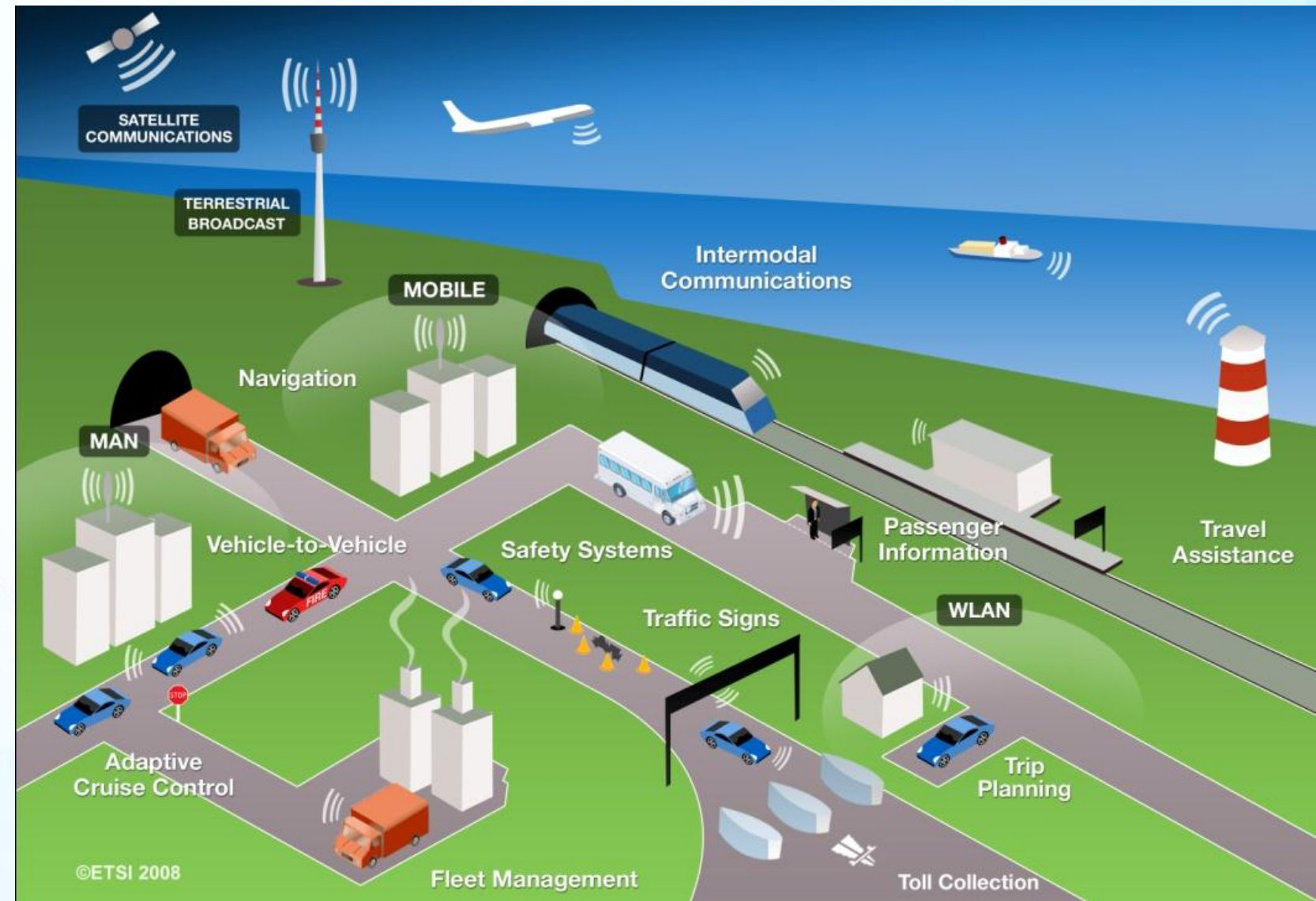
V2X TO DEBUT ON 2017 CADILLAC CTS

Technology allows cars to communicate with each other (V2V), the infrastructure (V2I), and pedestrians (V2P)



INTELLIGENT TRANSPORTATION IN THE NEXT DECADE (2025)

- ▶ Automated Highway Driving
- ▶ Partial/Full Urban Driving
- ▶ Extensive V2V (and V2P) capability
- ▶ Acceleration of Intelligent Infrastructure
- ▶ High-Volume/High-Speed Integrated Connectivity
- ▶ Efficiency/Electrification
- ▶ Shared Mobility



TRANSFORMING DATA INTO INSIGHT FOR MAKING BETTER DECISIONS

Prescriptive
Analytics

***What should
we do?***

Optimization

Simulation

- Identifies and evaluates potentially *new* ways to operate
- Targets business objectives
- Balances all constraints

Predictive
Analytics

***What could
happen?***

*Predictive
Modeling*

Data Mining

- Predicts *future* probabilities and trends
- Finds relationships in data not readily apparent with traditional analysis

Descriptive
Analytics

***What
happened?***

Regression

Visualization

Data Modeling

- Prepares and analyzes *historical* data
- Identifies patterns from samples for reporting of trends

Techniques

COMBINING “BIG DATA” WITH SUBJECT MATTER EXPERTISE

- ▶ Significant opportunities to leverage trends of increasing available data
 - Transactional data
 - Unstructured data
 - Data from individuals
 - Sensor data
 - Publicly shared data
- ▶ Keep the risks (and ‘hype cycle’) in mind
- ▶ The haystack has gotten bigger
- ▶ Combining insights with deep subject matter expertise is critical to success

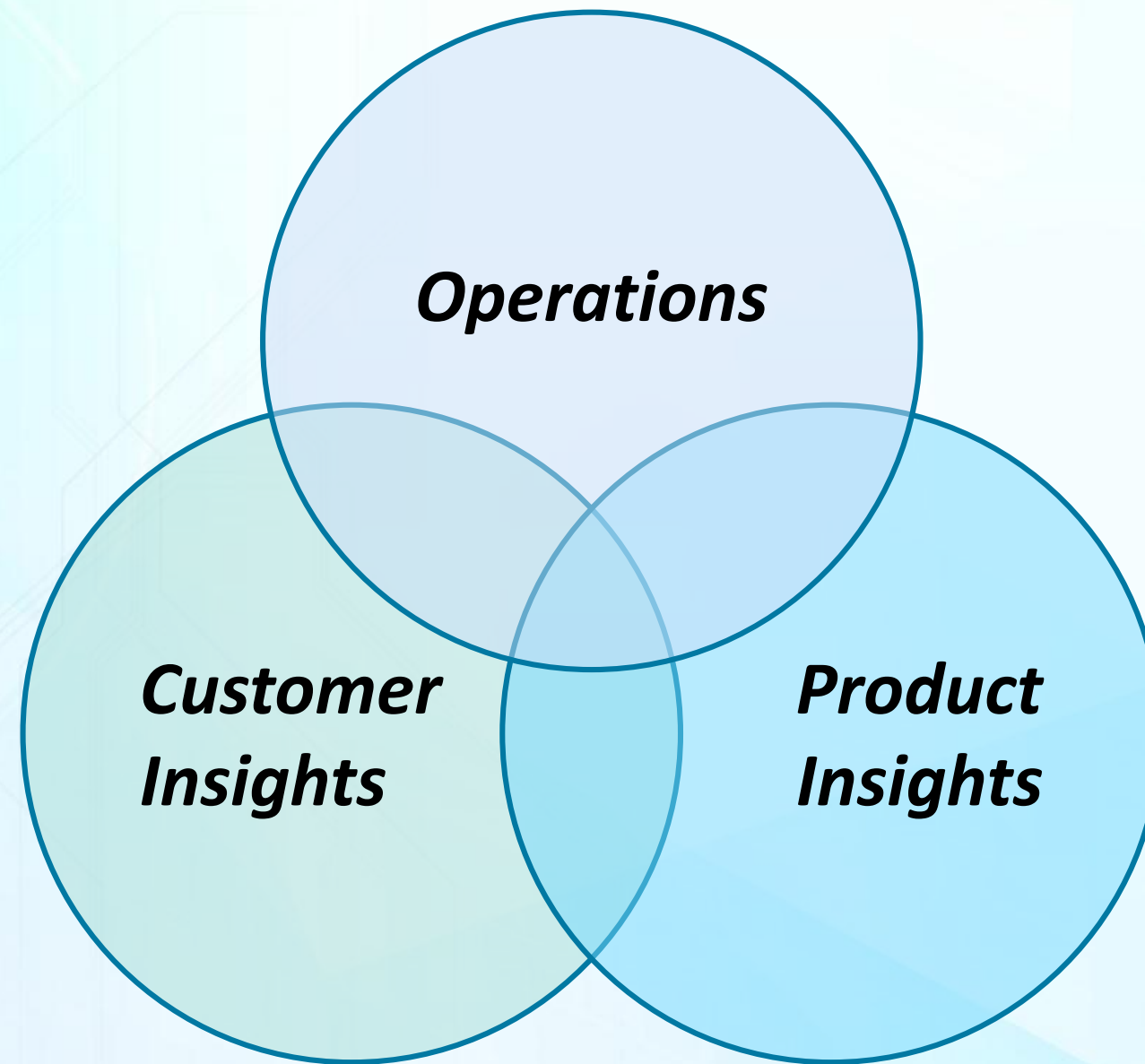
Big data is changing the whole equation for business

THE WALL STREET JOURNAL. March 11, 2013

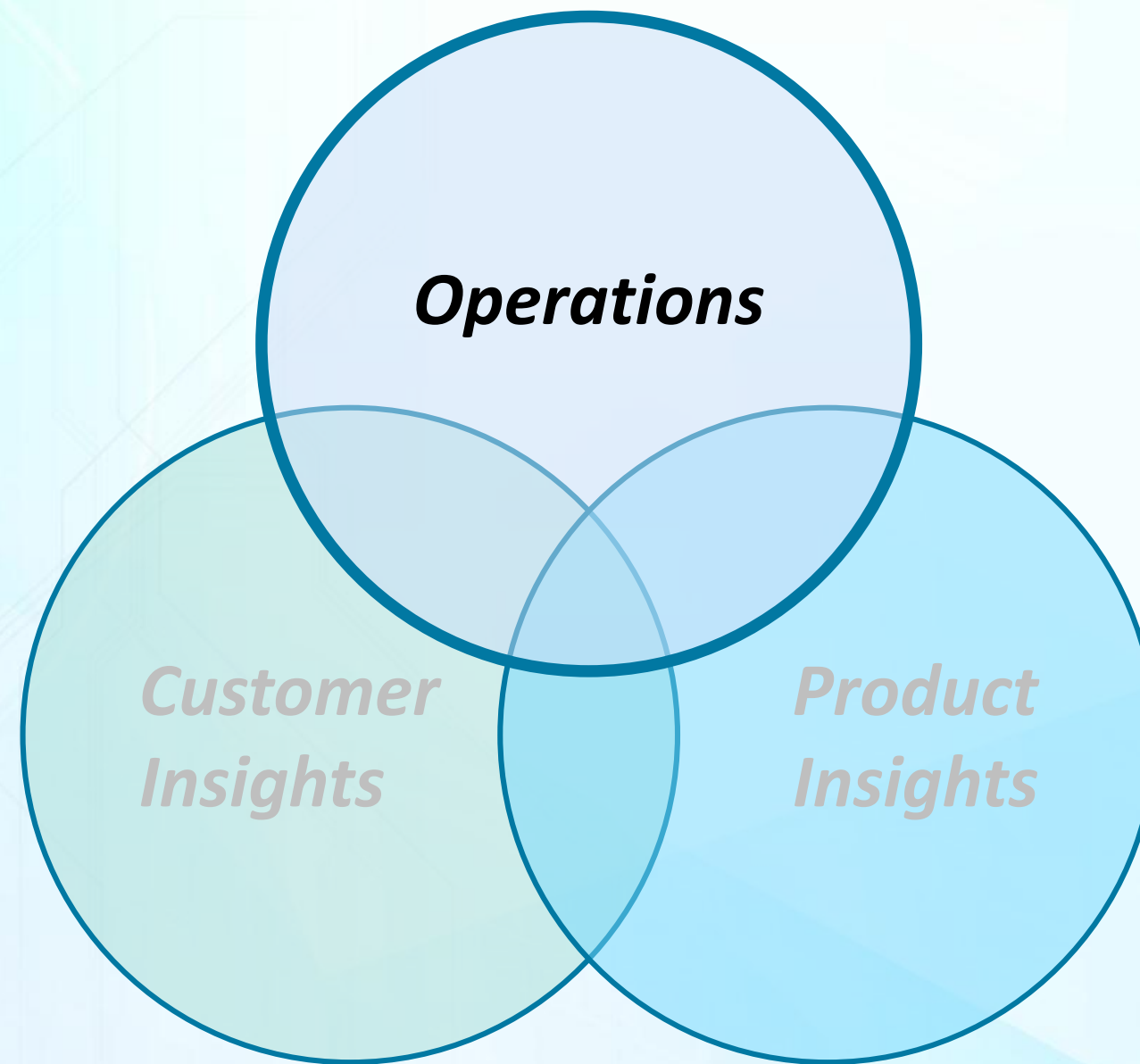
“Big data” has arrived, but big insights have not. The challenge now is to solve new problems and gain new answers – without making the same old statistical mistakes on a grander scale than ever.

FINANCIAL TIMES March 29, 2014

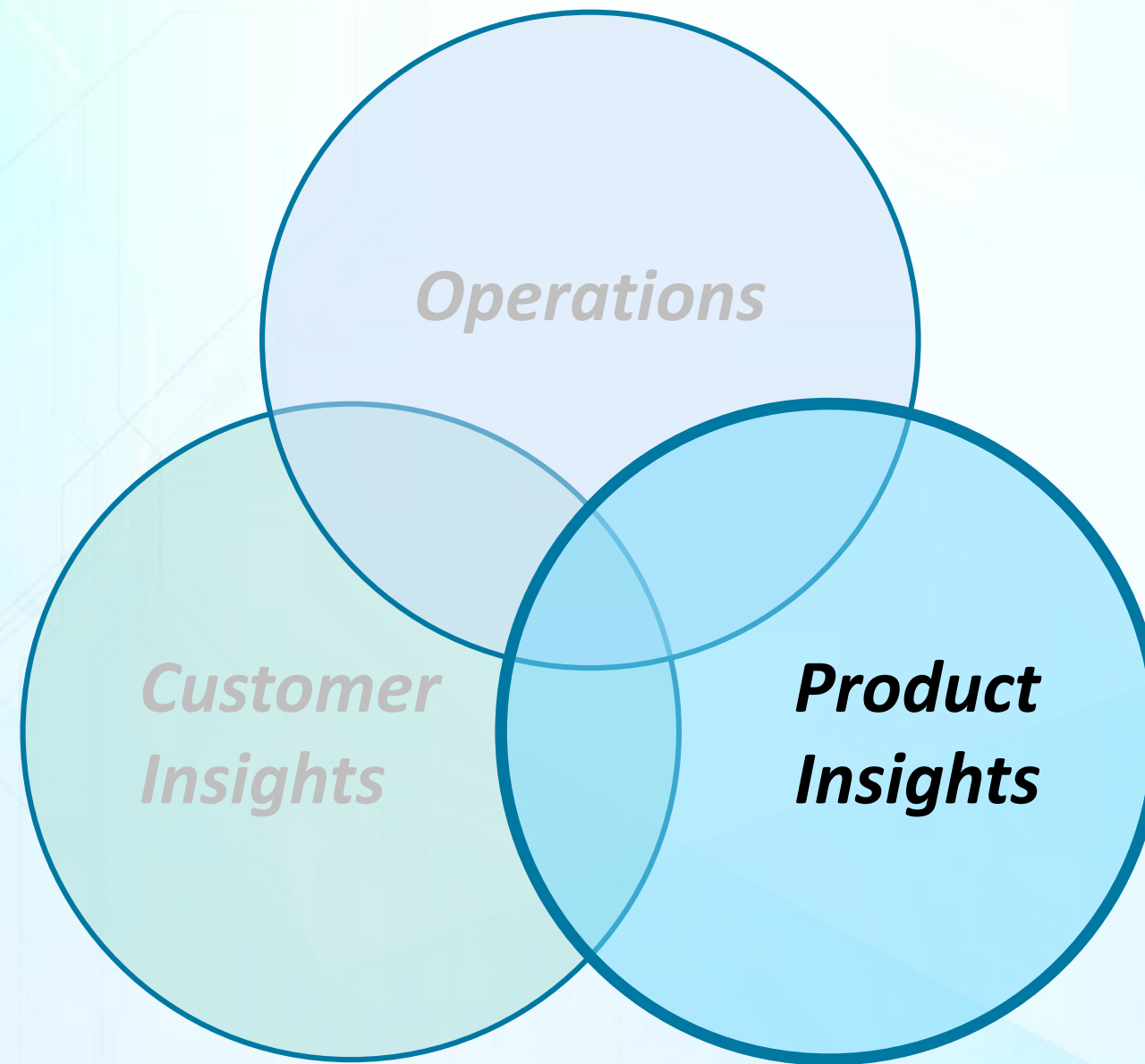
AREAS OF OPPORTUNITIES AND EXAMPLES



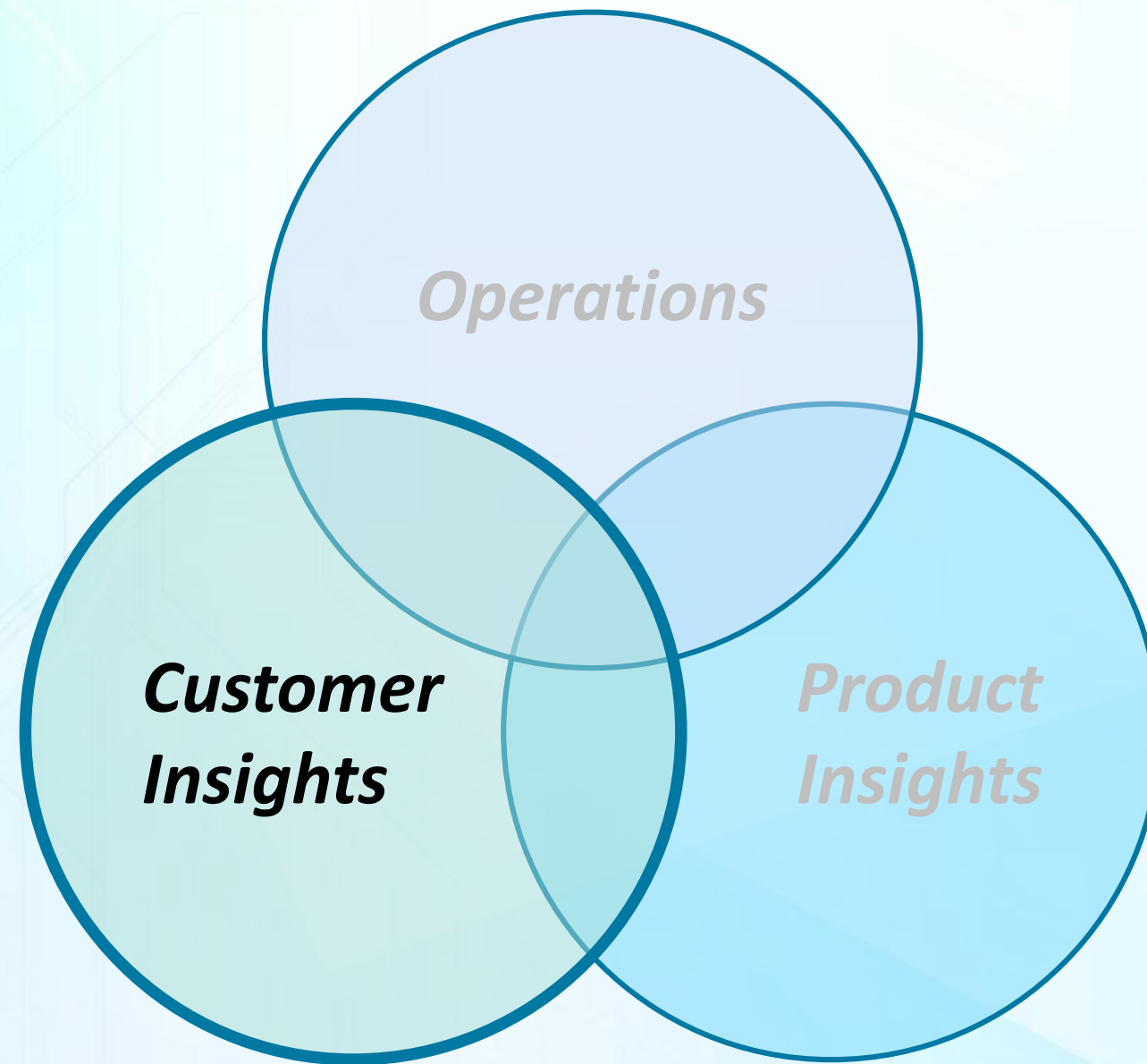
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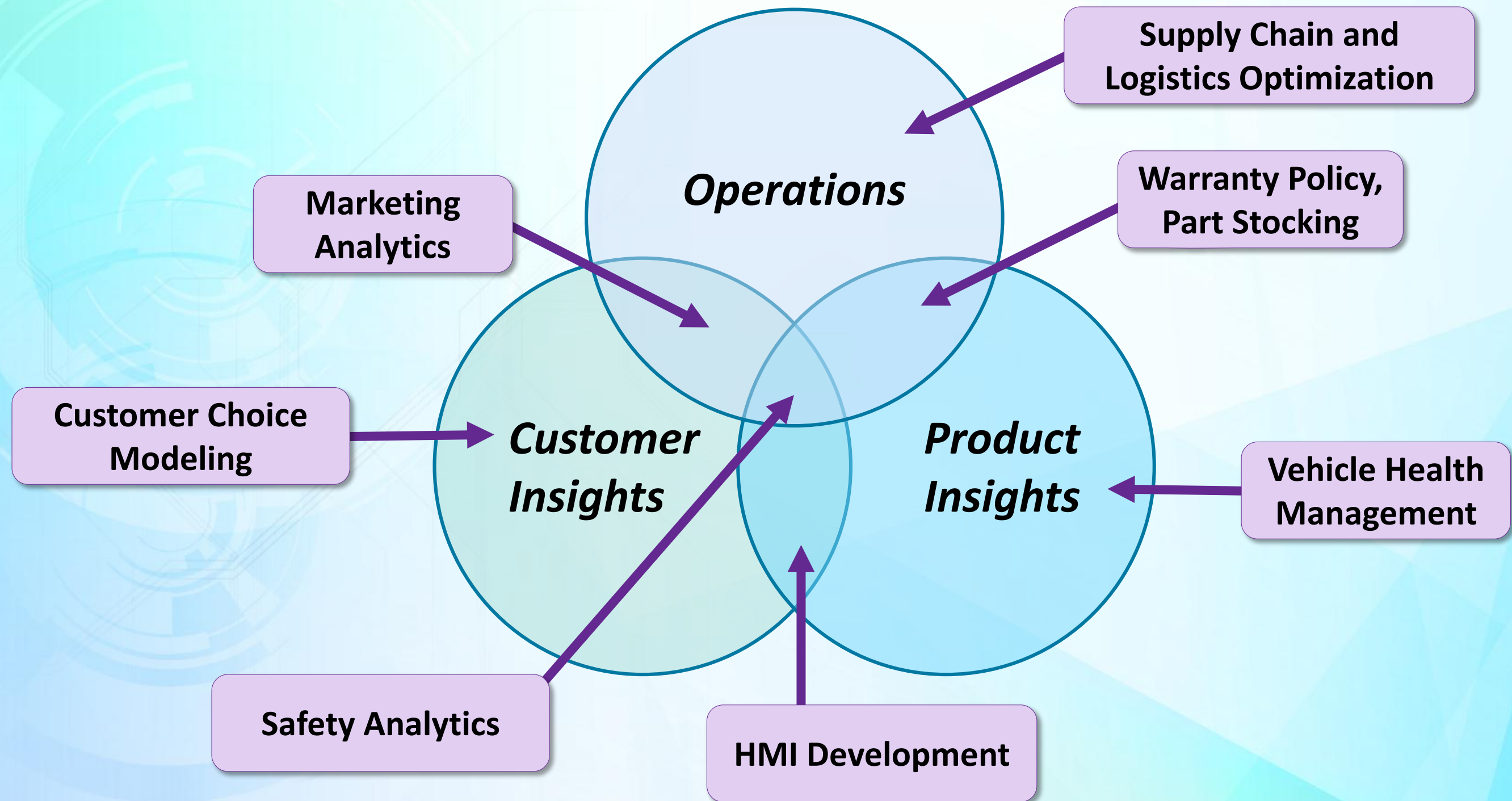
AREAS OF OPPORTUNITIES AND EXAMPLES



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EVERYTHING STARTS AND ENDS WITH GREAT PRODUCTS

