Data Management SPICE at HERE Technologies

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HERE - who are we ?

Forty years ago, we started with a digital map of San Francisco. Today, we set the standard for automotive-grade maps globally.

Our customers are leading automakers, logistics firms, mobility providers and technology brands.

Our map is powering the next generation of vehicle automation and safety, enabling innovation and efficiency, and driving sustainable growth across industries.

40 years of mapping the future

1985

Barry Karlin and Galen Collins launch **Karlin & Collins,** Inc. to develop navigational software using an electronic map

1987

NAVTEQ

Karlin & Collins, Inc becomes **NAVTEQ**

DriverGuide provides printed driving instructions at countertop kiosks around the San Francisco Bay Area

1990s

We offer the first **in-car sat nav systems**

1996

First company patent (5,543,789) issued for online route guidance on user interfaces like **mobile devices** – the precursor to basic navigation guidance on phones

1999

Patent 5,999,878 is granted, covering the method of driving the roads and **collecting accurate GPS data** for creating maps

2001

Patent 6,253,151 allows users to select a feature in a map and **report an error** – today, virtually every navigation app available has this pioneering feature

2004

Our **location data** is used to create maps for **mobile devices** such as phones

Our technology is used in the first advanced **driver-assistance systems**

2008

NOKIA

NAVTEQ is bought by **Nokia**

2011

Nokia's Location and Commerce Business

NAVTEQ forms core of **Nokia's broader location business**

Patent 7,970,749 lets **video game** creators use our map data to showcase specific locales in games

2012

We rebrand to become **HERE**

2015

DAIMLER

BMW, Audi and **Daimler** acquire **HERE** to develop high-definition mapping for self-driving vehicles and other applications

2017-18

intel

BOSCH

Continental

Pioneer

HERE shareholder structure broadens, with **Intel, Bosch, Pioneer and Continental** as new investors

2018

Mercedes-Benz Drive Pilot brings HERE HD Live Map to L2-L3 driving systems

2017-18

Mitsubishi Corporation

NTT

HERE welcomes **Mitsubishi Corporation** and **NTT** as new investors

2022

HERE powers hands-free driving in BMW 7 series across Germany, California and Nevada

2024

HERE launches new corporate purpose, vision, and strategy; finishes year with 5,930 patents

2025

aws

HERE & AWS sign $1B collaboration to accelerate software-defined vehicle development

A platform operating at scale

40

years of experience in map-making and location technology

166bn

API calls per month

1.5k

enterprise customers, including auto, tech and logistics leaders

222m+

vehicles shipped with HERE data and solutions

600k

direct developers

70+

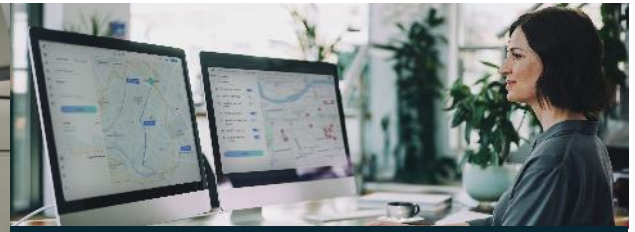
automakers use HERE data and solutions

HERE solutions support use cases across many industries

Automated driving

EV routing & charging

Professional navigation



Professional navigation

Streamline operations

Digital cockpit

Fleet routing

Asset tracking

Location analytics

Next-generation mapmaking

Gen 1

Download era

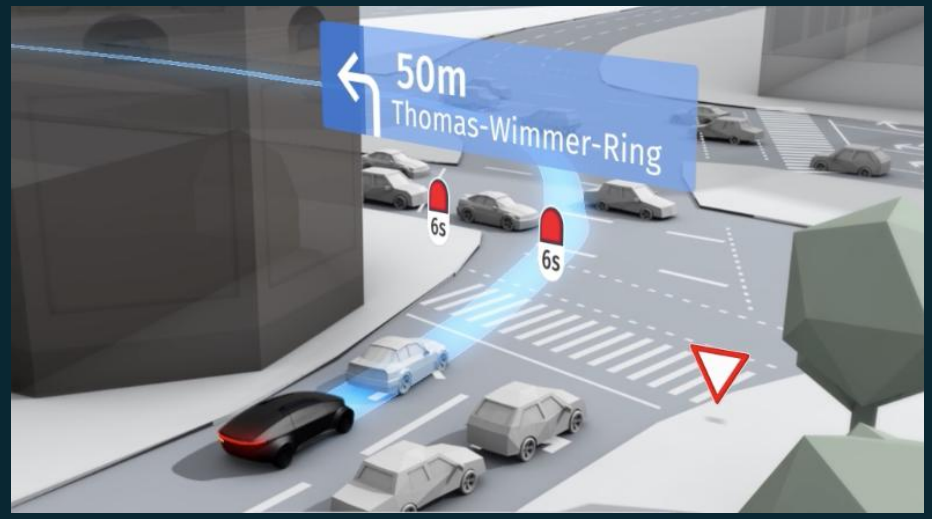
- Manual updates required
- Driven by vehicle production
- Stand alone functionality
- Customized for each OEM

Gen 2

Streaming era

- Updates available, but delayed
- Became standard across OEMs
- Heavy inspired by mobile UX
- Gateway to a map in every car

Where we have been



Gen 3

AI live map era

- Unified map for human and machine use
- A learning map through feedback loop
- Many new use cases pre- and post-production

Where we are going

Next-generation mapmaking

HERE's automated mapping system revolutionizes how maps are created, updated and used.

Unified

HERE fuses **large quantities of data from diverse sources – including vehicle sensors, industrial lidar and satellites – into one fully aligned, unified global map.**

Live

Our maps have **moved from static snapshots closer to dynamic "live maps."** Some changes can now be detected and updated within 48 hours.

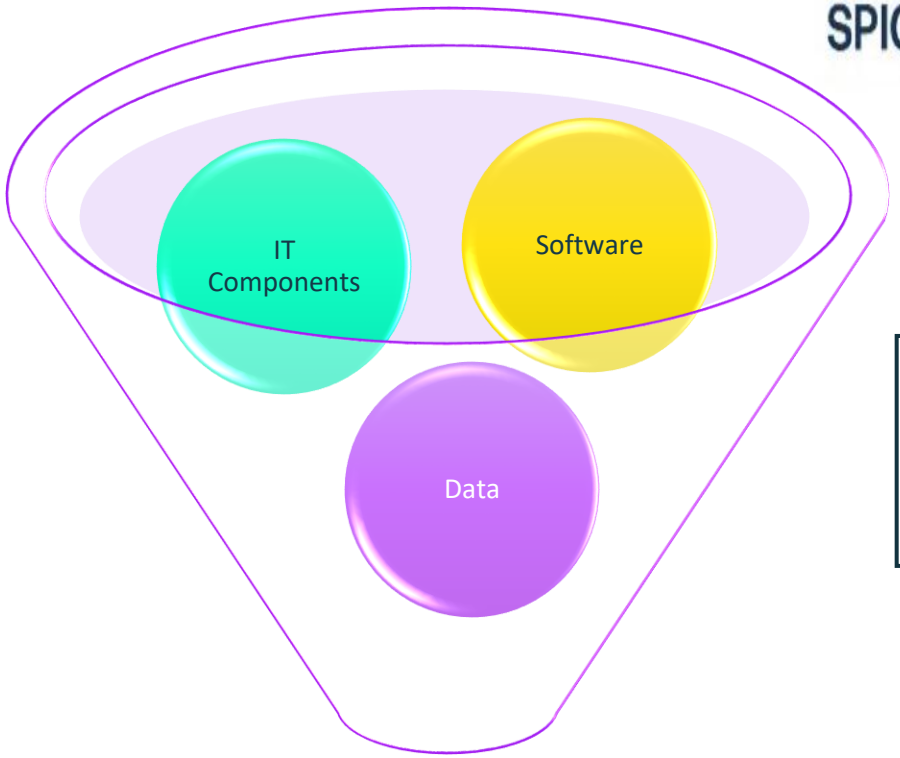
Learning

We **constantly receive and validate human and machine feedback** about where our map might differ from reality. This feedback helps keep our map accurate and fresh.

Artificial intelligence & machine learning are key enablers

Motivation for Data Management SPICE

Transformation to digital services & data-driven solutions



Digital Services

SPICE for IT-Services

AUTOMOTIVE SPICE®

Data Management SPICE

The 3 elements can typically not be fully segregated for digital service & data-driven solutions

Automotive SPICE as customer requirement

SW mainly used for data processing

Data as our core business

Recognized Data Management SPICE to be more relevant

IT Components used for data transfer and dynamic data live streaming

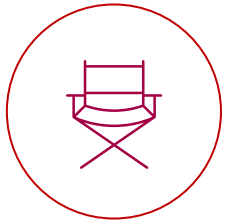
SPICE for IT-Services applied to cover all data management systems aspects

A measure of success for us: implement good data management principles

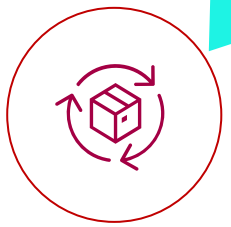
- Clearly identified and empowered individuals / teams are responsible for data ownership and data governance

- The whole lifecycle and related ownership are considered – cradle to cradle.

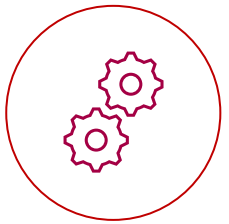
- Data and data quality requirements and related objectives as well as criteria for understanding and improving data are kept up to date, under control, traceable, and consistent throughout collection, processing, use and retirement.



CLEAR DATA RELATED RESPONSIBILITIES



HOLISTIC VIEW ON THE DATA LIFECYCLE



CONSISTENT DATA QUALITY IMPROVEMENT PRACTICES

- Assets and processes are there to help individuals and teams to work effectively and efficiently.
- Governance helps to achieve business, product, customer, process and data management objectives.

PROCESSES ARE USEFUL

FOCUS ON PEOPLE

MANAGING DATA RELATED WORK

- Plans are created based on realistic and traceable estimates
- Actual status and risks are made transparent at regular points in time based on data
- Decisions are consciously made based on potential alternatives, data, risks and agreed on criteria.

- Collaborating across disciplines based on a common product vision and common directives
- Delegating decision making and empowering individuals and teams
- Maintaining a steady and sustainable pace
- Lifelong learning and competency build up

Data Management SPICE Journey at HERE

Q1’24 – Q1’26

#1: Discovery and strategy definition

- Data Management SPICE framework study in HERE context
- Defined a HERE ‘Data Management & Data Quality Strategy’
- Structural process alignments

#2: Fostering data management principles

- Data Management SPICE awareness trainings
- Inclusion of strategy aspects into QA & Config Mgmt review criteria
- Introduction of data ownership and stewardship

#3: Establishing alignment

- Update of the ‘DM & DQ Strategy’ to reflect HERE`s mission and objectives
- Alignment of data management related standards and policies

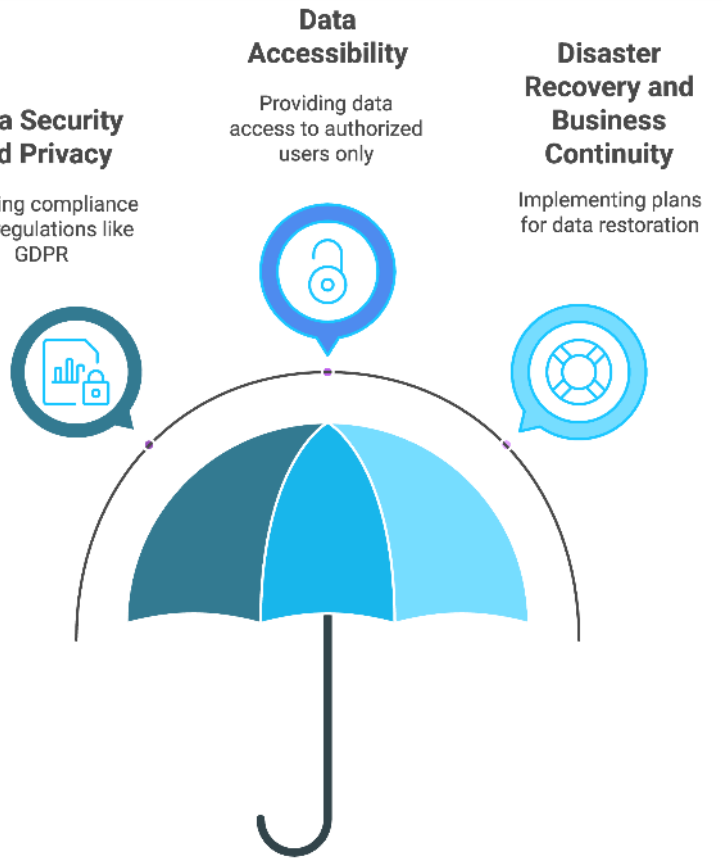
#4: Transition to v2.0 and scope expansion

- Adoption of new Data Management SPICE version 2.0
- Expanded ‘DM & DQ Strategy’ to dynamic data types

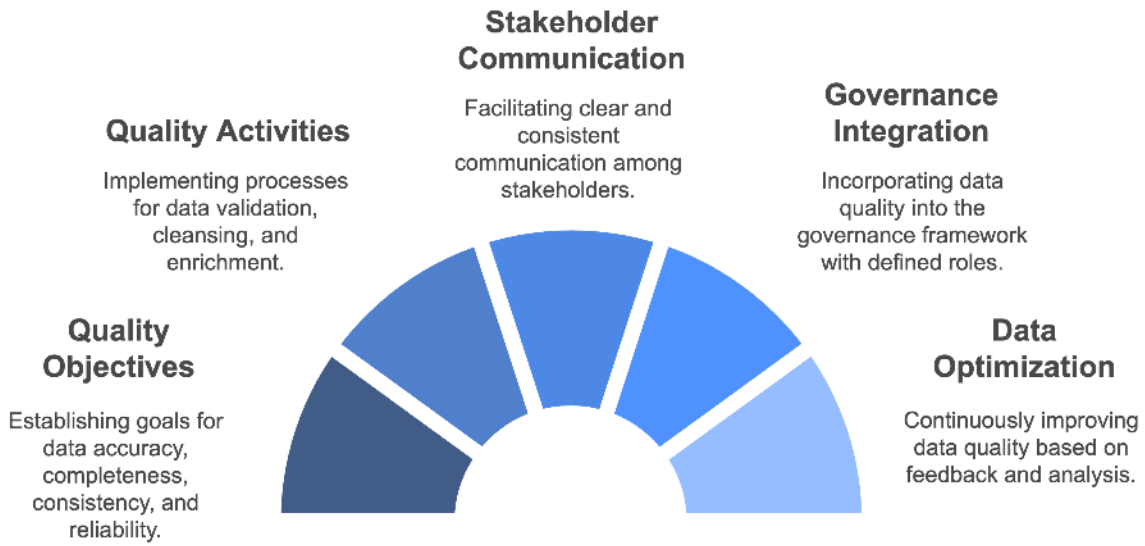
HERE Data Management & Data Quality Strategy

Objectives, principles and government to ensure data management and data quality are established

Data Management Objectives



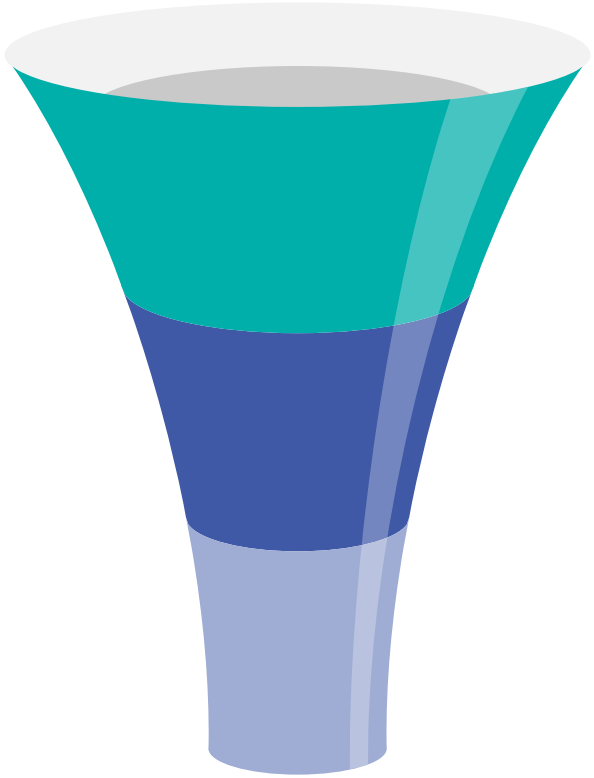
Data Quality Objectives



HERE Data Management & Data Quality Strategy

A systemic approach to evaluate data quality is a key part of the Data Management & Data Quality Strategy

High Level Data Quality Approaches



Quality Criteria and Metrics:

Established by each process for data contributing to the products across the chain in line with the criticality/risk of data in scope.

1

Data Assessment

Conduct regular assessments of data quality to identify anomalies, errors, and inconsistencies:

- Quality control checks/moderation during content creation
- Database inspection (validations, violations analysis, queries)
- NDS product validation
- Ground Truth Assessments

2

Data Profiling

Analyze data to determine its structure, quality, completeness, and other characteristics which will provide insight into how it can be used for further analysis or decision making:

- Quality checks on drive files and ingested data
- Third Party source evaluation

3

Data Cleansing

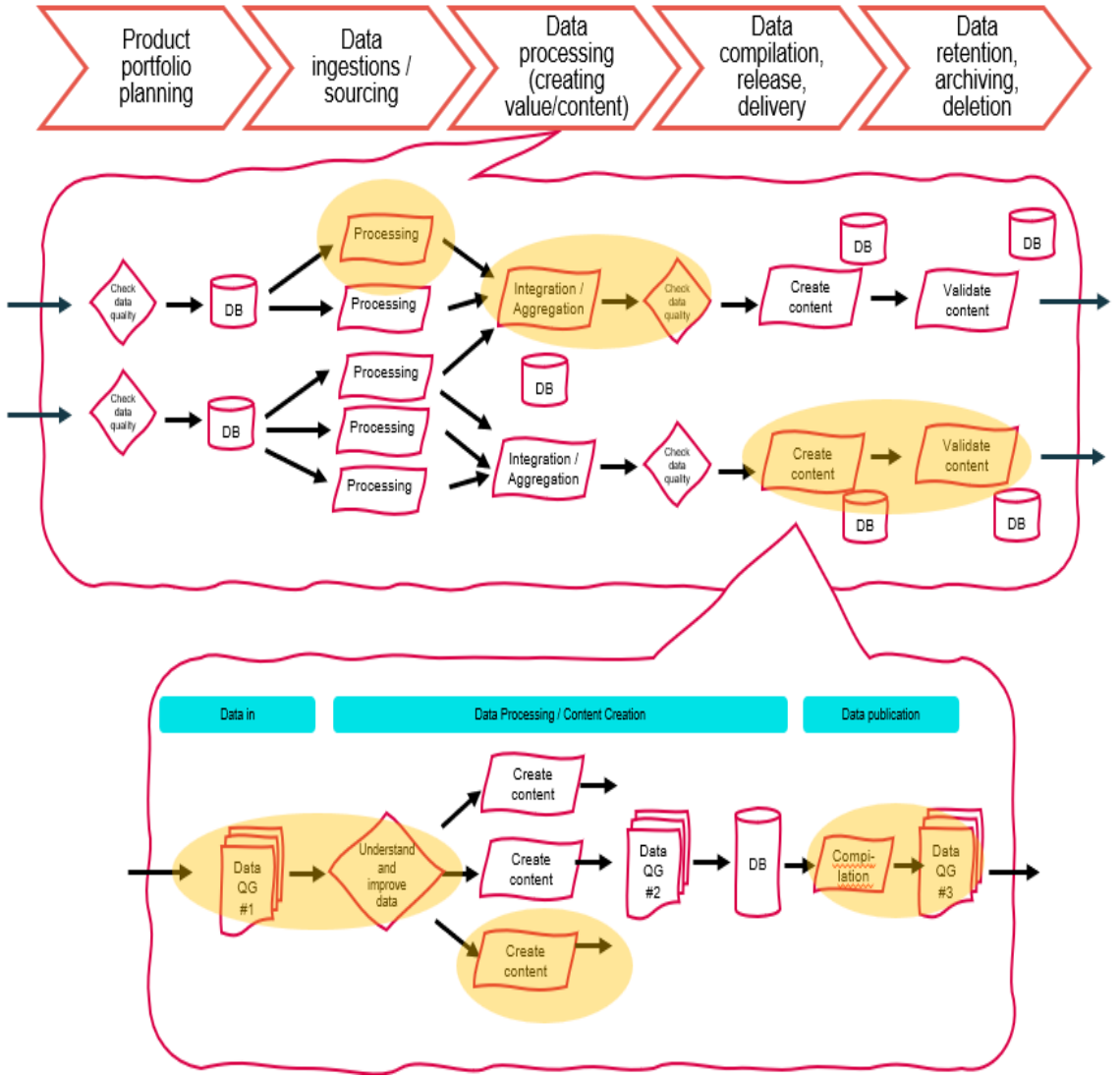
Plan and execute activities to correct, enrich, and deduplicate data to maintain its quality over time:

- Onboarding and normalization of Vehicle Perception Data
- Onboarding and normalization of Traffic data

Highly complex data flow and environment

Data lifecycle (simplified) - from requirements intake to retirement

1. **Business Case:** Product/Service requirements and product quality requirements as input for data requirements.
2. **Collection and Acquisition:** Based on product requirements, appropriate data sources are identified, data is collected/acquired & evaluated for integration.
3. **Deployment & Storage:** Data and SW architecture define the platforms and architecture that will be used as the operational environment for data.
4. **Operations:** Data Operations (processing, validation, and optimization) takes place through content creation (man./aut.)
5. **Publication:** Data compilation, validation and release/delivery.
6. **Retirement:** Business decisions on retirement of products using the Product Lifecycle Management Framework and Data Retention Policy.



Challenges of Data Management SPICE implementation

In a complex data environment

Vast product/service portfolio with many different data types causing a highly complex data environment to be controlled

Data pipeline involves a significant number of different organizational groups/roles/data owners/processes/assets/infrastructure/tools

Establish and maintain traceability and consistency of data quality requirements/criteria/understanding across the data pipeline

Key benefits and take aways from our implementation

Structured approach to ensure effective data management & data quality

Strategic Alignment

with company mission

> HERE objectives enabled to implement the strategy

> High-level objectives of the strategy provide guidance for individual functions to align and implement their own objectives

> Quality objectives:

- Common refence - Specifications ensure content consistency

- Quality criteria defined by individual process areas

Clear Governance

> Communication strategy covers communication of the strategy, key objectives and data requirements

> Governance Model in place for overarching objectives; delegated to individual process areas and functional management. Overall policies, improvements and escalations handled by governing bodies.

> Review of **strategy objectives** which are also business objectives are done as part of management reviews

> Reliable decision-making across the organization

Transparency / Effective Data Mgmt

> Meaning and **scope of 'Data'** for HERE.

> Mapping of data to various processes in the pipeline to ensure understanding across stakeholders, i. e. connection to E2E flow

> Flow of Data Requirements – from Product Management through the pipeline

> Data Lifecycle to manage map data, including end of life; aligned with the E2E flows

> Enhanced data quality assurance along the E2E flow

Consistent implementation of the strategy was key to get a common view and terminology across the organization

Thank you

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