EAMS for Future Grids

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SAFER, SMARTER, GREENER

- What is EAMS?

- Why EAMS?

- How EAMS helps?

DNV GL - Organized to maximise value for our customers
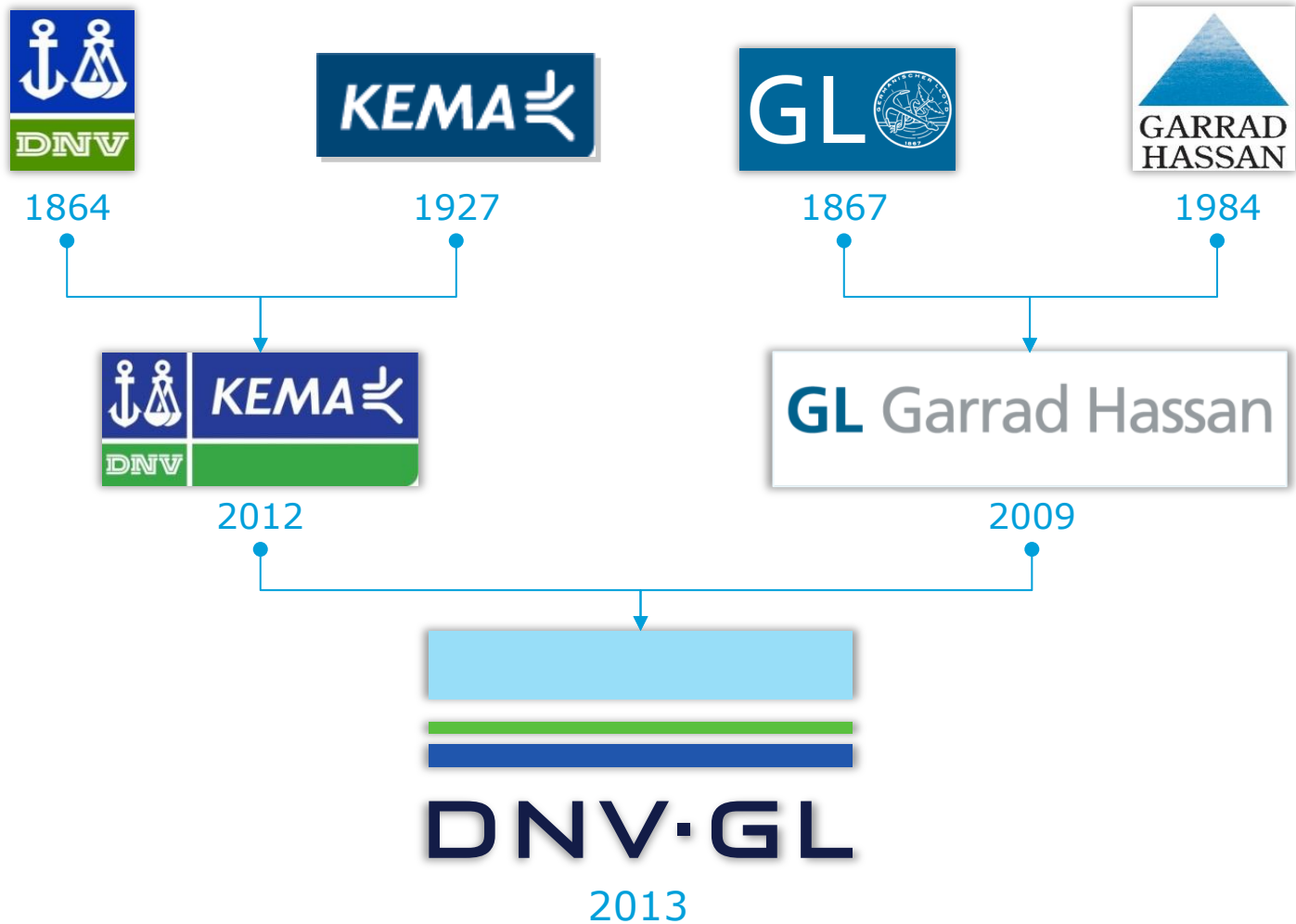

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- MARITIME
- OIL & GAS
- ENERGY
- BUSINESS ASSURANCE

SOFTWARE

RESEARCH & INNOVATION

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Industry consolidation through mergers

Highly skilled people across the world

150
years of operation

300+
offices

100
countries

16,500
employees

Software : 700
Energy : 2,500

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What is EAMS?

(EAMS: Energy Asset Management System)

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EMS & AMS play key roles in managing the system and assets

Conventionally, EMS & AMS exist separately in power system

AMS
(Asset Management System)

- Monitor conditions of assets (E.g. Transformers, etc.)
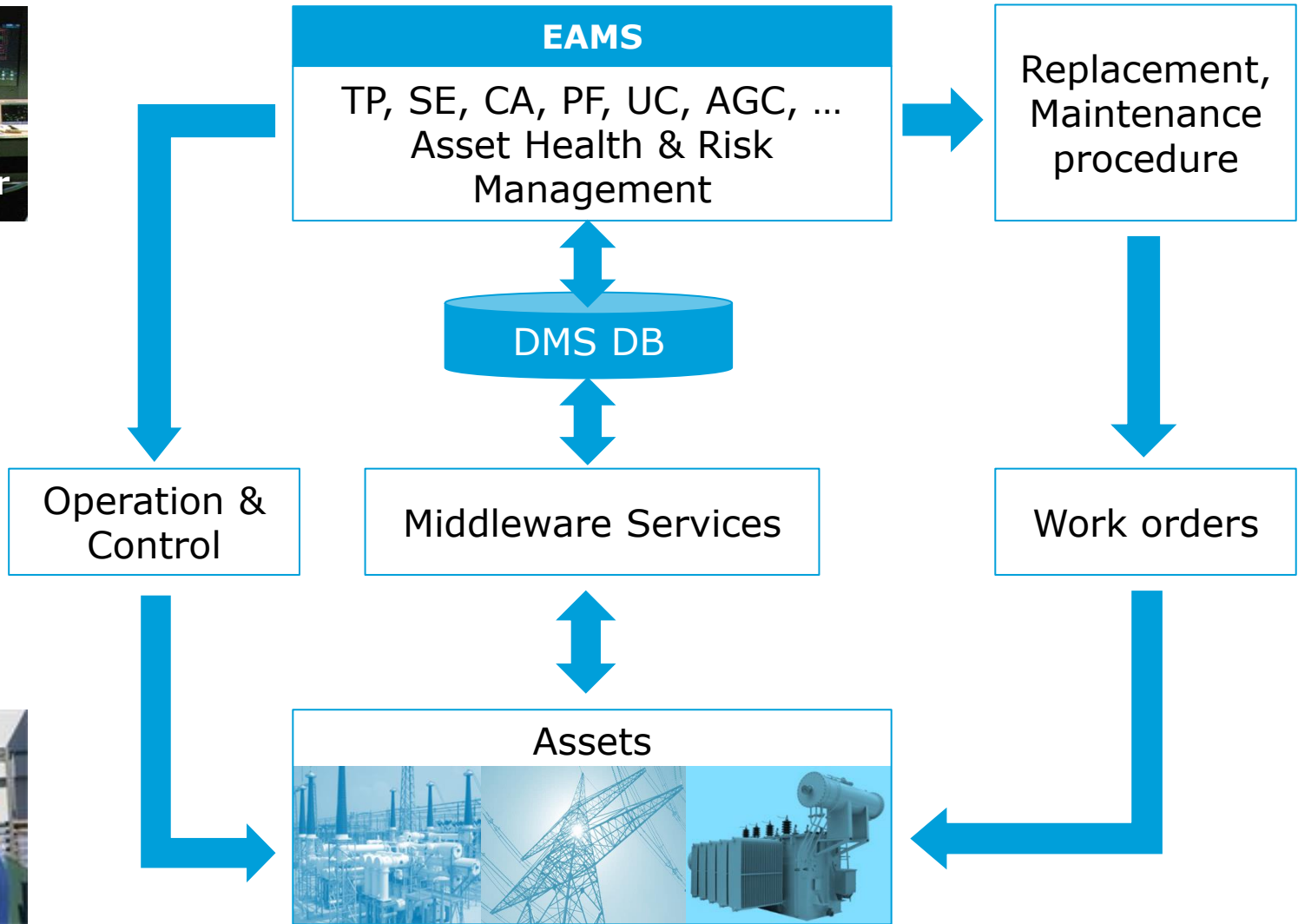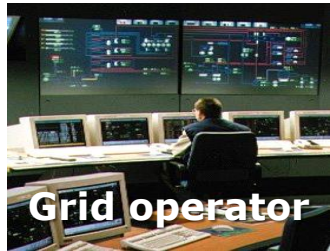- Reduce operational costs
- Control the risk of failure

EMS
(Energy Management Systems)

- Improve energy efficiency globally (E.g. frequency, voltage quality, loading percentage, power losses, etc.)

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Integrated EAMS

Grid operator

SCADA

Field Engineer

EAMS

TP, SE, CA, PF, UC, AGC, …
Asset Health & Risk
Management

Replacement,
Maintenance
procedure

DMS DB

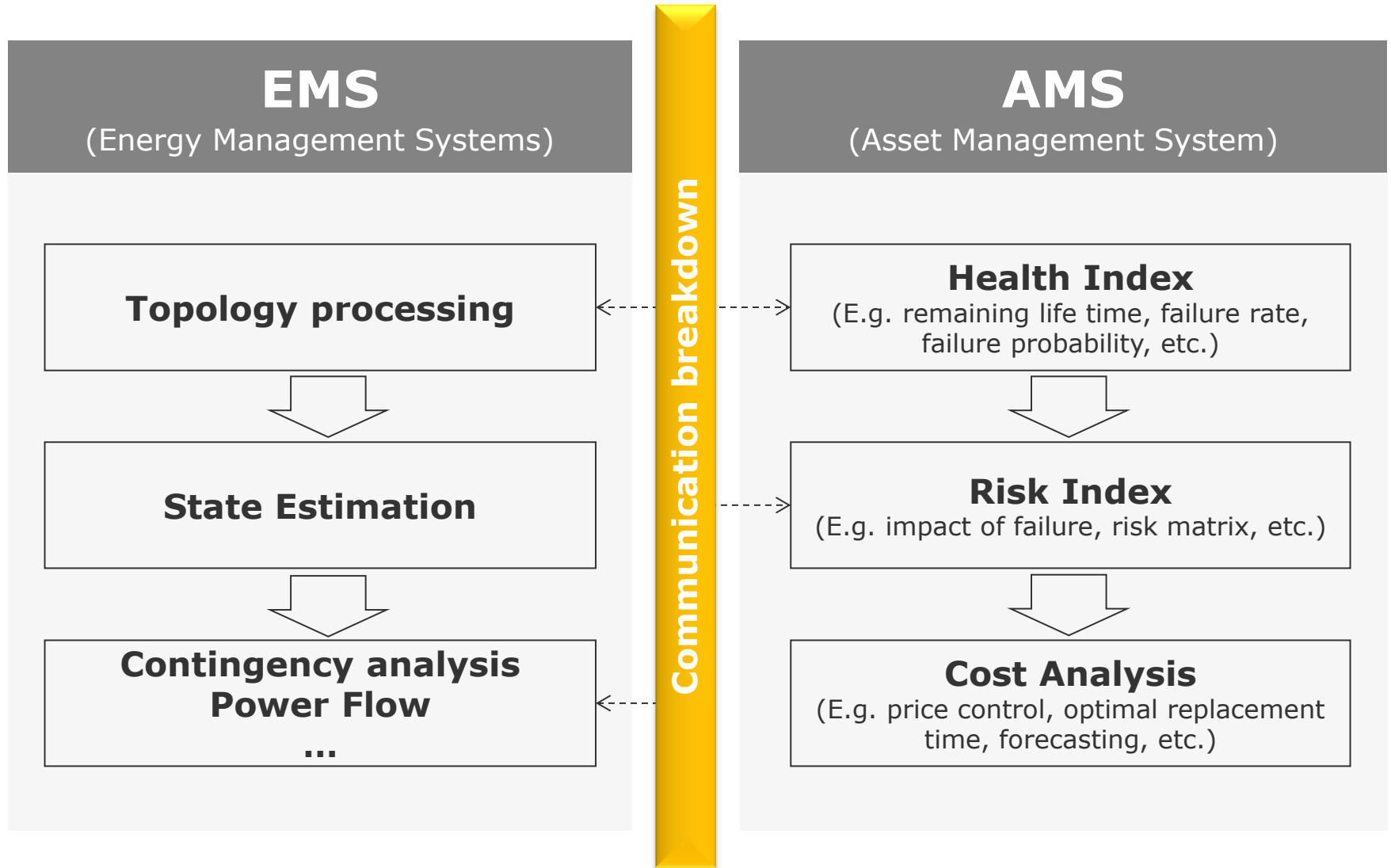Operation &
Control

Middleware Services

Work orders

Assets

Why EAMS?

- Independence of EMS & AMS

- High penetration of DERs coming soon

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Challenges caused by two separated systems

| EMS (Energy Management Systems)	AMS (Asset Management System)
Topology processing	**Health Index** (E.g. remaining life time, failure rate, failure probability, etc.)
State Estimation	**Risk Index** (E.g. impact of failure, risk matrix, etc.)
Contingency analysis **Power Flow** **...**	**Cost Analysis** (E.g. price control, optimal replacement time, forecasting, etc.)

Communication breakdown

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Challenges caused by DERs especially RE
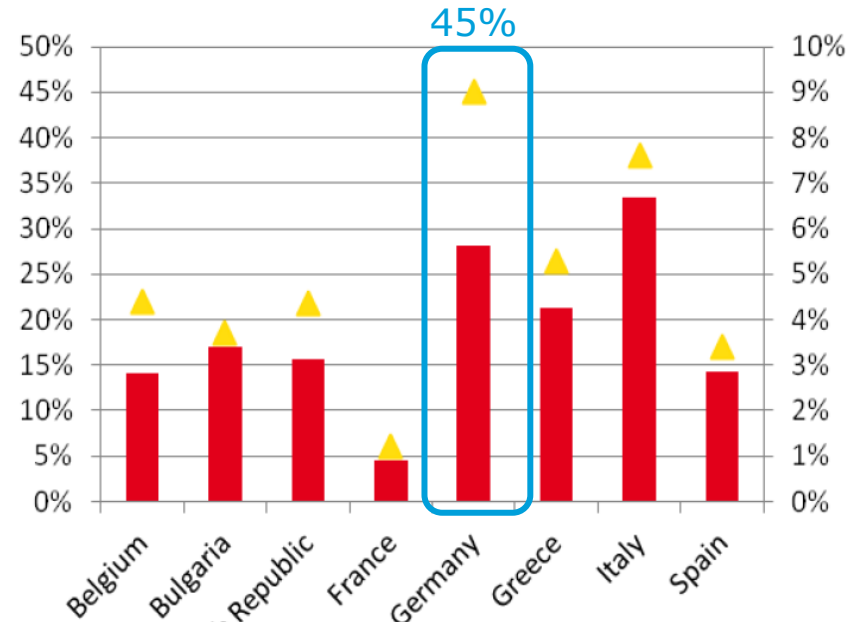
Globe:
- PV has been fastest deployed in past few years, 139GW by 2013, 55% annually

Germany:
- Deployed largest capacity of PV in the world (33GW by 2013)
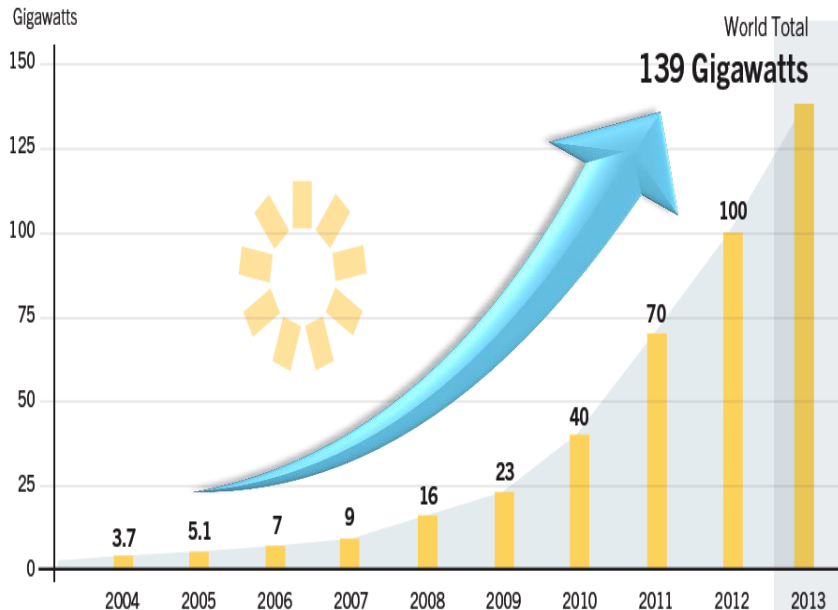
(World total installed PV capacity)

(PV penetration level)

Source: PV Grid, Bundesnetzagentur

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The high penetration cause many challenges

Benefits:

- Defer capacity upgrades with proper planning
- Improve power system **resiliency**
- Reduced **energy losses**
- Provide distribution **voltage support** and ride-through, improve **voltage quality**
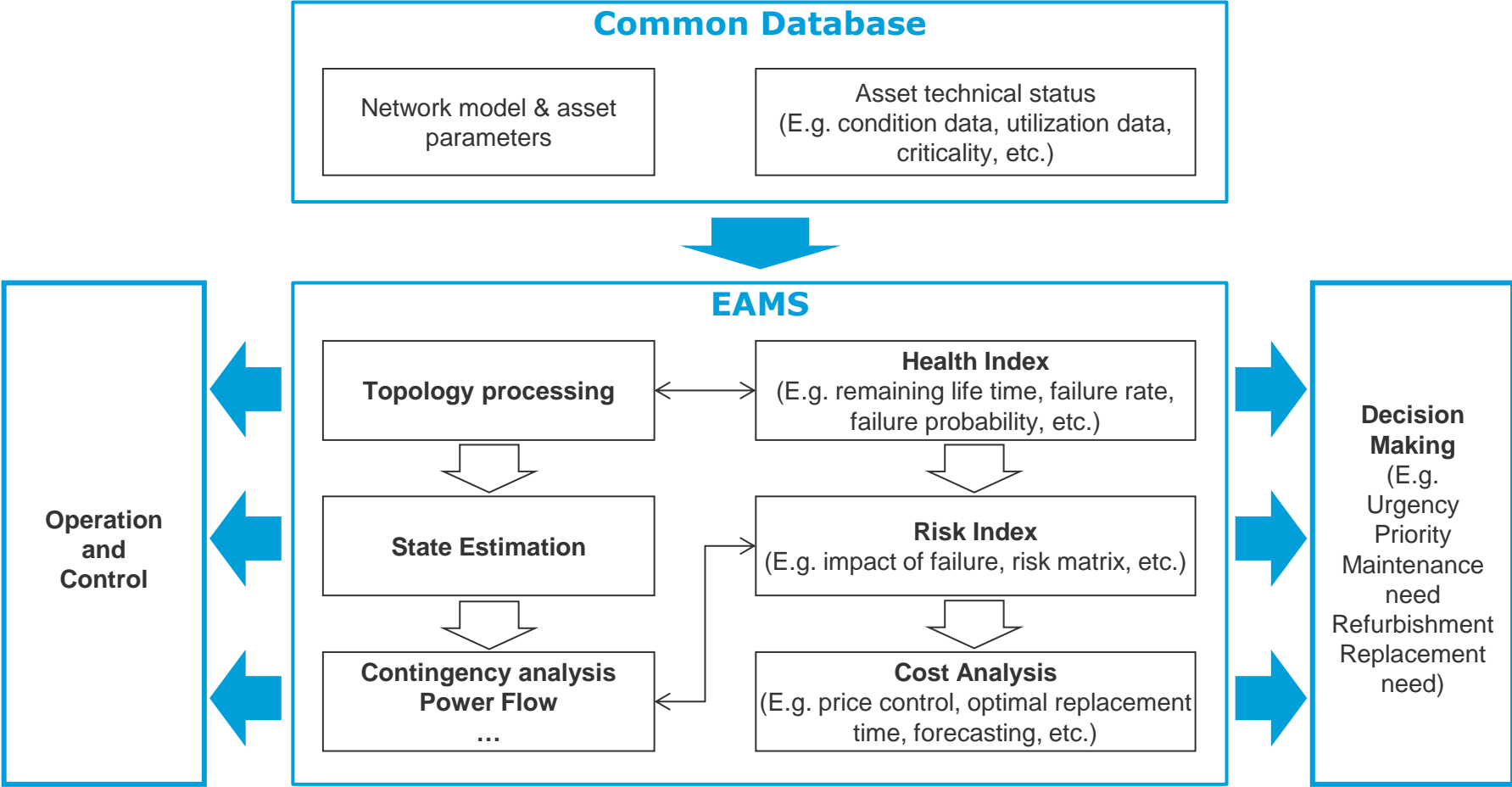- Reduce **environmental impact**

Challenges:

- Reversed power flow in distribution system & additional power flow in transmission system
- Grid congestion
- Operation, control, and protection
- More uncertainties
- Higher risk

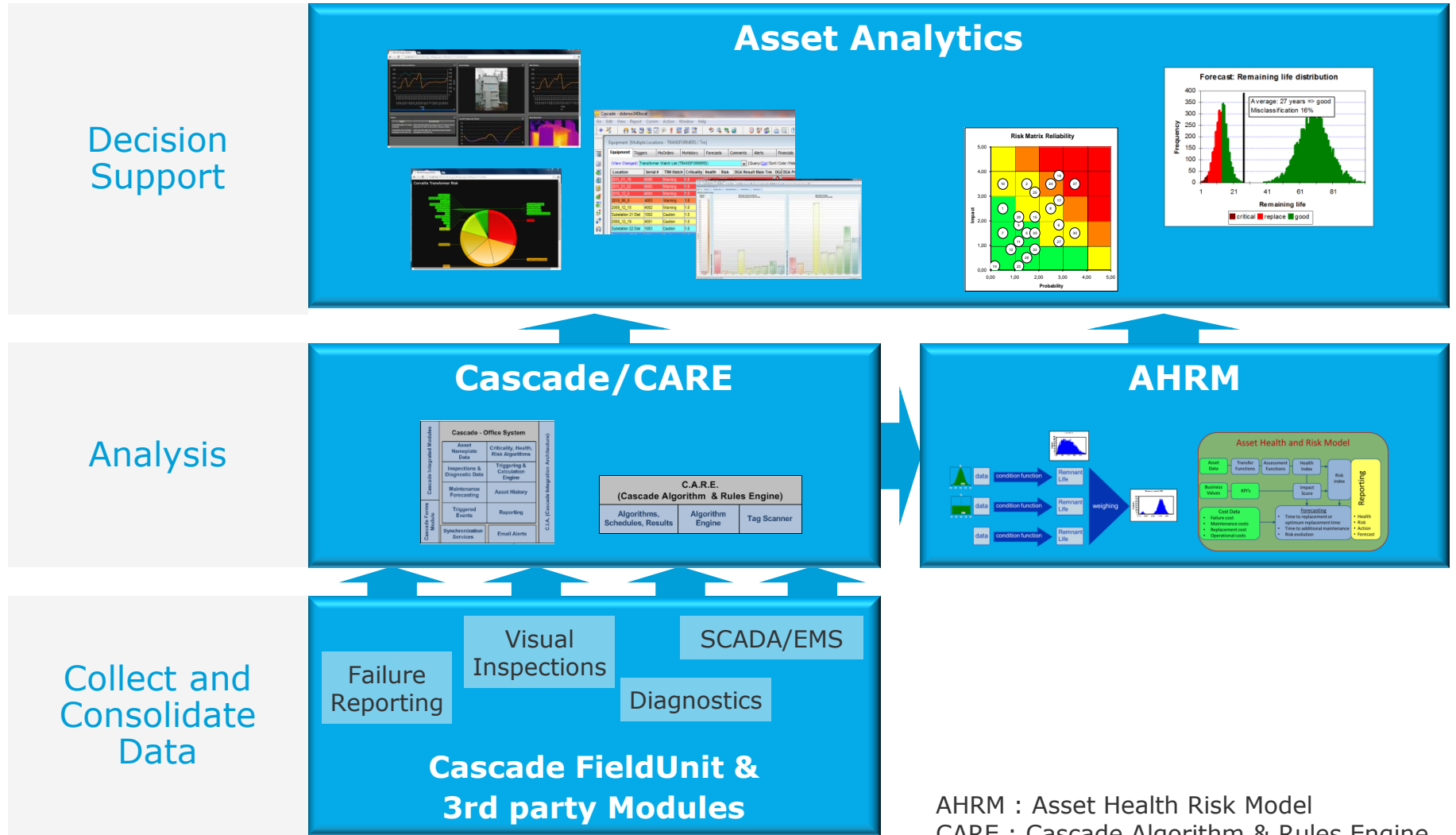EMS & AMS need to be more robust to deal with the complexity while maximizing the benefits of DERs

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How EAMS Helps?

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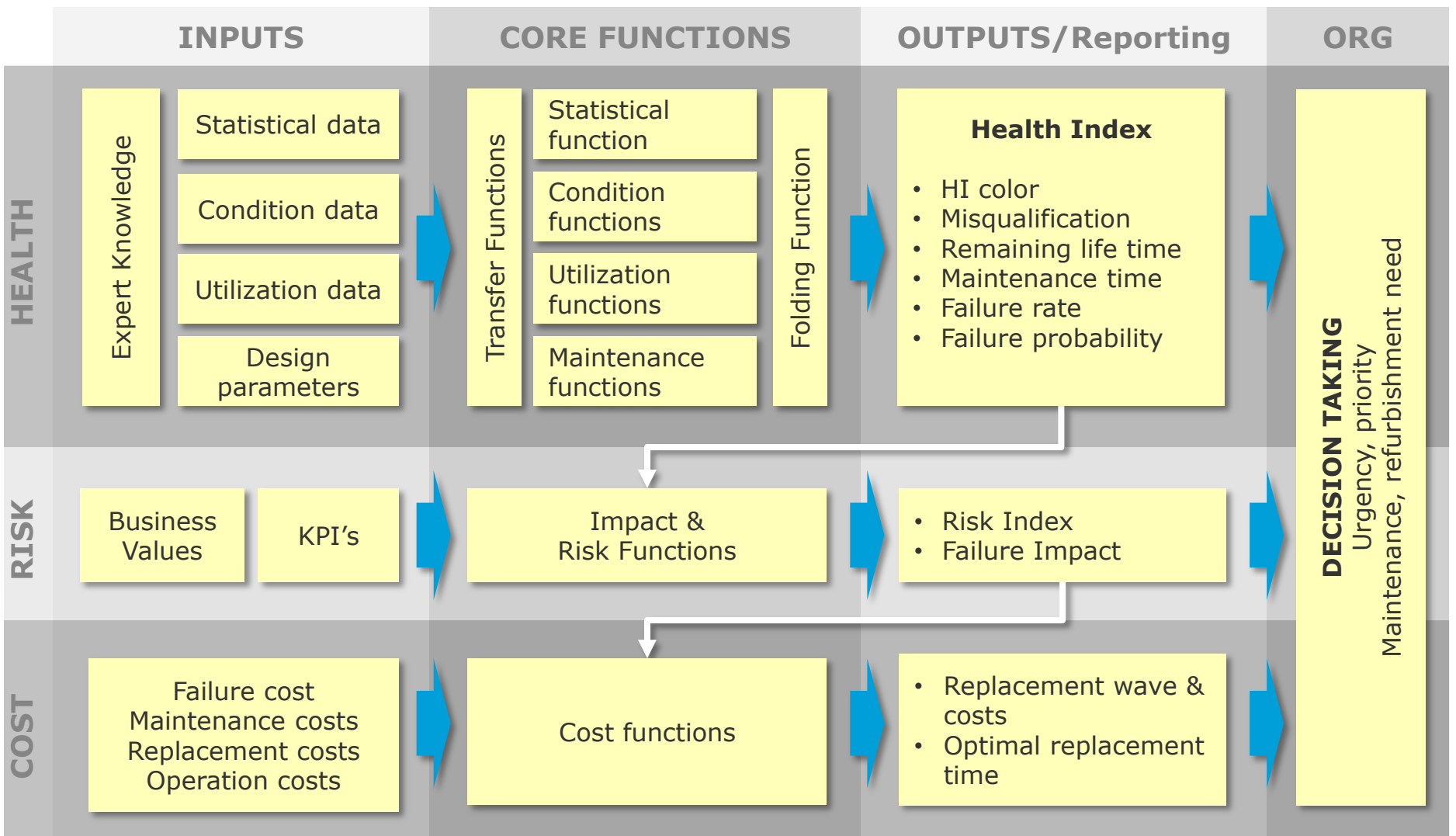# EAMS Core Functions
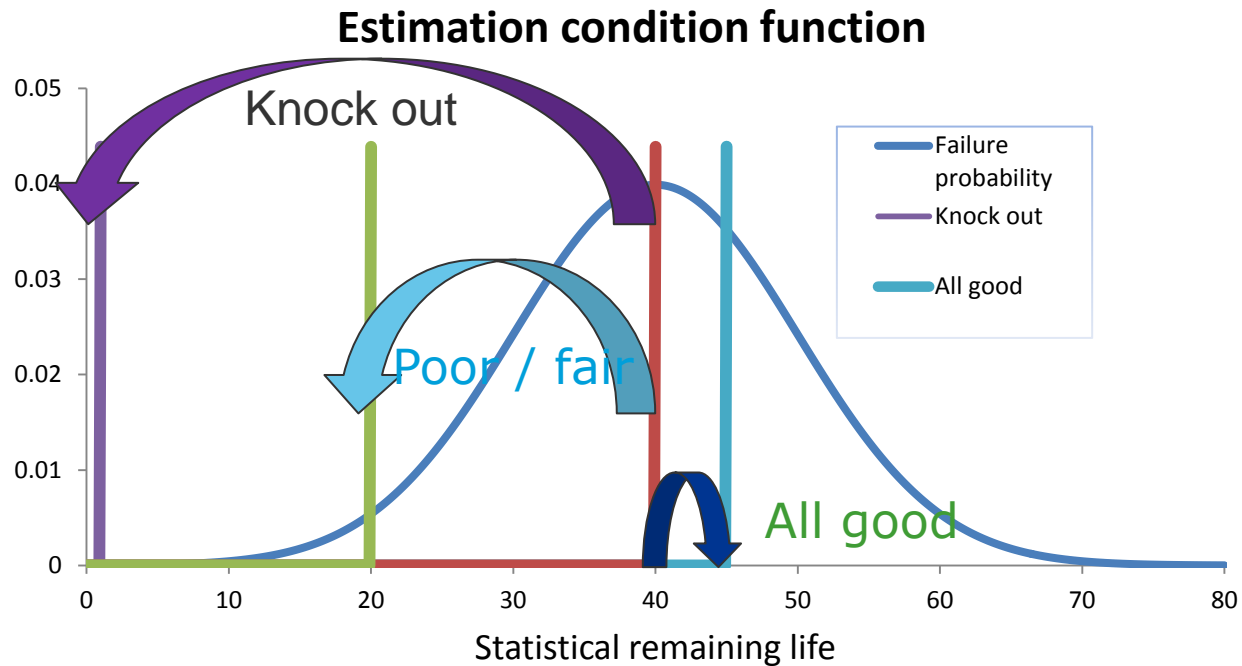
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Cascade – DNV GL Asset Management System

AHRM : Asset Health Risk Model
CARE : Cascade Algorithm & Rules Engine

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AHRM – DNV GL's Advanced Asset Management Model

INPUTS	CORE FUNCTIONS	OUTPUTS/Reporting	ORG

HEALTH

Expert Knowledge

- Statistical data
- Condition data
- Utilization data
- Design parameters

Transfer Functions

- Statistical function
- Condition functions
- Utilization functions
- Maintenance functions

Folding Function

Health Index

- HI color
- Misqualification
- Remaining life time
- Maintenance time
- Failure rate
- Failure probability

RISK

- Business Values
- KPI's

Impact & Risk Functions

- Risk Index
- Failure Impact

COST

Failure cost
Maintenance costs
Replacement costs
Operation costs

Cost functions

- Replacement wave & costs
- Optimal replacement time

DECISION TAKING
Urgency, priority
Maintenance, refurbishment need

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AHRM - Statistical & Condition Function

Estimation condition function

- **Statistical function** handles statistical data (e.g. historical failure data, mean time to failure) based on **Monte Carlo distribution** technique
- The input's **uncertainty** is captured and reflected in outputs intensity or **misqualification**
- DNV GL uses the **Knock-out concept** in the condition function to represent the **severity** of the different conditions.

Advantages of EAMS

Advantage	EMS functions	AMS functions
More accurate	Full screen for high risk contingencies & high failure probability contingencies → do not miss out critical contingencies	Making use of more accurate component's criticality & utilization information (e.g. loading condition)
Higher performance	Fewer contingencies (e.g. filter out low failure probability)	Better incorporate the EMS functions into AMS algorithm
Better big-data management	One single database	
More effective	Avoid redundancy of assessments and processes	
More optimal	Decisions are made based on a more comprehensive assessment considering both **global** and **local** aspects	

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Conclusion

EAMS will more effectively address the technical challenges caused by DERs

DNVGL Service & Solution

- Electricity transmission and distribution
- Energy management and operations services
- Energy efficiency services
- Software

- Power testing, inspections and certification
- Asset Management maintenance strategy review and optimization
- ISO 55000 based Asset Management system consulting

- **CASCADE**: 20+ year software for Asset Management, to 100+ power utilities
- **AHRM**: Asset Hearth & Risk assessment, cost analysis and decision support

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Thank You for Your Attention!

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