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Toyota Motor North America, R&D

Hideki Hada

February 8, 2017

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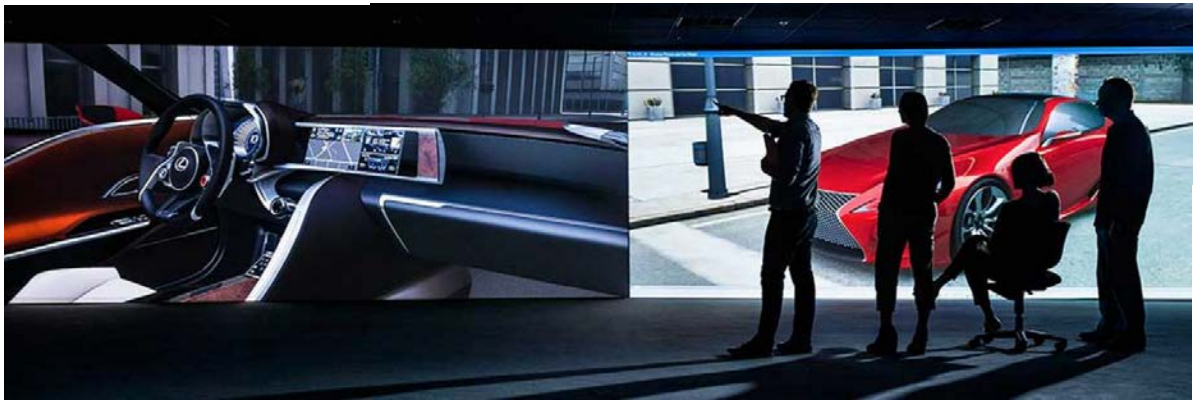
Toyota Motor North America

25 million

vehicles built in North America

40,000

team members



11

manufacturing plants

16

different models

TOYOTA MOTOR NORTH AMERICA

R&D

https://www.toyota.ca/toyota/en/about/north-america

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Toyota in North America

1957 60th
Toyota Motor Sales

1972
Manufacturing Operation

1973
Calty Design Research

1977 40th
Toyota Tech Center

1986
Kentucky Production

1987
Toyota USA Foundation

1988
1st Canada Production

1993
Arizona Proving Ground

1995
Engine Production

1996
US Manufacturing HQ

1997
5 million NA Production

1999
1 million Production

2000
1st Hybrid in US

2002
10 million NA Production

2003
1st Lexus Production

2006
Hybrid Production in US

2010
NA Center for Quality

2011
Collaborative Safety Research Center

2012
15 million NA Production

2015
Plano HQ Construction

2016
7 million Production

TOYOTA MOTOR NORTH AMERICA R&D

http://www.toyota.com/usa/operations/map.html
http://www.tmmc.ca/en/about-tmmc/history-milestones

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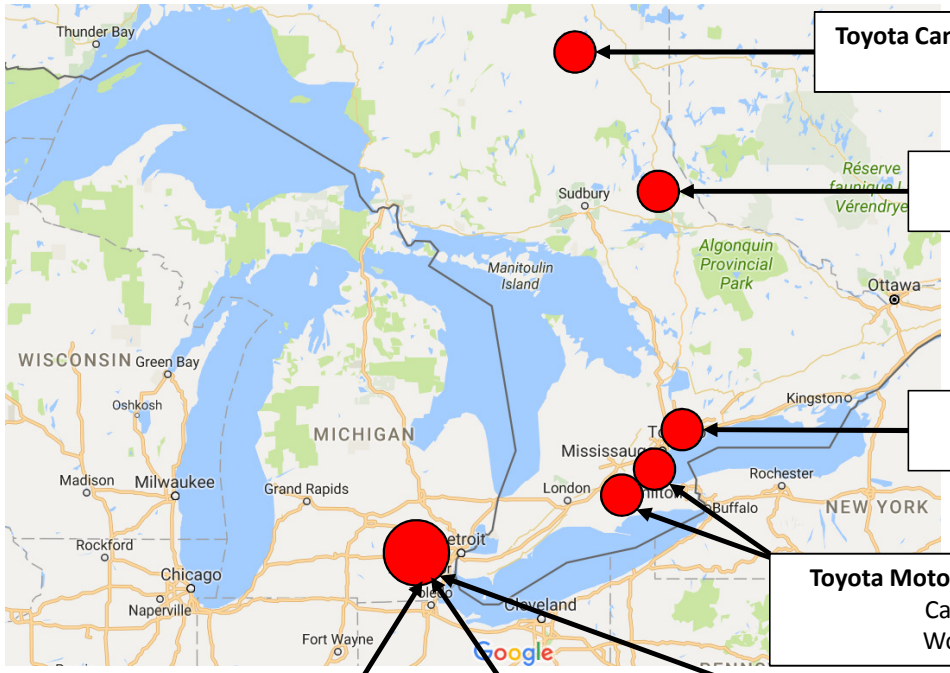
Toyota in Michigan & Ontario

North America

TMNA R&D

Vehicle Design
Vehicle Evaluation
Powertrain
Research
Adv. Development
Purchasing
Supplier Engineering
Etc.

Michigan & Ontario



Toyota Canada Cold Research Centre
Timmins, ONT

Miller Technology
North Bay, ONT

Toyota Canada, Inc.
Toronto, ONT

Toyota Motor Manufacturing Canada
Cambridge, ONT
Woodstock, ONT

Toyota Motor North America
Ann Arbor, Saline, Detroit,
Plymouth, Livonia

Calty
Ann Arbor, MI

Toyota Research Institute
Ann Arbor, MI

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http://www.toyota.com/usa/operations/map.html#!/Operations-By-State
http://www.toyota.com/usa/operations/map.html#!/ttc_ann_arbor_and_saline
http://corporatenews.pressroom.toyota.com/releases/toyota+advanced+automated+vehicle+technology+us+roads+sept4.htm

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Developed & Manufactured in US & Canada

Mississippi

Corolla

Toyota Motor Manufacturing, Mississippi, Inc. (TMMMS)

Kentucky **R&D**

Camry

Toyota Motor Manufacturing, Kentucky, Inc. (TMMK)

Kentucky **R&D**

Avalon

Toyota Motor Manufacturing, Kentucky, Inc. (TMMK)

Kentucky

Lexus ES 350

Toyota Motor Manufacturing, Kentucky, Inc. (TMMK)

Indiana **R&D**

Sienna

Toyota Motor Manufacturing, Indiana, Inc. (TMMI)

Indiana

Sequoia

Toyota Motor Manufacturing, Indiana, Inc. (TMMI)

Indiana

Highlander

Toyota Motor Manufacturing, Indiana, Inc. (TMMI)

Texas **R&D**

Tacoma

Toyota Motor Manufacturing, Texas, Inc. (TMMTX)

Texas **R&D**

Tundra

Toyota Motor Manufacturing, Texas, Inc. (TMMTX)

Cambridge

$21,980 as shown[1]

2017 Corolla
$18,500 starting[1]
28/36 est. mpg[2]

Woodstock

$36,150 as shown[1]

2017 RAV4
$24,910 starting[1]
23/30 est. mpg[2]

Cambridge

RX
STARTING AT $43,120*
295 HP 3.5L V6

Cambridge

RX HYBRID
STARTING AT $53,035*
30 MPG COMBINED RATING*

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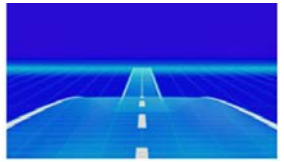
http://www.toyota.com/usa/operations/map.html
http://www.tmmc.ca/en

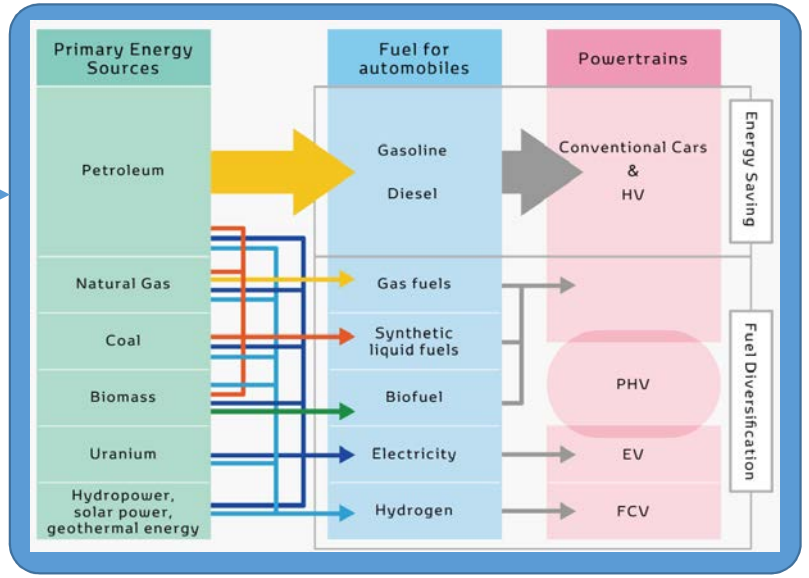
Toyota: Innovation

Environment Technology

Safety Technology

Intelligent Transportation





http://www.toyota-global.com/innovation/vision/

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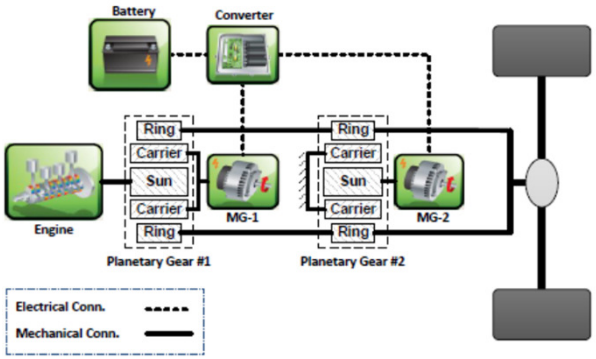
Innovation & Collaboration: Powertrain

Improve automotive powertrain efficiency: development process and energy



Math-based modeling for virtual development of complex systems

Using information technology for reduced energy consumption and greenhouse gas emissions

University of Waterloo

Prof. John McPhee

Prof. Nasser Lashgarian Azad

Maplesoft
Mathematics • Modeling • Simulation

Matching Fund Partners

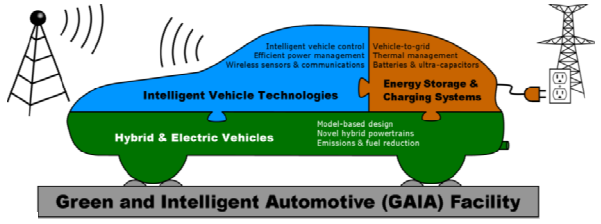
- Natural Sciences and Engineering Research Council of Canada (NSERC)
- Automotive Partnerships Canada
- Canada Foundation for Innovation
- Ontario Centres of Excellence
- Ontario Research Fund

GAIA

Green and Intelligent Automotive Facility

University of Waterloo

TMMC



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Innovation & Collaboration: Safety

CSRC Collaborative Safety Research Center
TOYOTA

By collaborating on research with the best and brightest from universities, hospitals and researcher institutions across North America and by sharing the results with academics, government and the rest of the automotive industry – we're working to advance transportation safety and help reduce the number of traffic injuries and fatalities.

Active Safety

Passive Safety

Human Factors

Data Analytics & Tools

CSRC Collaboration Partners

The Children's Hospital of Philadelphia · TASi · UC San Diego · The University of Iowa
AGELAB · Michigan Tech Research Institute · The Ohio State University
UMTRI · University of Toronto · University of Virginia · Virginia Tech
Virginia Tech Transportation Institute · Washtenaw Area Transportation Study · Wake Forest School of Medicine · Wayne State University School of Medicine
Universidad Anáhuac · New York Medical College · The University of Wisconsin Madison

Designing feedback to help induce safer driving behaviors

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http://www.toyota.com/csrc/#
http://hfast.mie.utoronto.ca/

AUTO21

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Innovation & Collaboration: Safety

Designing feedback to help induce safer driving behaviors

PI
Birsen
Donmez

UNIVERSITY OF TORONTO | Human Factors & Applied Statistics

http://hfast.mie.utoronto.ca/research/driver-feedback/

Providing feedback to drivers

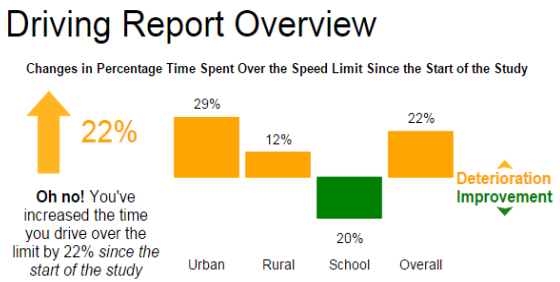
- to enhance their performance
- to change their long term behaviours
- without imposing distractions detrimental to safety

Specific objectives:

- feedback characteristics to inhibit risky behaviors.
- when feedback can become a potential distractor and what type of individuals are more prone to it.
- the learning curve, how drivers adapt to feedback over time, and if benefits sustain when feedback is not available.

Voluntary distraction: Some drivers are more willing to engage in a secondary task, e.g., sending a text message

Involuntary distraction: some drivers are more likely to be distracted by irrelevant stimuli, e.g., phone ringing



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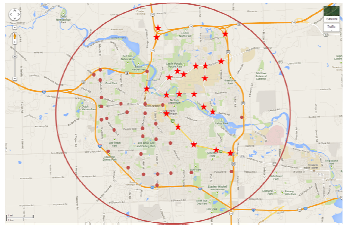
Innovation & Collaboration: ITS & ADAS

MOBILITY TRANSFORMATION CENTER
UNIVERSITY OF MICHIGAN

Government – Industry – Academia Partnership to Accelerate **Research & Deployment of Connected & Automated Vehicle (CAV) Technologies**

Leadership Circle

Developing an entire system of connected and automated transportation on the streets of southeastern Michigan through 2021.
→ **Deployment of Vehicle to Vehicle (V2V) & Vehicle to Infrastructure (V2I)**

Pillar 1 Connected Ann Arbor	Pillar 2 Connected SE Michigan	Pillar 3 Connected-Automated
		
Expand DSRC fleet and infrastructure in Ann Arbor		M-City Test Course
		
Start DSRC installation to up to 1000 TTC lease cars	Expand DSRC infrastructure in Southeast Michigan	Connected & Automated Test Vehicle

http://www.mtc.umich.edu/

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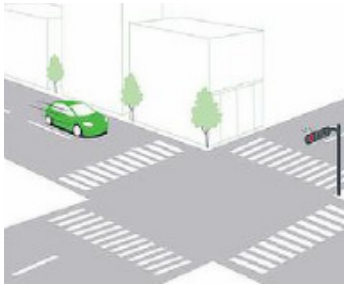
Innovations: V2X Technology

Toyota's Vehicle to Infrastructure (V2I) and Vehicle to Vehicle (V2V) Products (since 2015)

iTS CONNECT

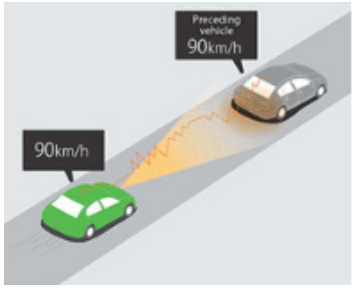
Right-Turn Collision Caution

Red Light Caution

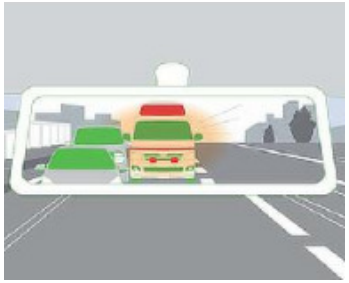


Signal Change Advisory

Communicating Radar Cruise Control



Emergency Vehicle Notification



Roadside Unit

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http://toyota.jp/technology/safety/itsconnect/
http://lexus.jp/brand/technology/itsconnect/
http://newsroom.toyota.co.jp/en/detail/9676551

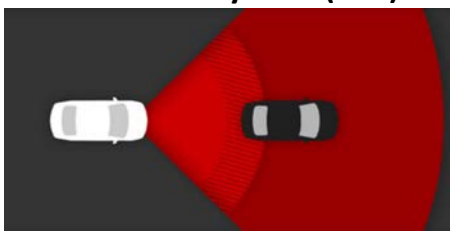
Innovations: ADAS Technology

Almost all Toyota & Lexus models will have Toyota's ADAS Package as standard by the end of 2017.

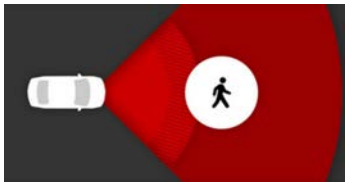
TSS **Toyota Safety Sense**
LSS+ **Lexus Safety System +**

Package of key ADAS features using sensor fusion

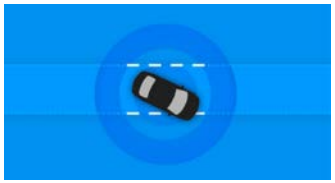
Pre-Collision System (PCS)



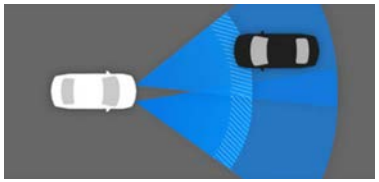
Pre-Collision System With Pedestrian Detection Function (PCS w/PD)



Lane Departure Alert (LDA)



Automatic High Beams (AHB)



Dynamic Radar Cruise Control (DRCC)

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http://www.toyota.com/safety-sense/
http://newsroom.toyota.co.jp/en/detail/4228443

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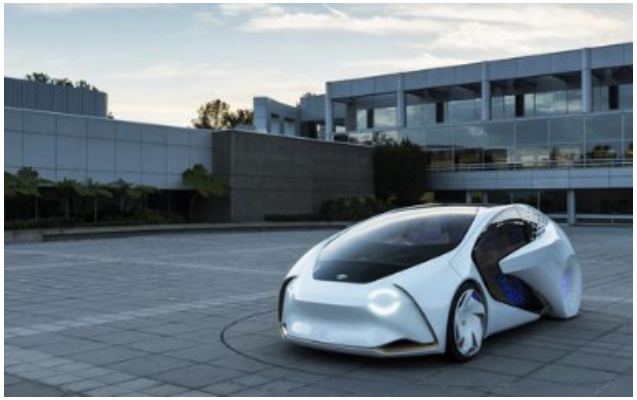
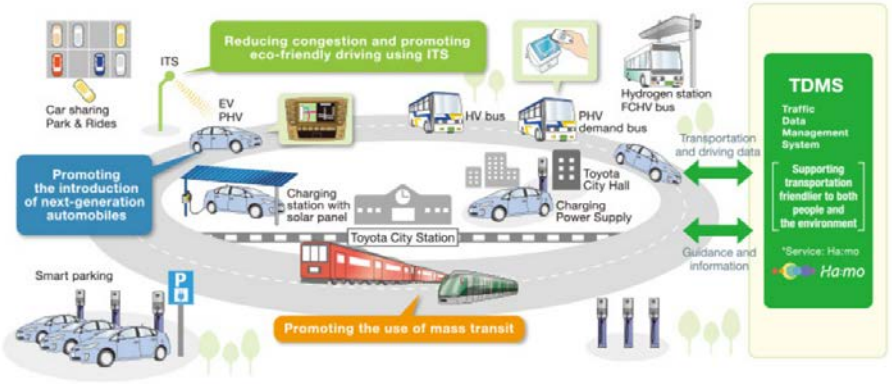
Innovations: Opportunity (even easier)

Driving Automation
Automated driving Technologies



ITS & Mobility Eco-System



Ultra-Compact Mobility Sharing Network

Two Major Events in 2017 Connecting Michigan & Canada and Cars & Roads

Michigan

Vehicle SAFETY
6/5-8, 2017
Cobo Center, Detroit
https://www-esv.nhtsa.dot.gov/

Intelligent Transportation
10/29 – 11/2, 2017
Palais des congrès de Montréal
https://www.itscanada.ca/events/wc_2017.html

ITS World Congress 2017 Montréal

Canada

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http://www.toyota-global.com/innovation/intelligent_transport_systems/lowcarbon/

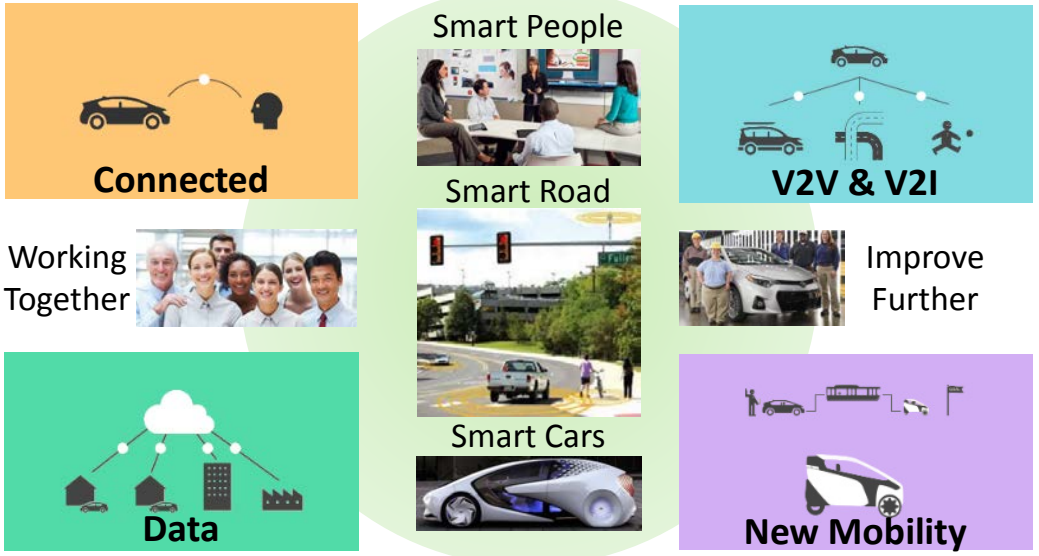
Summary

- Mobility improvement is a **global** issue with **regional** uniqueness.
- **Regional** talent can contribute to **improvement** of global issues.

Mobility Challenges

Senior Driver	Young Driver	Rural Mobility	Urban Mobility
Congestions	Emission	Crashes	Inefficiency

New Opportunities



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