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www.cir-strategy.com/events



The flexible nature of supply chains: Lessons in Agility & the importance of Supply Chain Risk Management for Electric Vehicle Supply Chains.

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Who am I?

- “Accidentally fell” into academia.
 - Engineer (CEng, Eur Ing, FIET)
 - Logistician & Supply Chain Professional (FCILT)
 - Procurement Professional (FCIPS)
 - U.K. National Teaching Fellow 2019 (NTF, PFHEA)
- Professor & Chair of Supply Chain Strategy
 - Cranfield – Postgraduate – Technology AND Management.
 - First Professor of Supply Chain Risk Management
 - My goal is “Knowledge into Action”.
- Immediate Past Chairman of the Chartered Institute of Logistics & Transport U.K.
 - Movement of Goods and People and their associated supply chains.

 [@SupplyChainProf](#)

- 2 • Work across all sectors and industries.

 <https://www.linkedin.com/in/richardwilding/>



Where do Cranfield work?



Global delivery capability

- More than 80 programmes each year delivered overseas
- 50% of programme income generated outside of the UK
- 80% of programmes have participants from more than one country

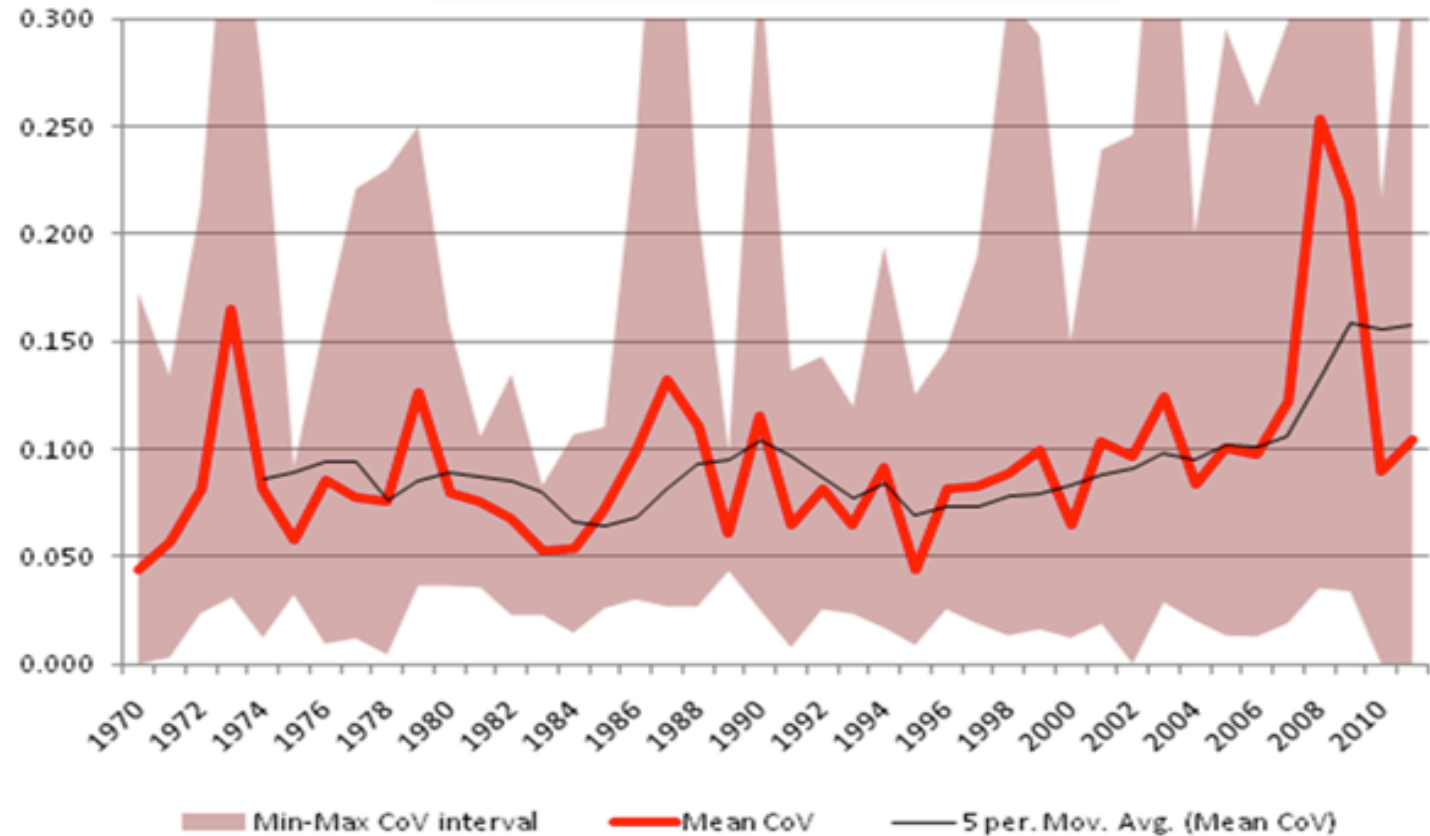
Ranked No.1 outside U.S. for influence & innovation in Logistics, Transport & the Supply Chain.

Agenda & Themes

- The VOCA world and the need for flexible Supply Chains.
- The Temple of Supply Chain Resilience.
 - The Foundation of Effective Supply Chain Strategy.
- Understanding the Risk Profile of the Electric Vehicle Supply Chain.
 - Consider the whole EV.
 - Consider the Lithium-ion Battery.

Surviving a VUCA World – Volatility, Uncertainty, Complexity Ambiguity

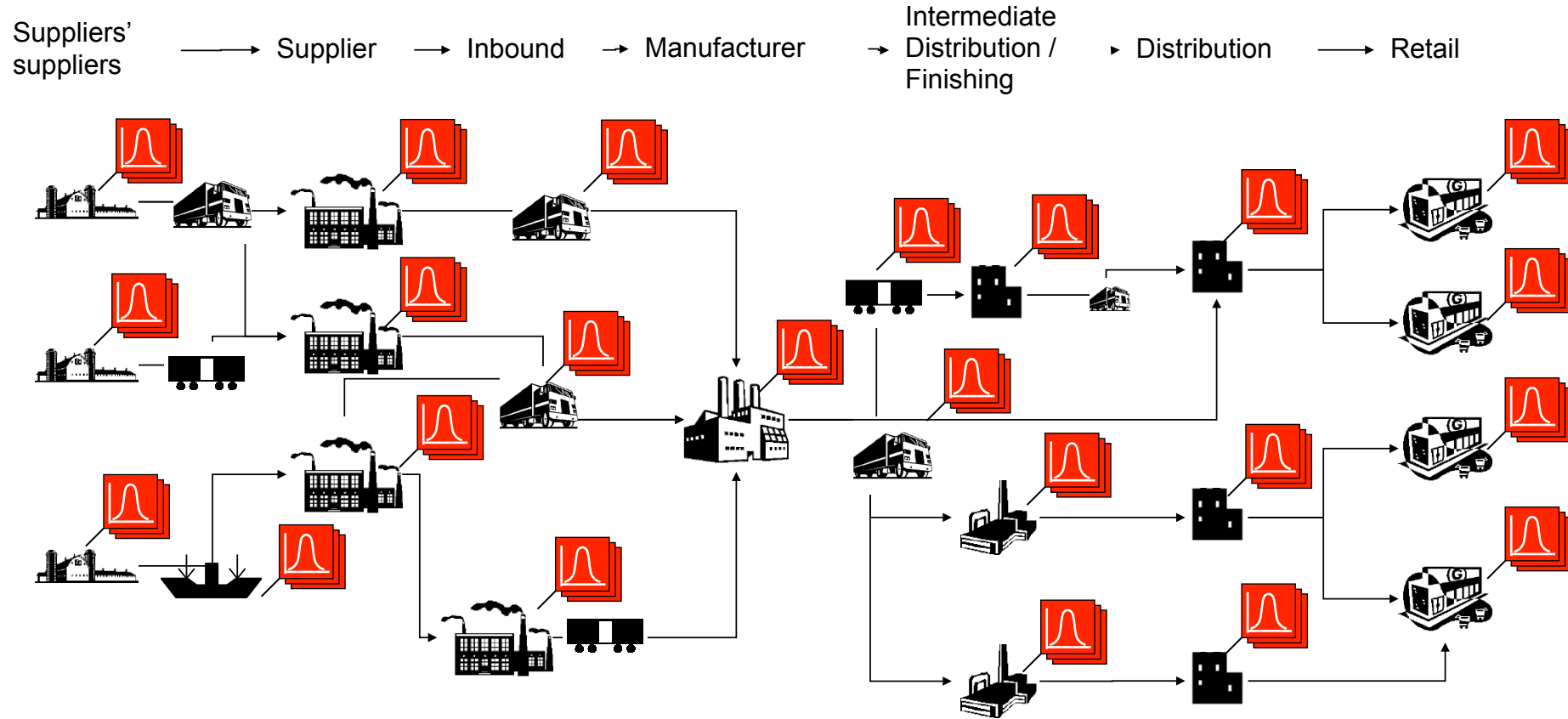
Volatility index



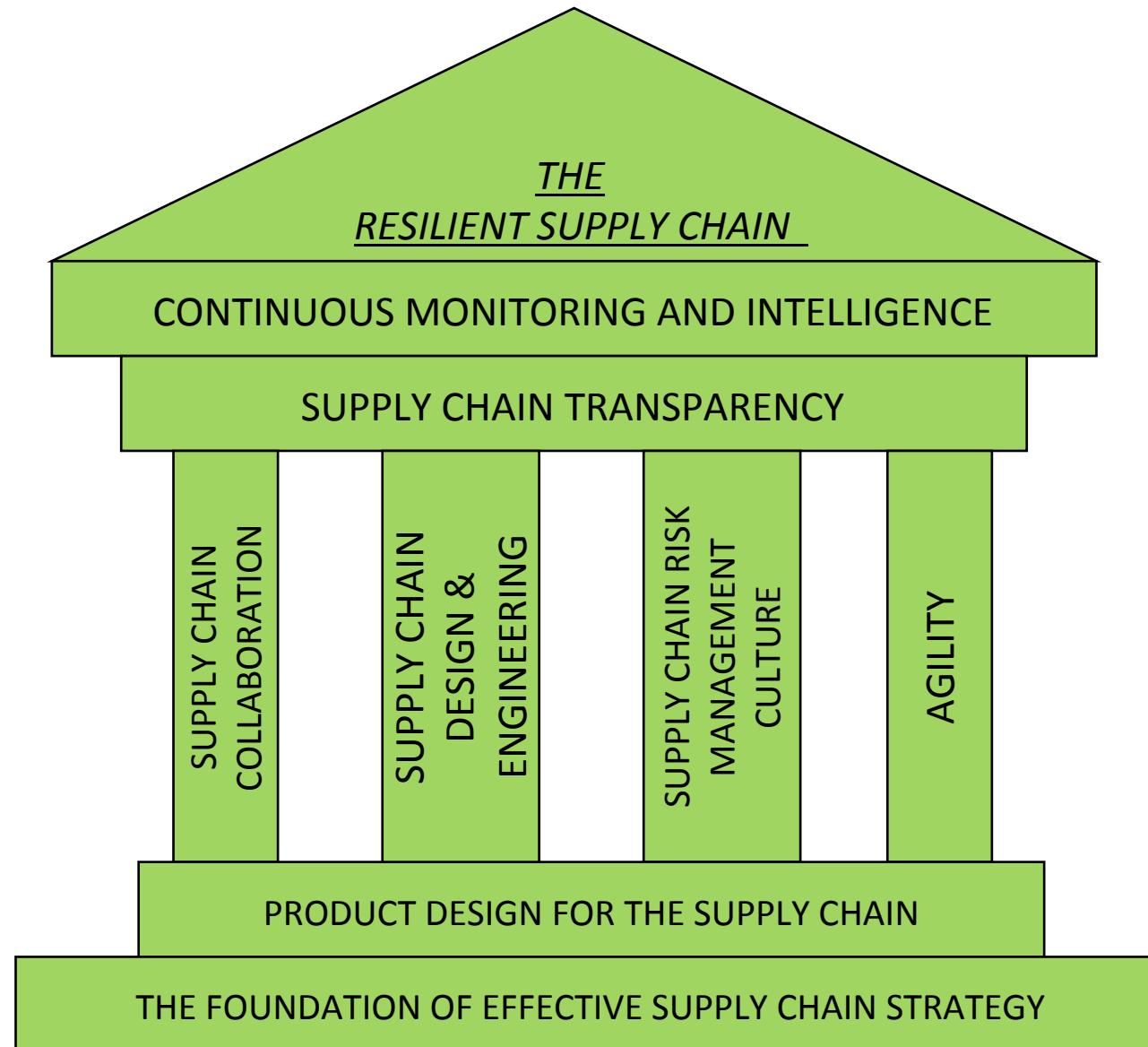
* List of constituents: EUR/GBP (WMR&DS) exchange rate; USD/GBP (WMR&DS) exchange rate; Crude Oil-Brent FOB US/BBL; Gold Bullion LBM US/Troy Ounce; LME-Copper, Grade A 3 Month £/MT; UK Clearing Banks Base Rate- middle rate; VIX from 1986; Baltic Dry Index from 1985

Source: Datastream; EIA (for crude oil data), Chicago Board Options Exchange (for VIX data)

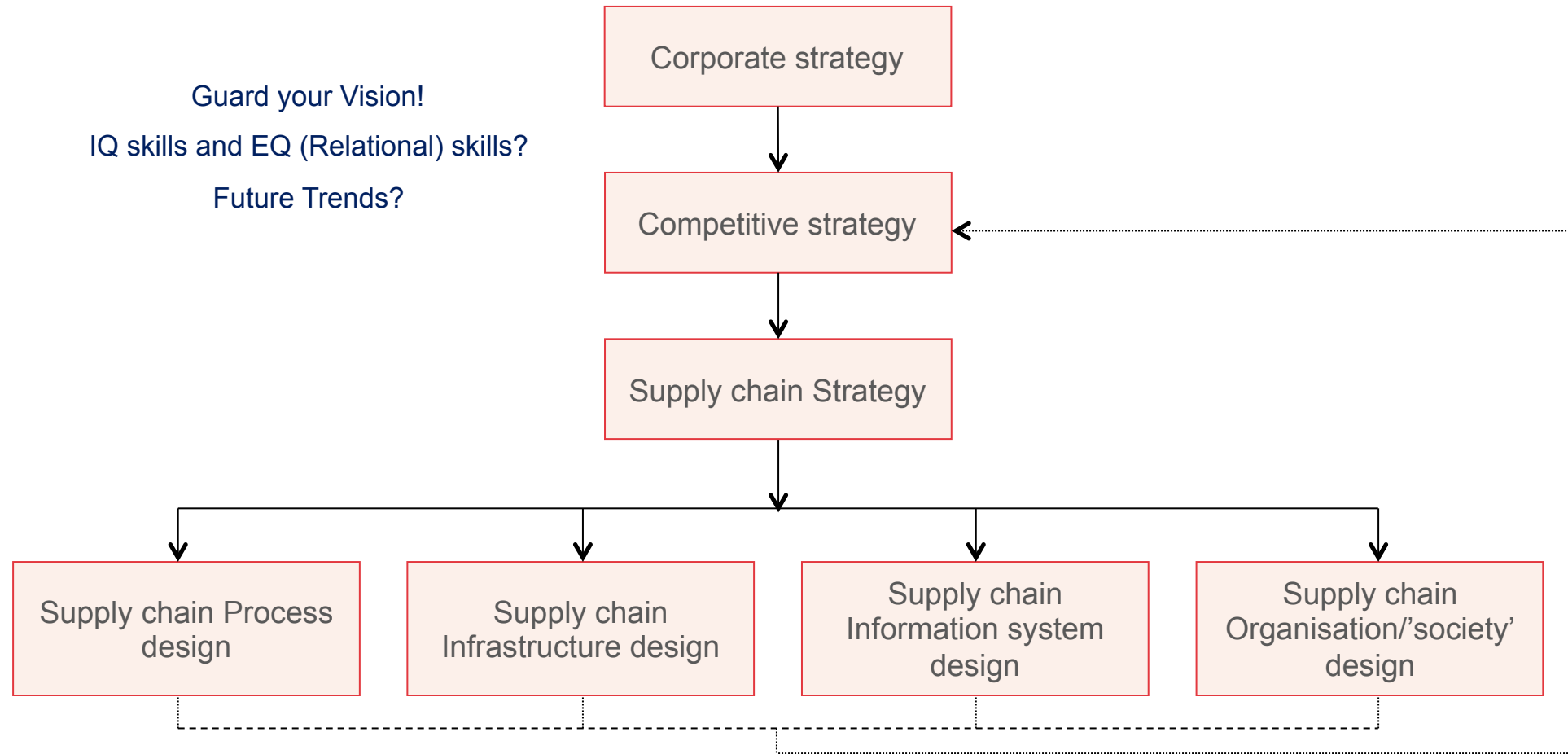
Global Supply Chains are networks or webs that accumulate risk



Building the Resilient Supply Chain to ensure flexibility.



The Foundation of Effective Supply Chain Strategy



Bimodal Supply Chain.

- Mode 1: Focus on Predictability. (Lean)
 - Efficiency and cost reduction, managing predictable swings and inventory fluctuations, and focusing on risk mitigation and prevention.
- Mode 2: Focus on Exploration. (Agile)
 - Speed; it's dynamic and iterative, strategies for solving the unexpected or adapting to new technologies.

“Organisations need to learn to manage both modes simultaneously”.

Adapted from Gartner 2016

The EV supply chain circles the World.



A Global Supply Chain with Multiple Suppliers.

Suppliers to the new BMW i8

ONE-WAY CLUTCH - 6 SPEED AUTOMATIC TRANSMISSION
BORGWARNER

COOLING FAN MODULE [TIER 2]
JOHNSON ELECTRIC

ENGINE & GEARBOX BRACKETS
FEMALK

FRONT BRAKE CALIPER
BREMBO

SOUND DEADENERS
FAIST CHEMTEC

PEDAL SENSORS
HELLA

ELECTRO-COAT
PPG INDUSTRIES

LASER LIGHT
OSRAM

FRONT GRILLE
SOLE SPA

STEERING WHEEL
TAKATA

SHOCK ABSORBERS
THYSENKRUPP

TIMING DRIVE SYSTEM
IWS

GRILL SHUTTER ACTUATORS
BROSE

GEAR SHIFT ACTUATOR [TIER 2]
NIDEC MOTORS & ACTUATORS

HEATING/COOLING/TURBOCHARGER LINES
CONTITECH



Automotive News Europe

ELECTRONIC CONTROL UNITS FOR BATTERY MANAGEMENT
PREH

PORTABLE ELECTRIC VEHICLE CHARGER
DELPHI

RGB LED PUDDLE & ENTRY LAMP
GRUPO ANTOLIN CML

DECOUPLING ELEMENT
TRELLEBORG/VIBRACOUSTIC

BODY CASTING STAMPINGS
MAGNA

FPC-ECU BRUSHLESS
OMRON

LOCKSETS
U-SHIN

TWO SPEED E-AXLE
GKN DRIVELINE

COLD & HOT GASKETS
FEDERAL-MOGUL

GULLWING DOOR STRUTS
STABILUS

CV-JOINTS (HALFSHAFTS)
HIRSCHVOGEL

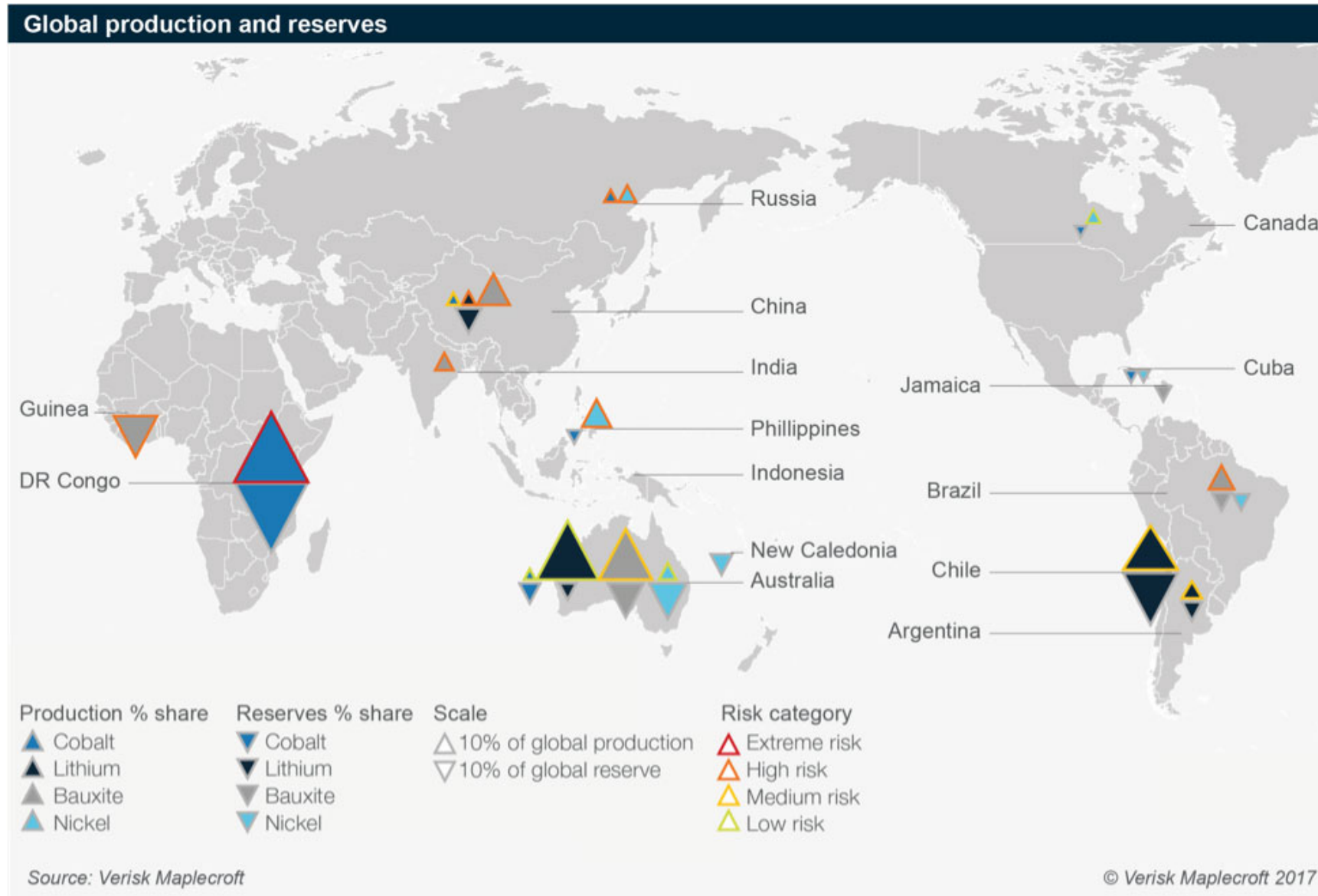
ELECTRIC MOTOR HOUSING
NEMAK

HYBRID STEEL PRESSURE TANK
MAGNA

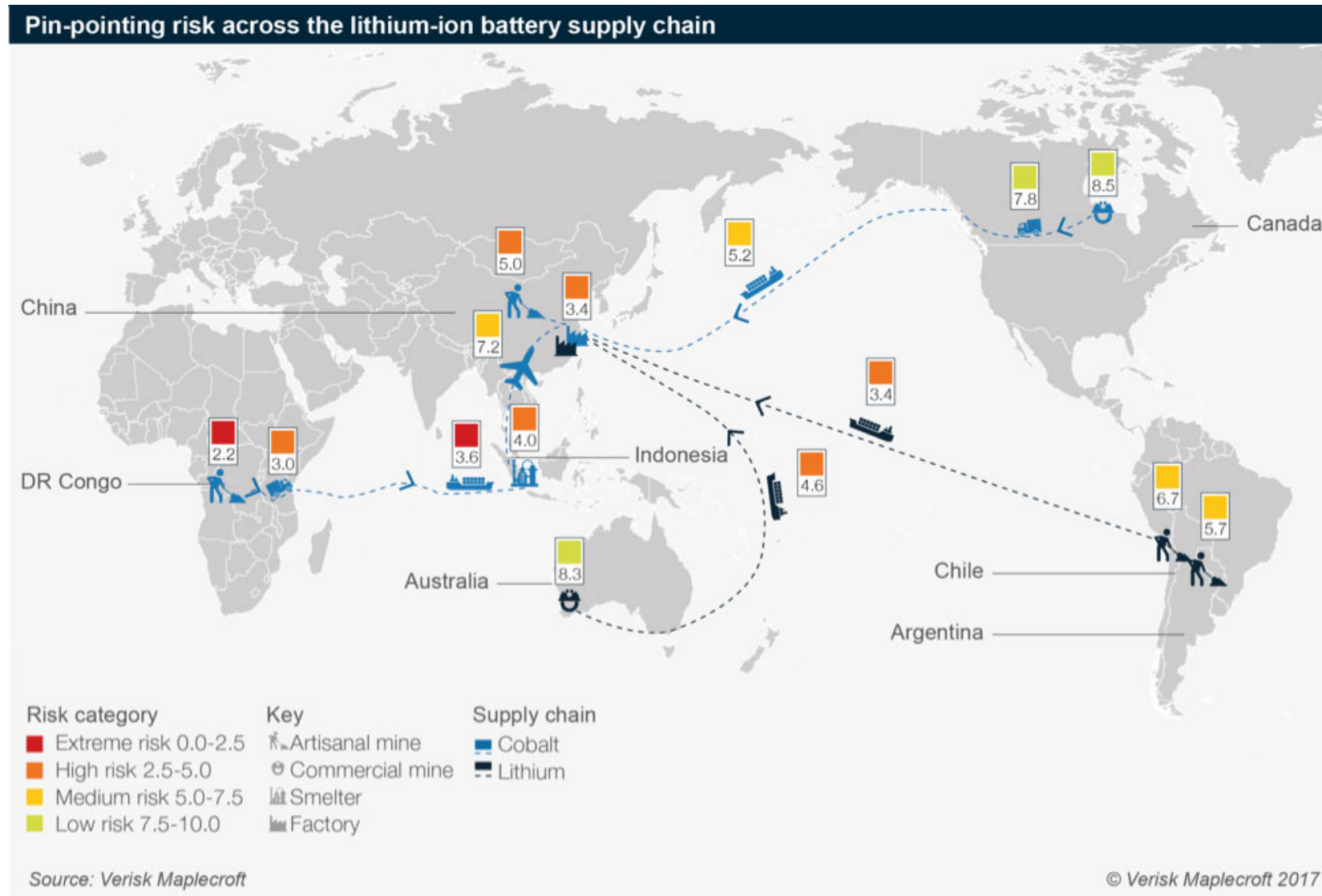
TRANSMISSION OIL COOLING MODULE
MAHLE

SPECIALITY GASKETS - EXHAUST SYSTEM
ELRINGKLINGER

Global Productions & Reserves of materials for EV Batteries.



Risk across the lithium-ion battery supply chain.



Different Technology, Different Risk Profile. Li Battery Example.

- Cobalt and Conflict Minerals.
- Washington Post reported on the **rampant child labor and human rights abuses enmeshed in the cobalt trade** in the Democratic Republic of Congo, where 60% of the world's cobalt originates. As Amnesty International researcher Mark Dummett had told the newspaper, **“We’d now like to see the downstream companies like Apple and Samsung disclose the names of their cobalt smelters”** (Source: <http://spendmatters.com/>)
 - Apple Achieves 100% Cobalt Supply Chain Mapping in 2017.
- LCO – Lithium Cobalt Oxide Battery – **High Risk**
- LMO – Lithium Manganese Oxide – **Medium Risk**
- NCA – Lithium Nickel Cobalt Aluminium Oxide – **Medium Risk.**

Source: Verisk Maplecroft - <https://www.maplecroft.com/>

- **Combine Risk Data on the Raw Materials + Risk Analytics along the chain = Supply Chain Risk Intelligence.**

The risk profile of your Electric Vehicle. Don't just consider the battery.

Identifying risk in your electric vehicle

Lithium-ion battery

Lithium	7.1
Cobalt	3.1
Manganese	5.6
Nickel	5.3
Graphite	4.3
Bauxite	5.2
Copper	4.9



Body

Glass	6.2
Silica	5.0
Bauxite	4.4
Mica	5.0

Interior

Plastic	5.5
Rubber	3.5
Leather	6.5
Cotton	4.3
Copper	4.9

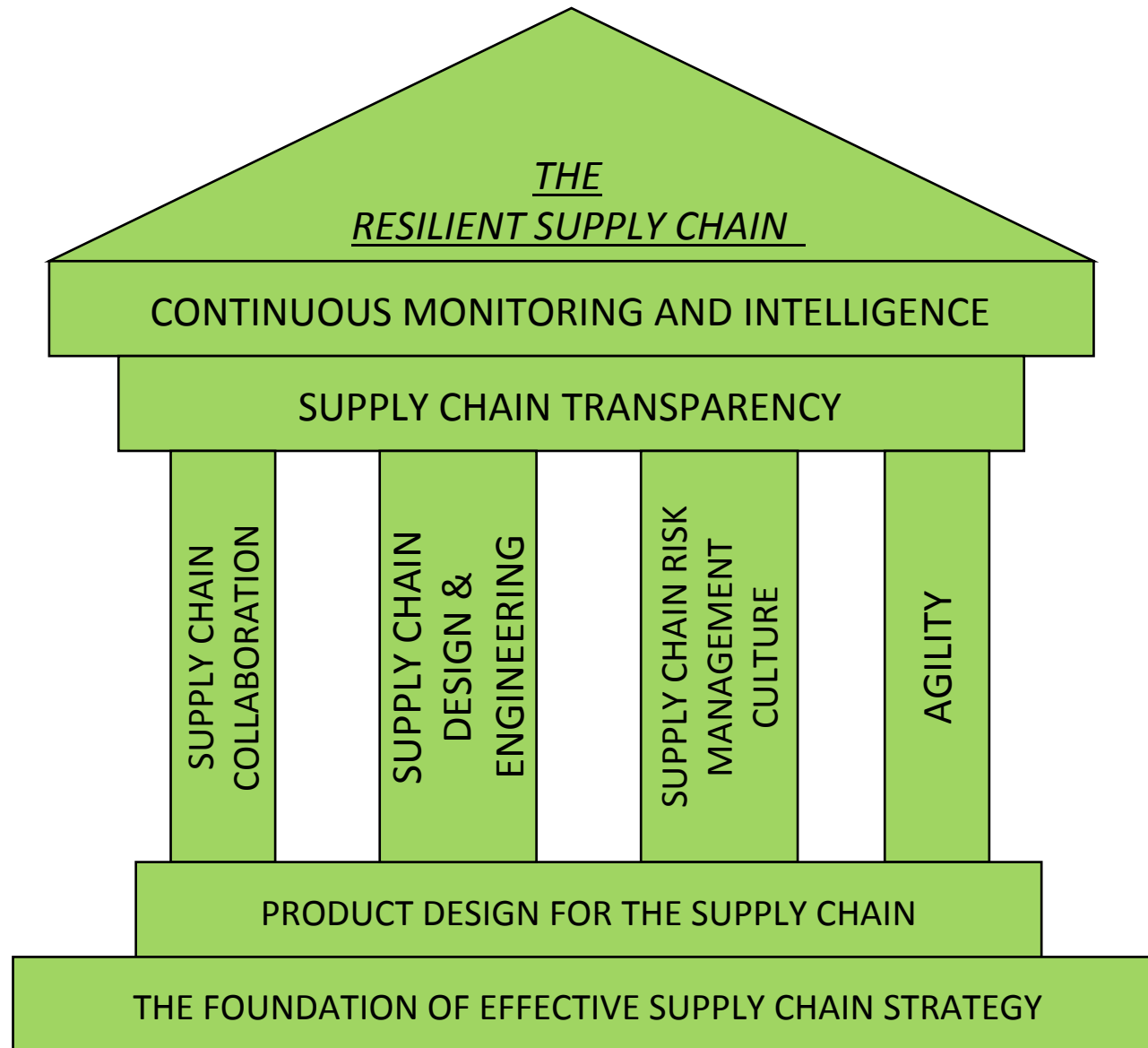
The above commodity risk scores are a global average for 20 ESG risks related to raw material production in key producing countries.

Legend: ■ extreme risk 0.00 - 2.50 ■ high risk 2.50 - 5.00 ■ medium risk 5.00 - 7.50 ■ low risk 7.50 - 10.00

Source: Verisk Maplecroft

© Verisk Maplecroft 2017

In Conclusion – Understand the risk profile of your supply chain.





Links – Keep in Touch

Download the free online iTunesU course, join over 60000 subscribers.

www.richardwilding.info/online-supply-chain-course.html

Download the free “Podcasts” and “Videos” www.supplychainpodcast.info or visit [iTunes.com](https://www.apple.com/itunes)

www.youtube.com/supplychainpodcast

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