MANNHEIM BUSINESS SCHOOL

DATA LITERACY & DATA INTUITION:

MAKING SMARTER DECISIONS WITH DATA

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UNIVERSITY OF MANNHEIM AACSB ACCREDITED EFMD EQUIS ACCREDITED AMBA ACCREDITED AQAS

What is this online module about?

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Data Literacy
=
"Ability to **read**, **write** and **communicate data** in context, including an **understanding of data sources** and constructs, **analytical methods** and techniques applied, and the ability do **describe the use case, application and resulting value"**

Data Intuition
=
"Data Intuition is **not** about **using your gut feel**. It is about the **intuitive understanding of concepts**, in other words, how to **apply the concepts"**

https://www.gartner.com/smarterwithgartner/a-data-and-analytics-leaders-guide-to-data-literacy

https://www.superdatascience.com/podcast/sds-102-intuition-vs-mathematics

Data Literacy & Data Intuition

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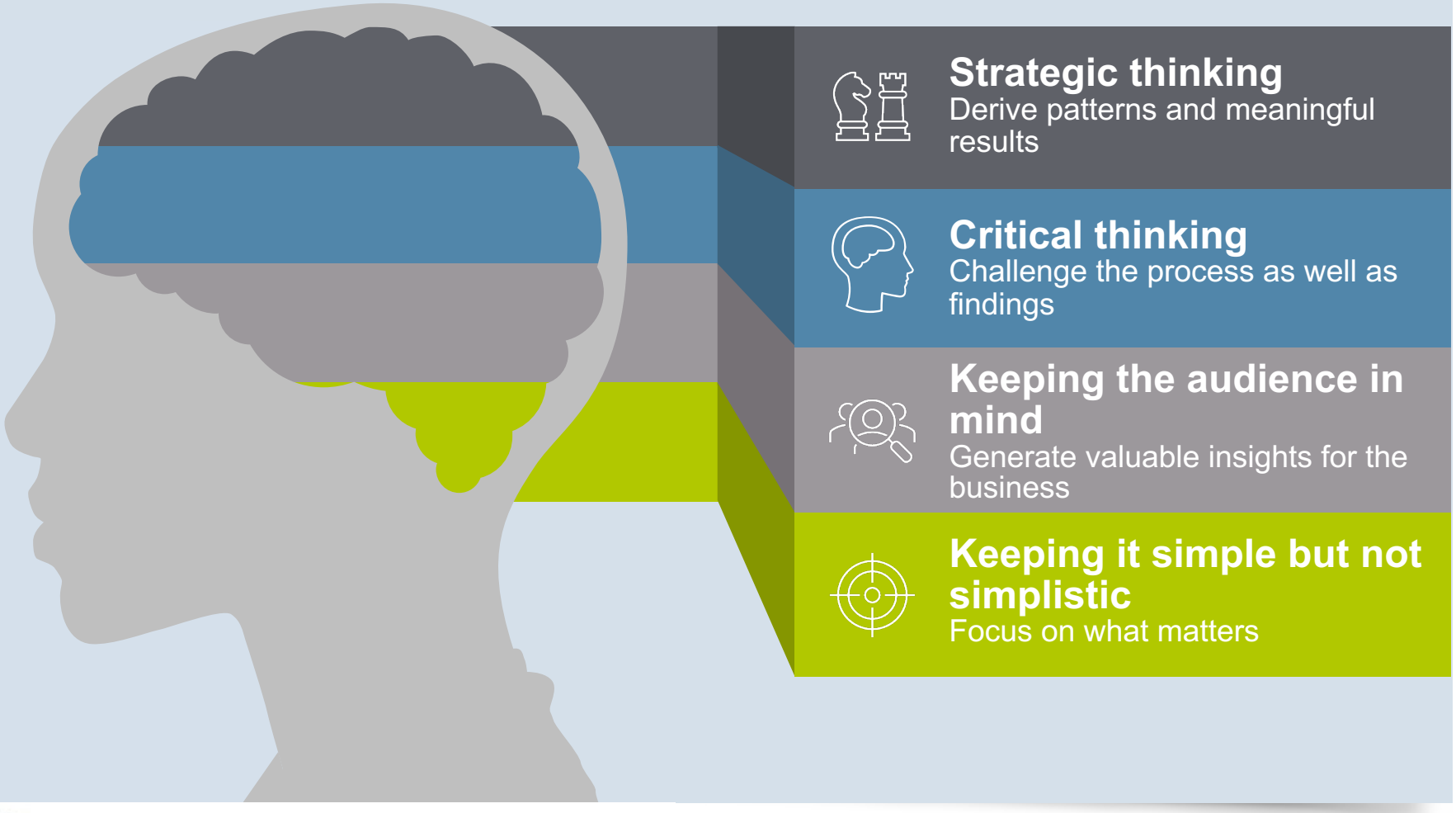
Key Take-away:
Data Intuition is About Mindset



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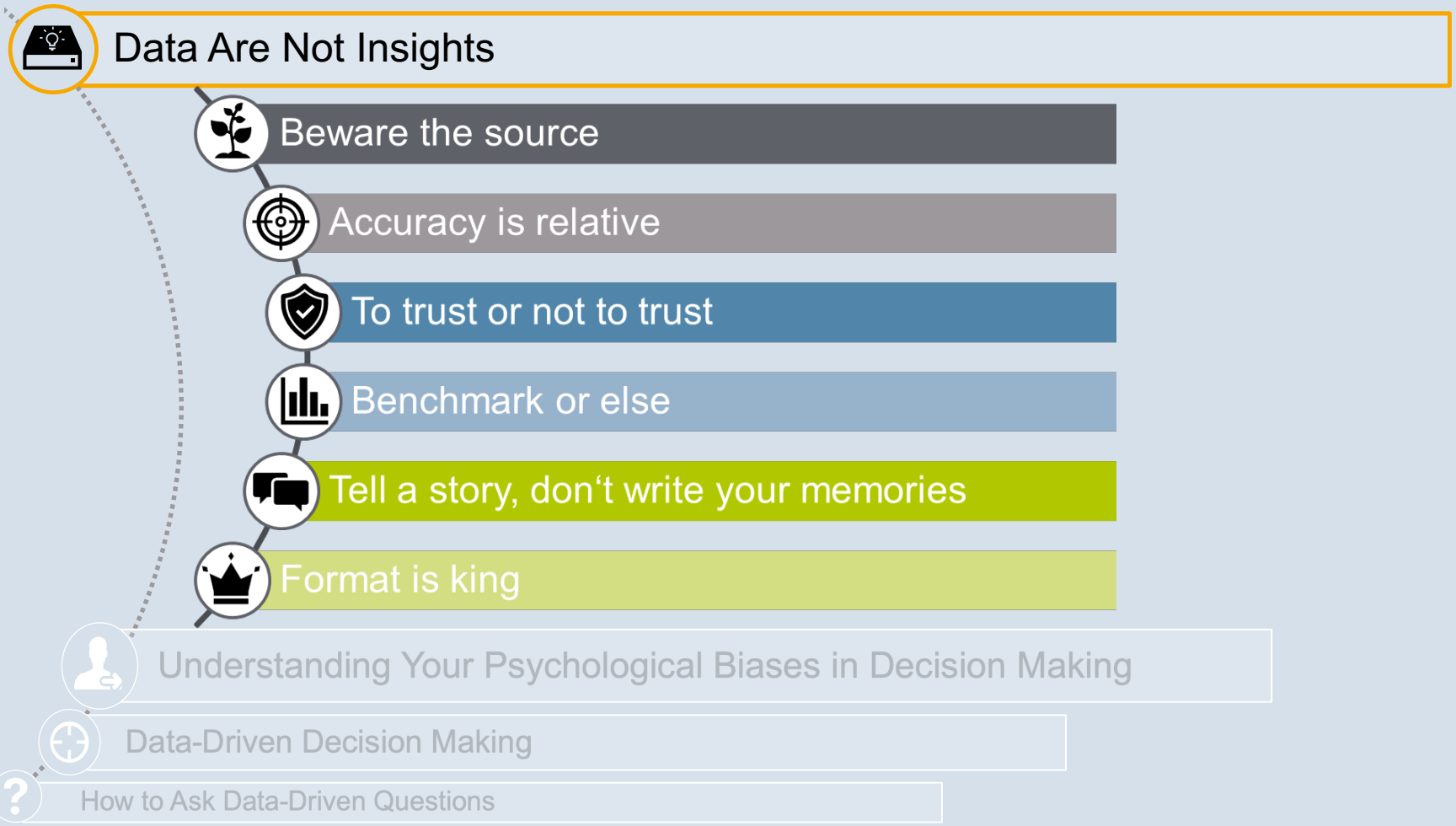

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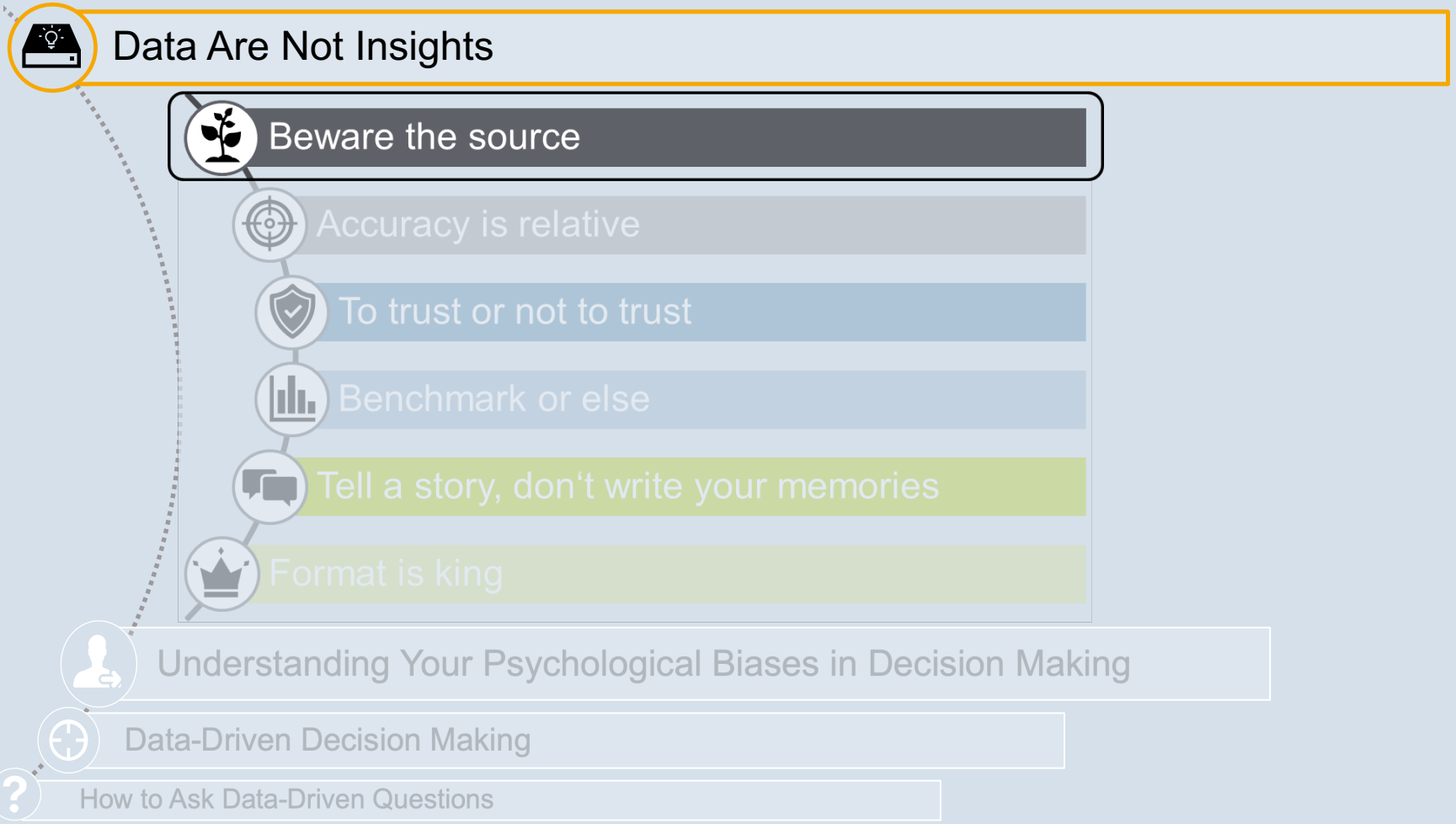

Data Quality Drives Quality of Insights

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Deriving powerful insights starts at picking the right source.

Different Sources Can Provide Fundamentally Different Data

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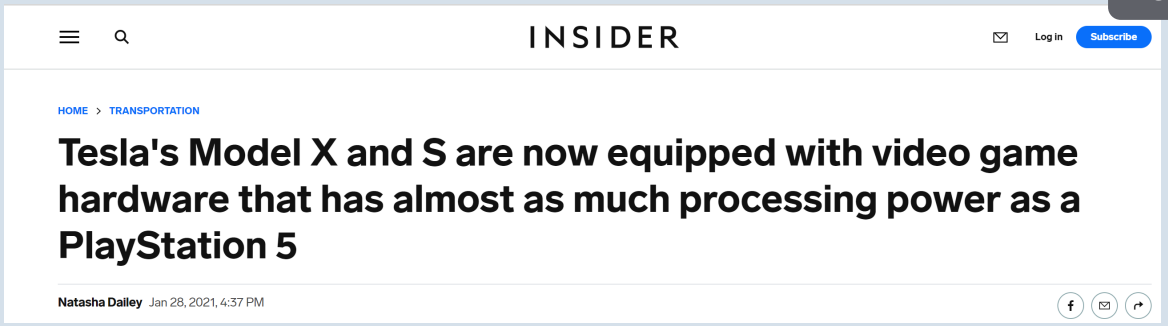
Beware the source


INSIDER

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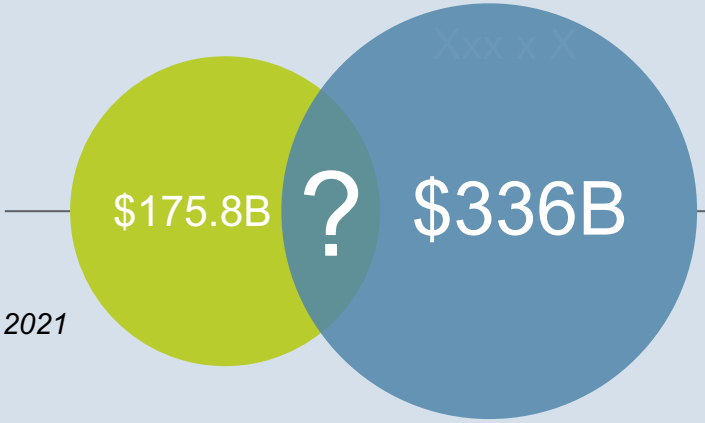
Tesla's Model X and S are now equipped with video game hardware that has almost as much processing power as a PlayStation 5

Natasha Dailey Jan 28, 2021, 4:37 PM

https://www.businessinsider.com/tesla-model-s-x-video-games-high-power-hardware-playstation-2021-1

Market Size of The Gaming Industry

Newzoo:
« Global Games Market to Generate **$175.8 Billion** in 2021 »
May 6th, 2021



Bitkraft:
« Gaming Industry Nearly Twice as Large as Reported, at **$336B**»
September 15th, 2021

- https://newzoo.com/insights/articles/global-games-market-to-generate-175-8-billion-in-2021-despite-a-slight-decline-the-market-is-on-track-to-surpass-200-billion-in-2023/
- https://www.bitkraft.vc/gaming-industry-market-size/

Data is Not Right or Wrong in Absolute Terms, but Relative to the User

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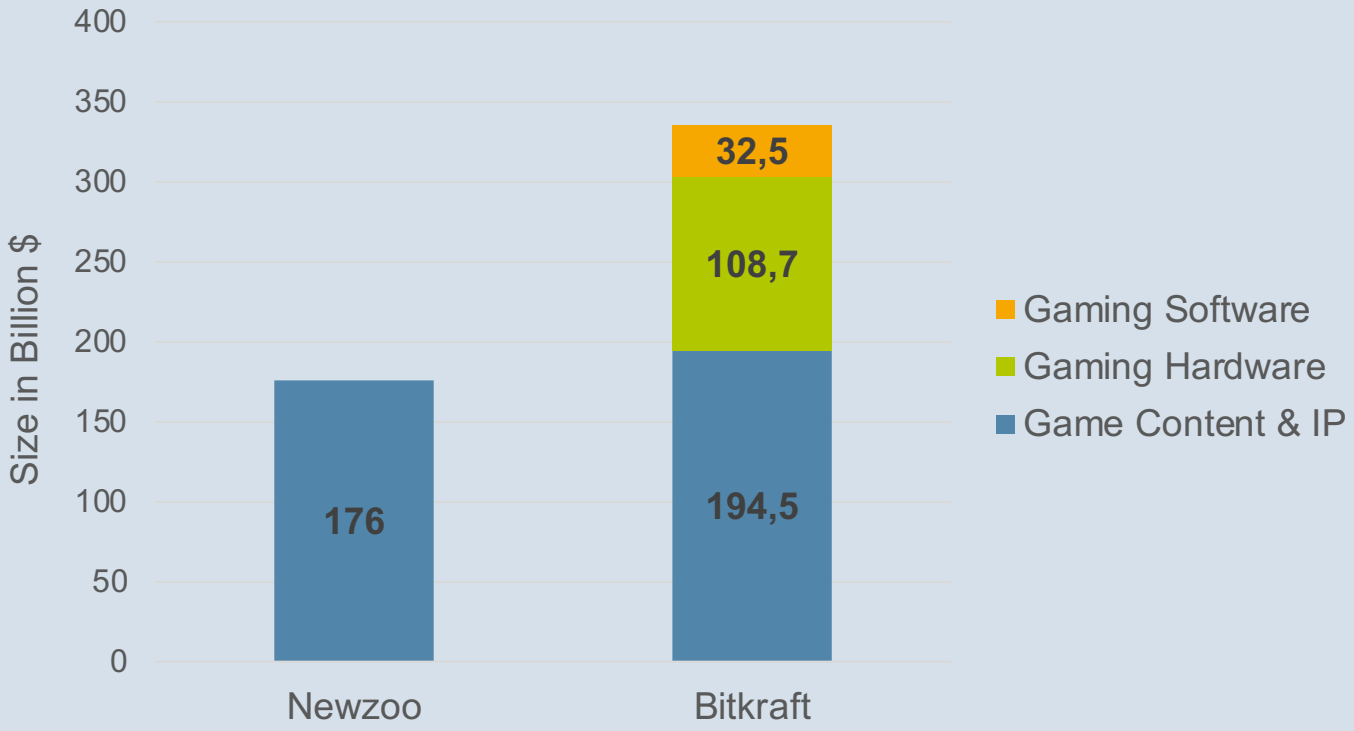
Beware the source



None of the data are actually right or wrong. You have to decide which one is **more important** and **more relevant** for yourself!

- https://www.bitkraft.vc/gaming-industry-market-size/

Example: Divergent Macro-Economic Data

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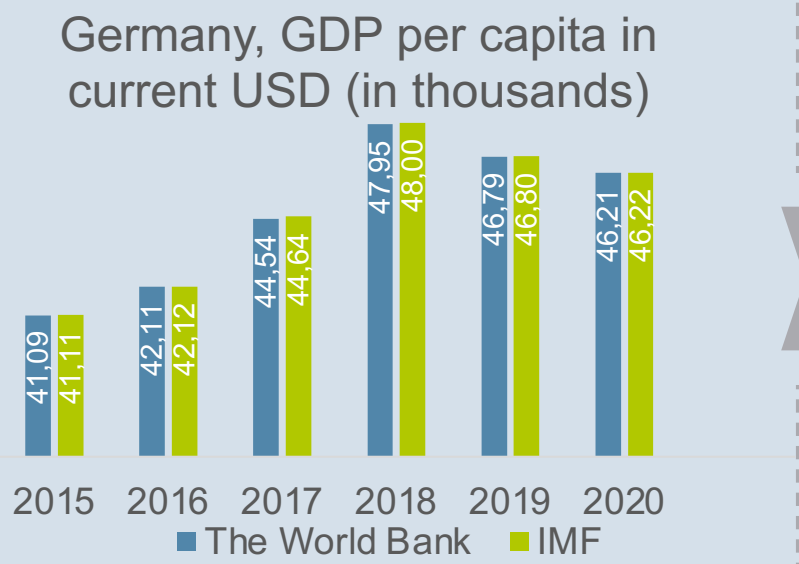
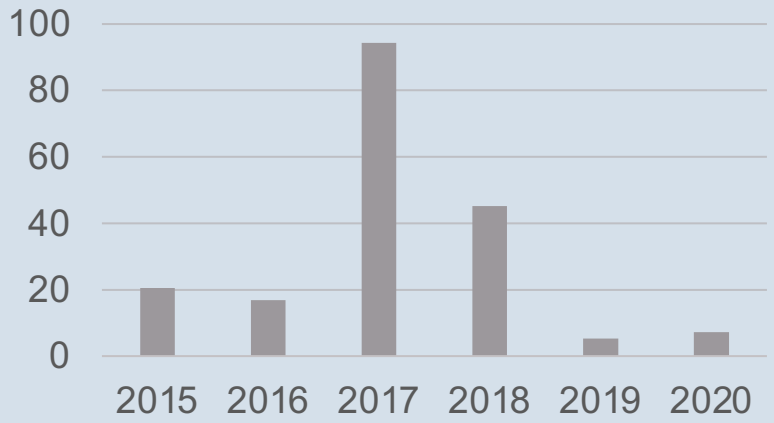
Beware the source





Even historic micro-economic data from best-in-class sources shows differing values and can be inaccurate showcasing that data always has to be questioned.

The 4 Cs of Data Sourcing

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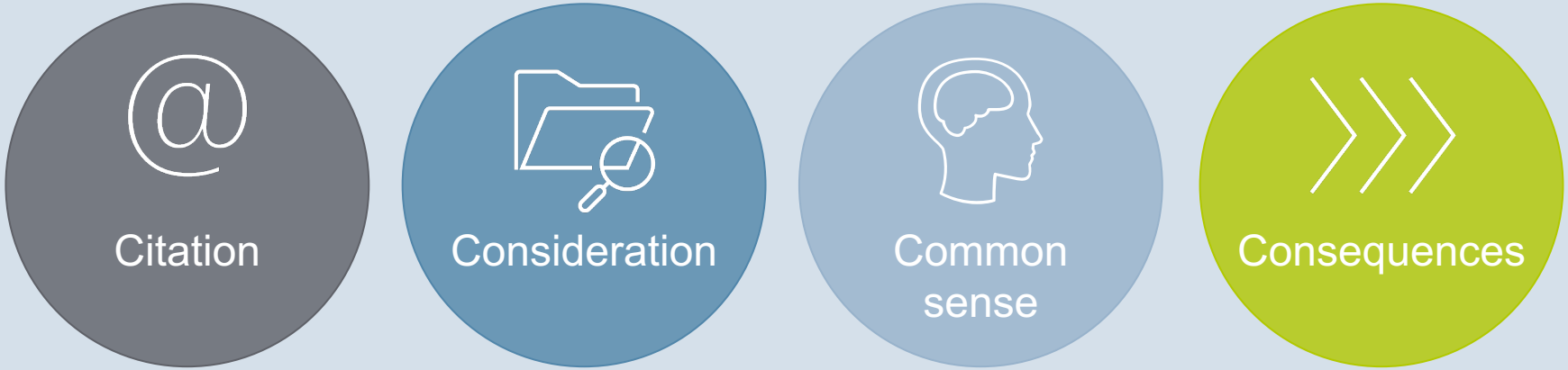
Beware the source



Always state the source

Carefully consider the source

Apply common sense in questioning both data and source

Be aware of the ramifications of using the data

Follow your intuition and always question the data source to be used in your analytics. Since data drives results – beware the source.

Data Literacy & Data Intuition

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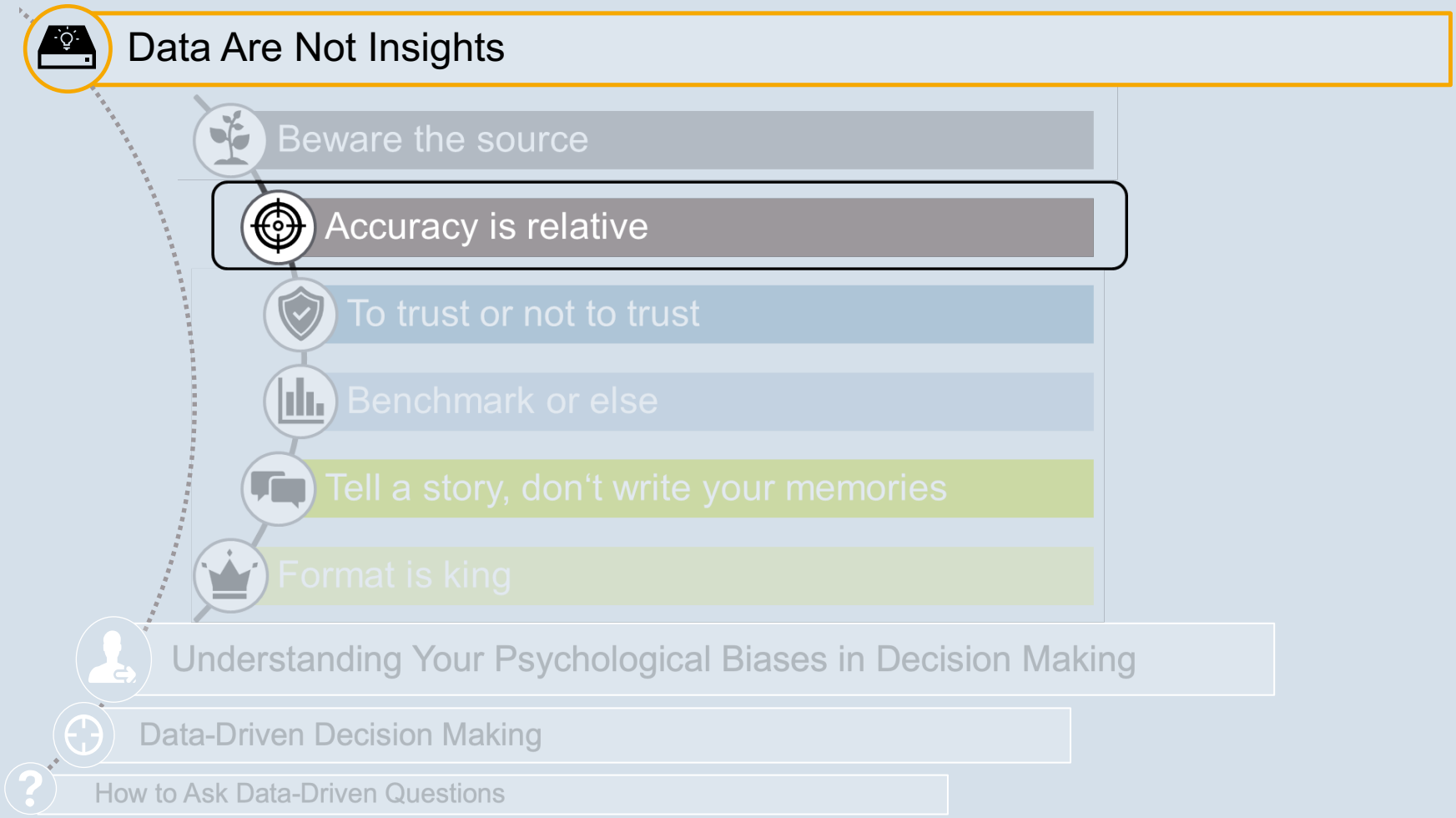

The Difference Between Accuracy and Precision

Accuracy is relative

Accuracy

Refers to **the degree** to which the **result** of a measurement, calculation, or specification **conforms to the correct value.**

Understand Estimates For What They Are

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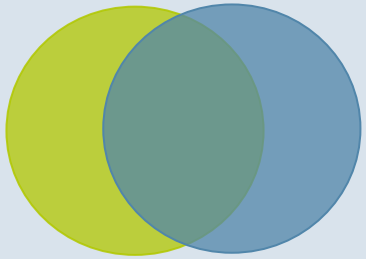
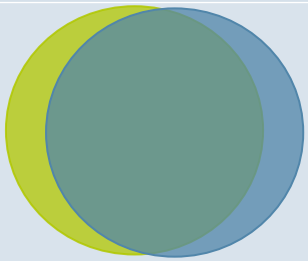
Accuracy is relative



Estimates are only calculations **based on assumptions** and the **data** you have!



Factors leading to **higher accuracy**:

- Greater **access** to information
- Greater **share of actuals** vs estimates

Beware of changes in reporting or calculations **methodology**!

Estimate
Reality

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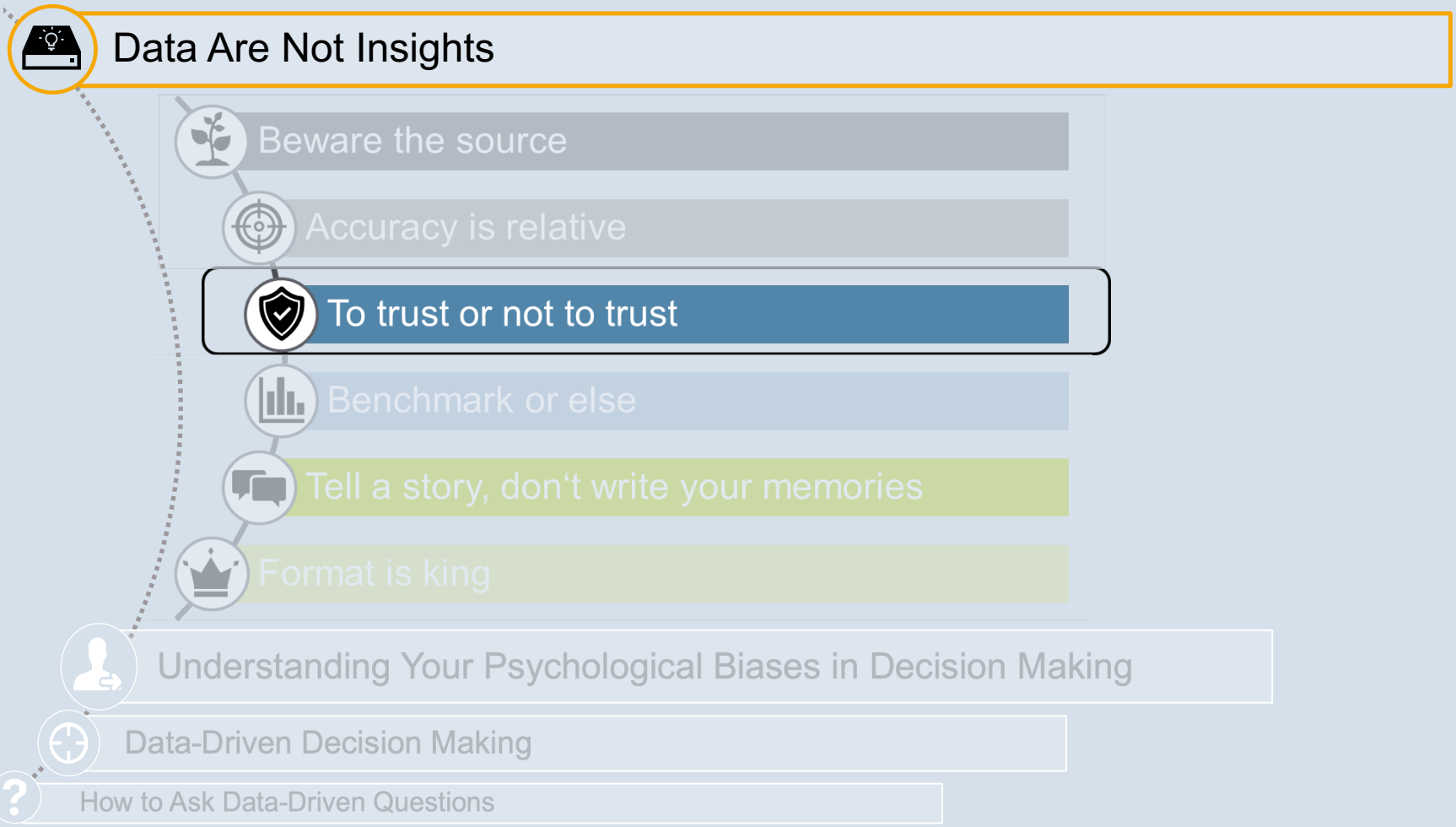
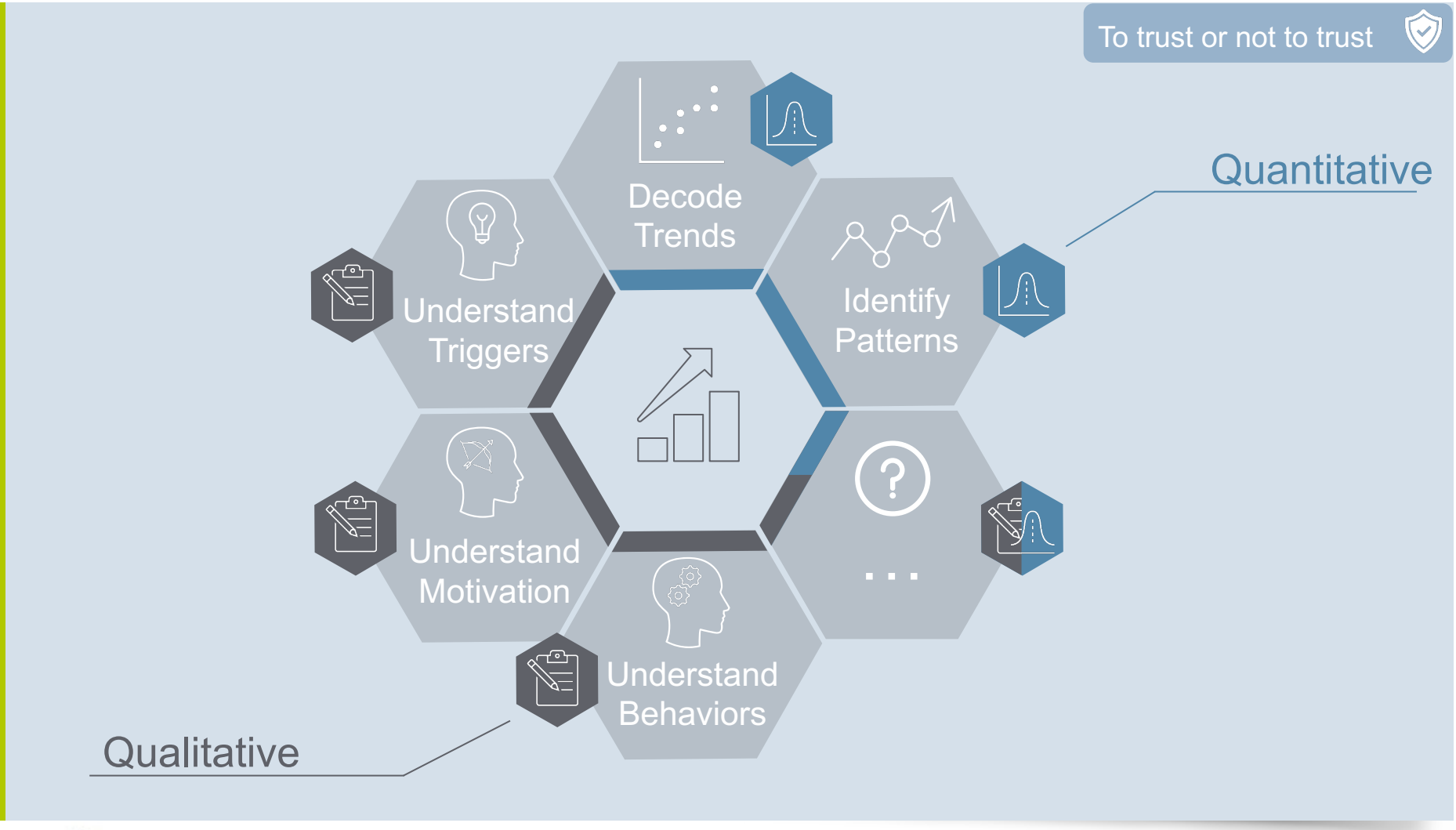


Goals of Primary Consumer Research



Survey Design –
The Don’ts of Consumer Research

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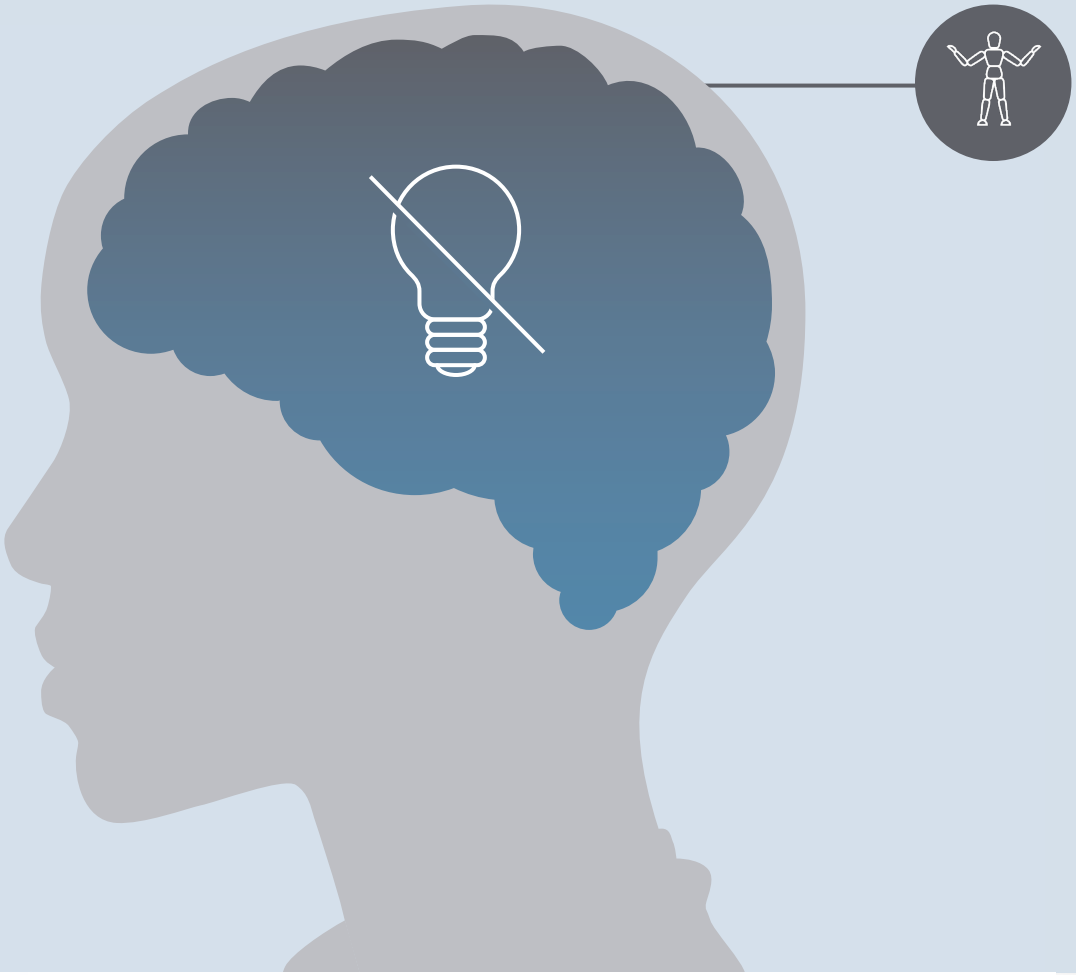
To trust or not to trust



Complicated & Unintuitive Questions

- Answers that require survey takers to make (multiple) assumptions and estimations cannot be trusted.

✗ “How much do you spend, on average, per year, on luxury items?”

Sample Selection

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To trust or not to trust

Regional Markets

Identify smallest individual cell

→ Bottom-up approach

Target Groups

Find representatives

→ Primary and secondary

Sample Size

Focus sample for efficiency

→ Smallest size n=50

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Figures are Always Relative and therefore Context Matters

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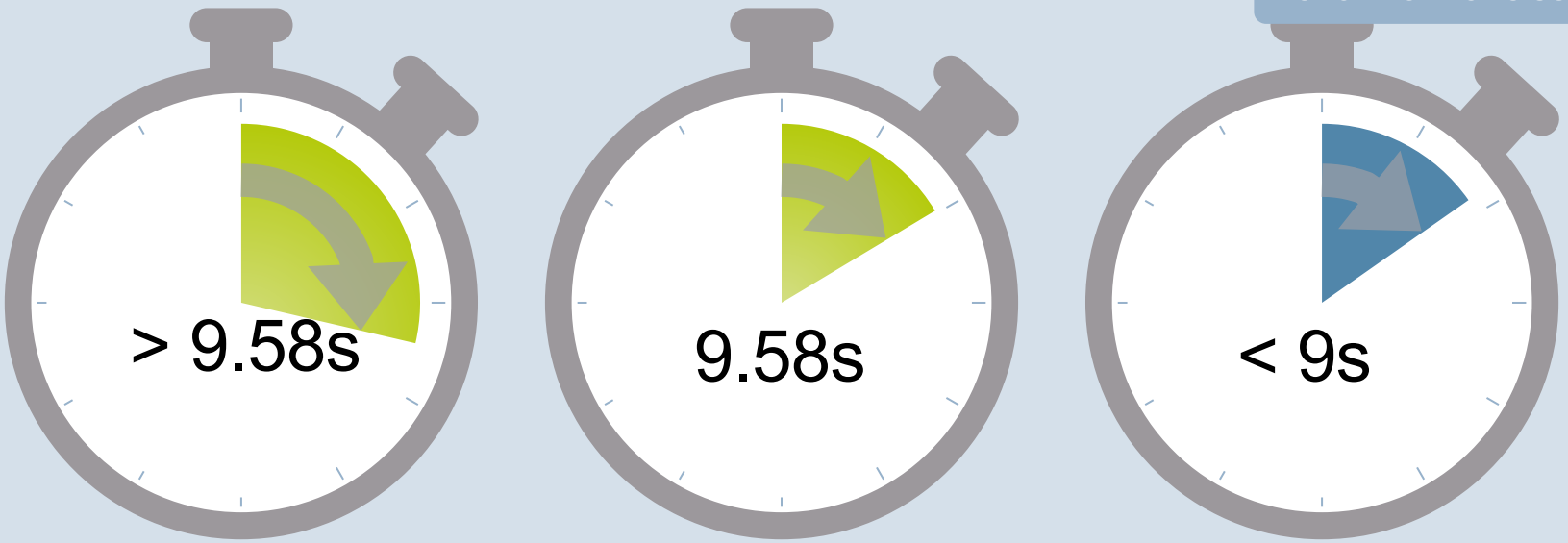
Benchmark or else



Average human 100m dash

Current 100m WR

100m dash of a Grizzly Bear

Data needs perspective, background information and/or benchmarking for their users to make sense of it.

Numbers of the Covid-19 Pandemic worldwide*

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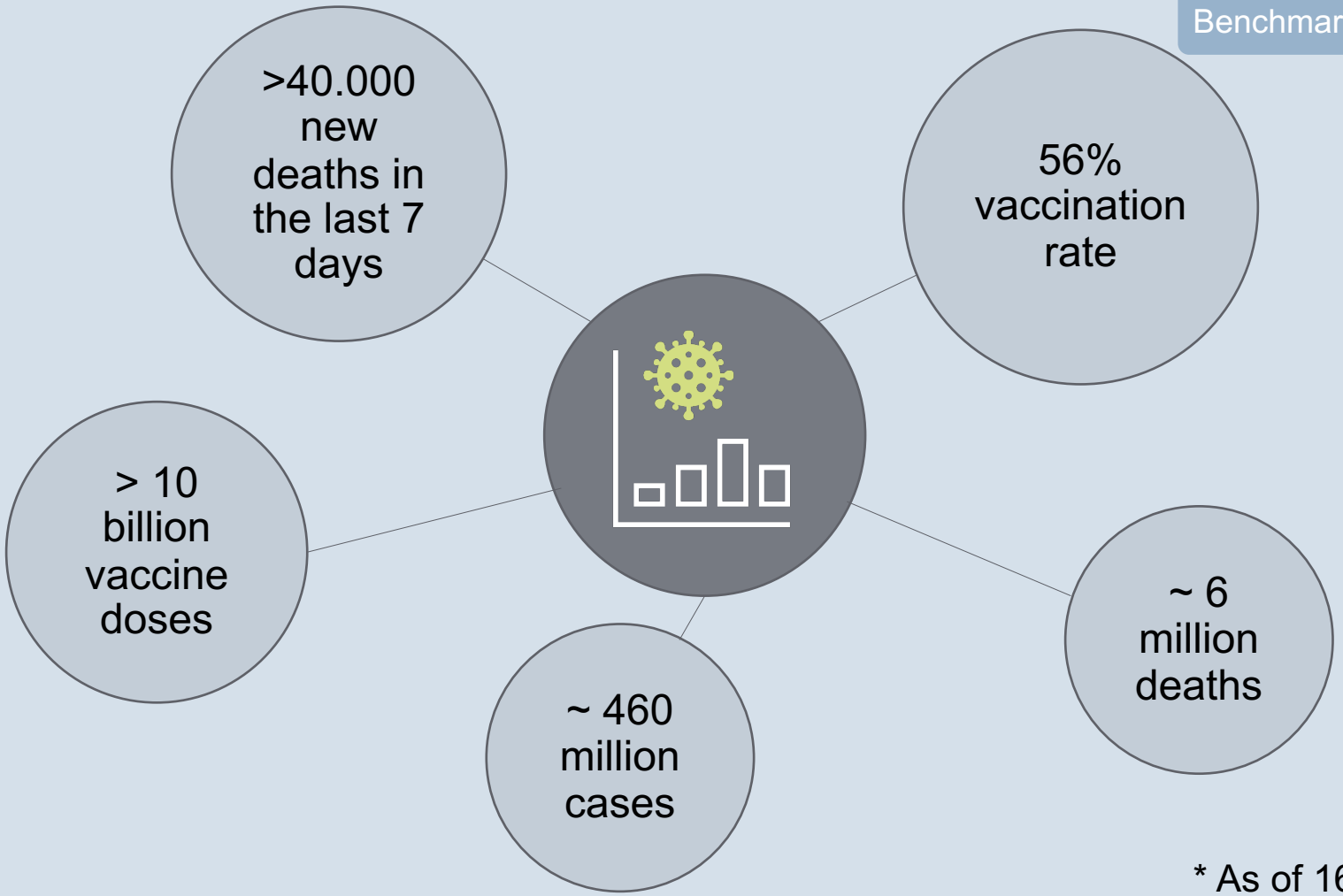

* As of 16.03.2022

› https://covid19.who.int/table

Putting Those Numbers Into Context

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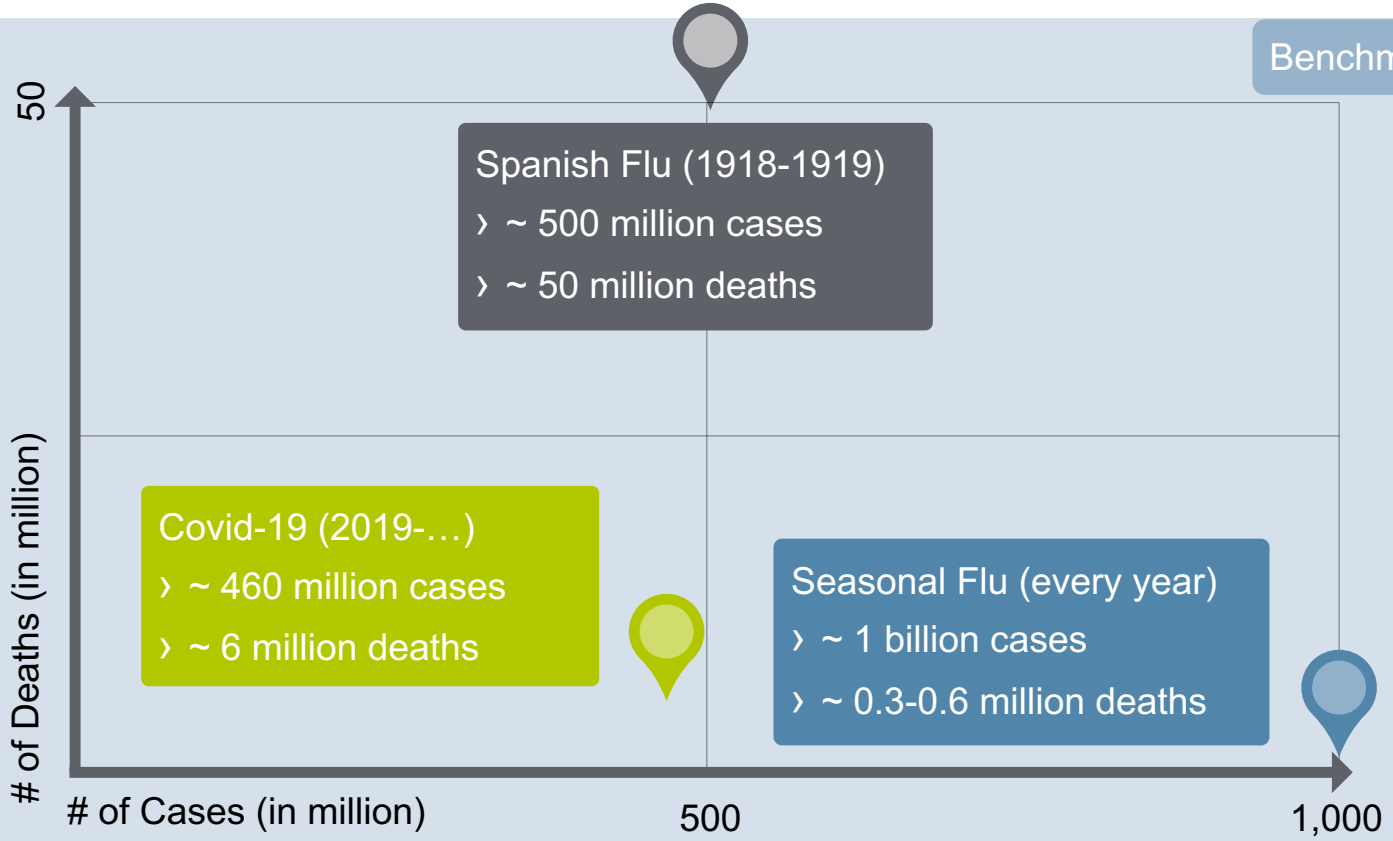

? **But**: Is such simple benchmarking already enough to draw insights from our data?

› https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/coronavirus-disease-2019-vs-the-flu
› https://www.cdc.gov/flu/pandemic-resources/1918-pandemic-h1n1.html
› https://covid19.who.int/table

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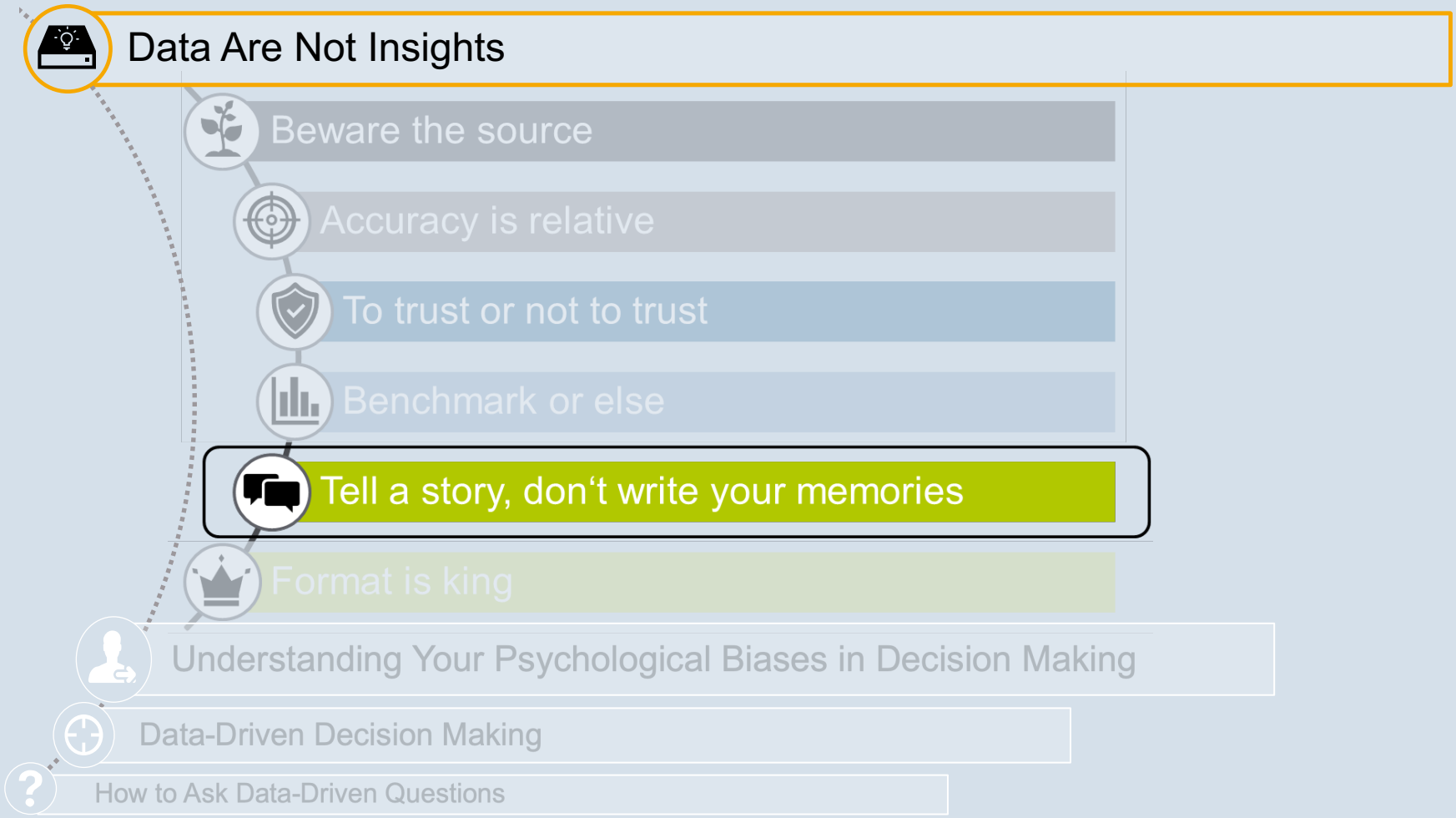

Data are Linear, Insights are Not – An Example from the Luxury Industry

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Tell a story

Kuwaitis

Qataris

Cluster analysis for Persian Gulf region

Although Kuwaitis and Qataris have very different characteristics in this segment, both were statistically clustered together – why?

Unlike data, insights are fueled by intuition. They go beyond facts and figures to show what actually matters to your business.

Finding the Story that Matters to the Business

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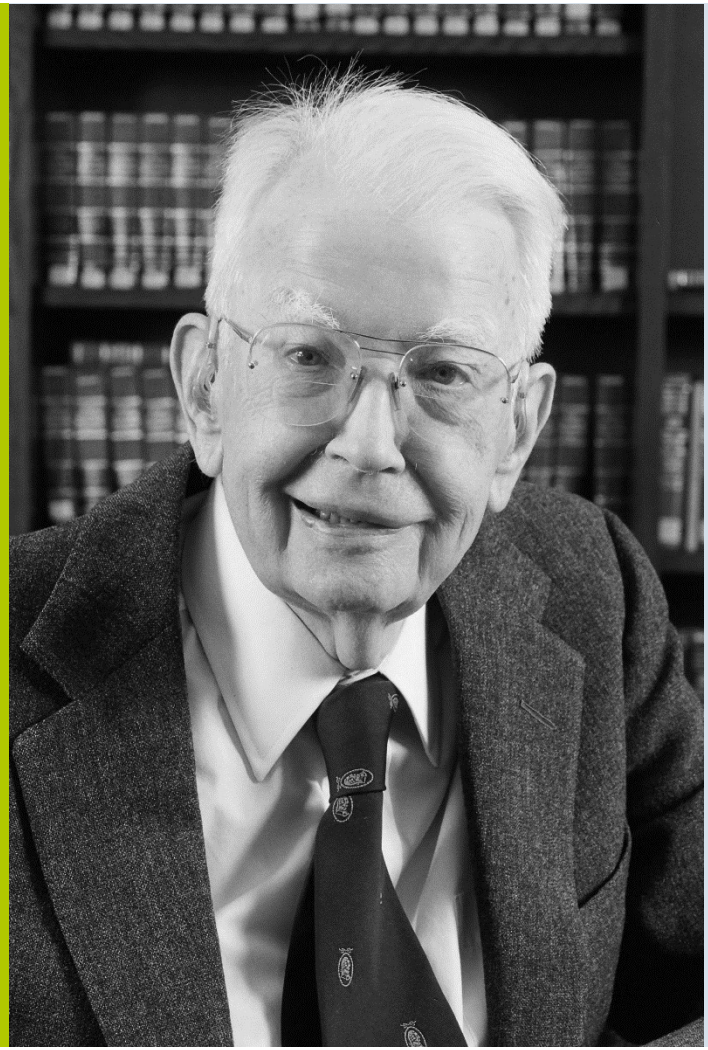

Tell a story

> If you torture data long enough, they will confess to anything.
>
> Ronald Coase

To Present Insights, Focus on the Essential Story

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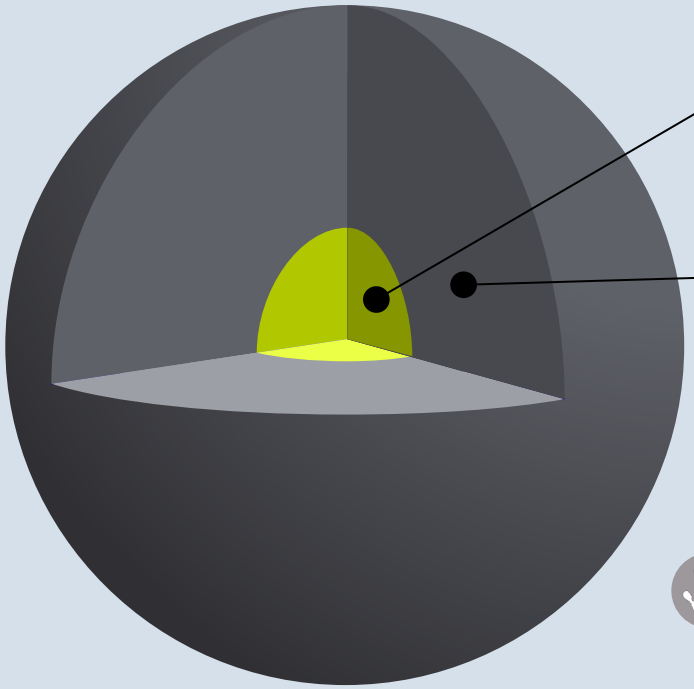
Tell a story



Present the Essence

Prepare backup for questions on the details

Aim the presentation not at showcasing your work, but on delivering the insight to an audience

Exemplary Flow of The Insights Presentation

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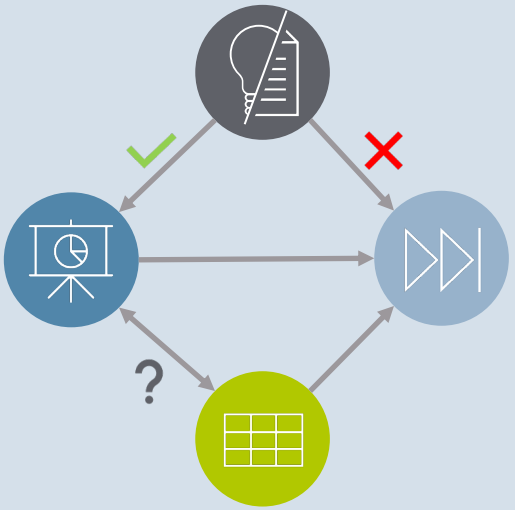
Tell a story

Key building elements of an insights presentation (exemplary):

- Introduction
- Argumentative Part
- Backup / Questions

Possible presentation flow:



The Three Key Layers to Drawing Powerful Insights From Data

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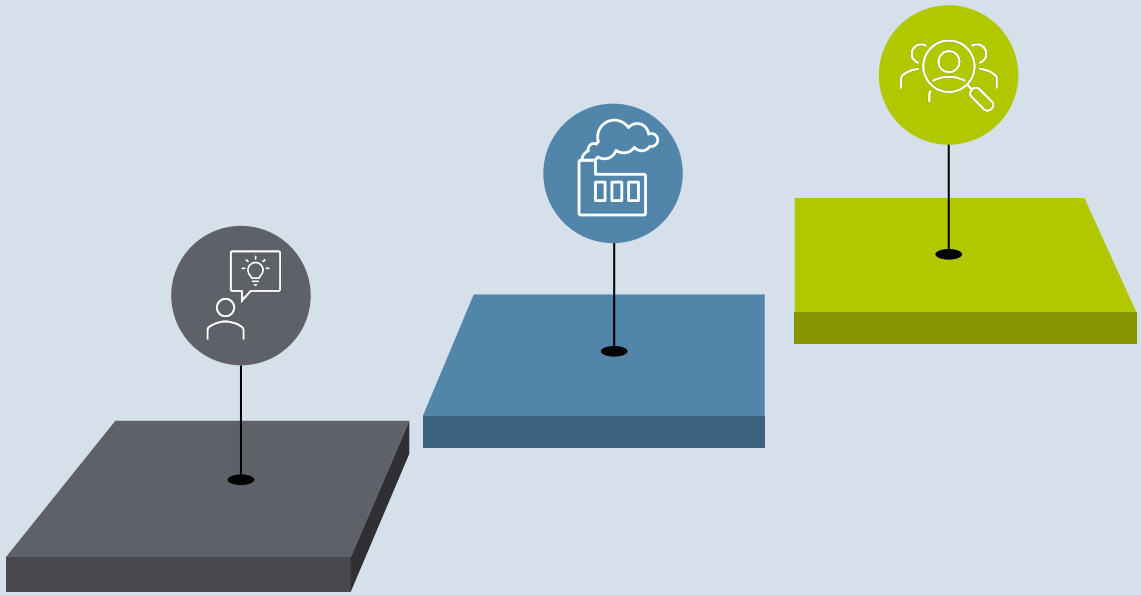
Tell a story



1. Knowledge of the market
2. Understanding of the industry
3. Audience-orientation

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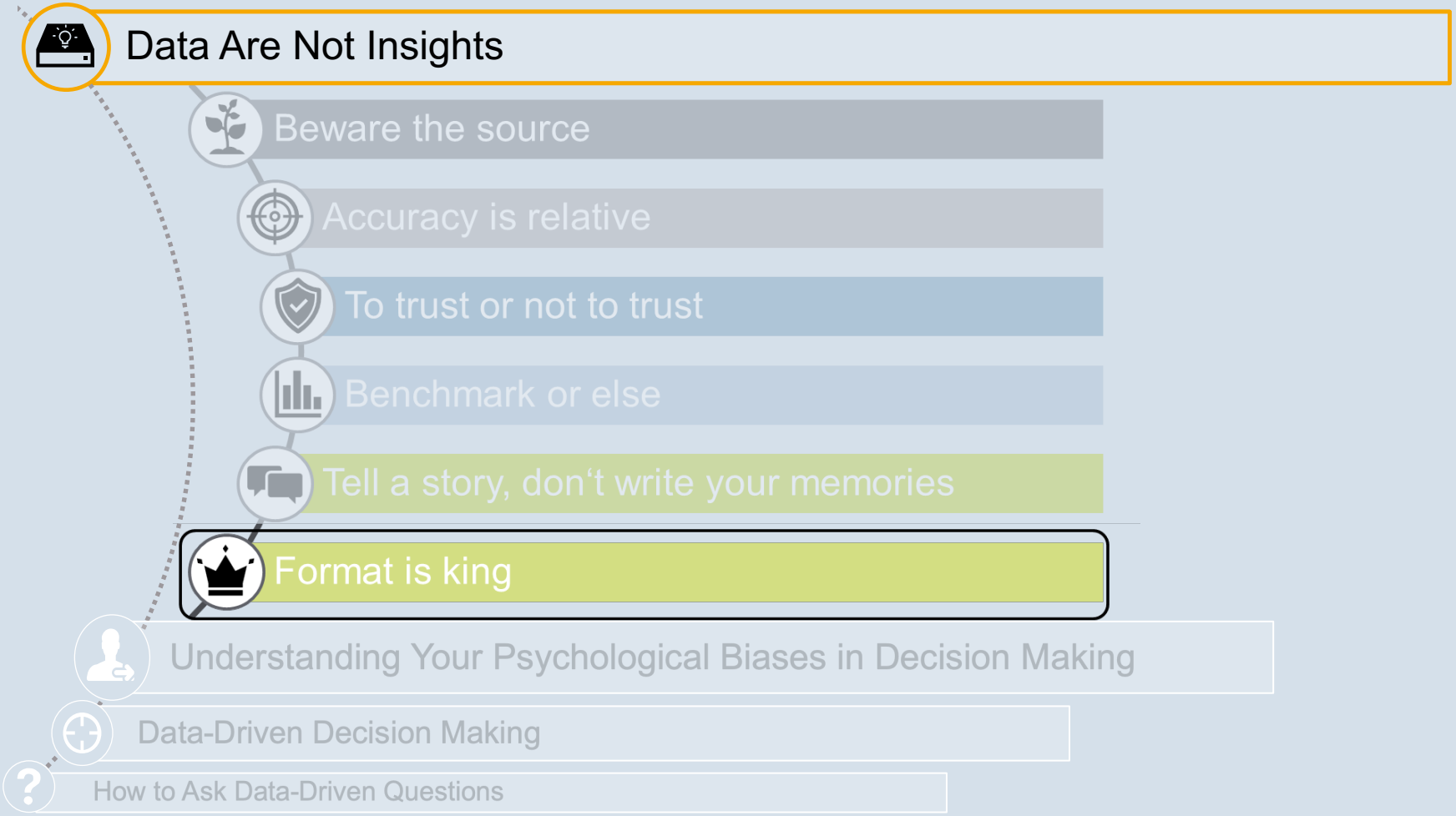

Design for Impact or Risk Making No Impact at All

Format is king

Visual presentation of insights will make or break the attempt of convincing the audience!

The Presentation is to the Insight, What a Trailer is to a Movie

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A trailer (is)…

- Short
- Dynamic
- Visually exciting
- Presents the main characters and plot

Avoid "death by Power-point"

A Trailer is Short

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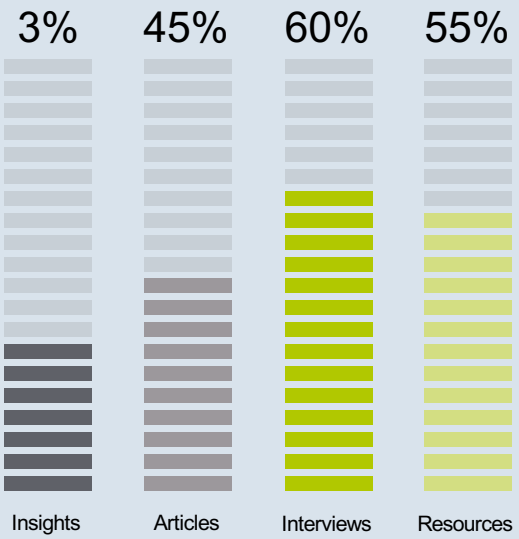
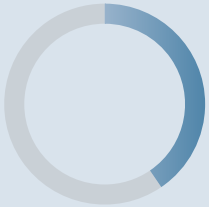
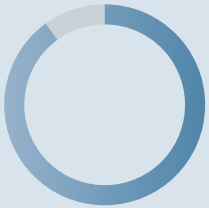
Format is king





45%

Xxxxxx x xx x xxx x xxx xx xxx x



90%

Xx xxxxxx xxxxxxxx x xx xxxxx

Visualize only key elements!

A Trailer is Dynamic

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Format is king

Xxx
Xx xxxxxxxxxxxxxxxxx x xxxxxx xxxxxx xxxxx x xxxxxx x

Xxx x
Xx xxxxxxxxxxxxxxxxxxx x xxxxxx xxxxxx xxxxx x xxxxxx x

Xxx x x
Xx xxxxxx xxxxxx x xxxxx xxxxxxxxxxxx xxx xxxxxx xxxxx

xxxxx x
Xx xxxxxx xxxxxxx x xxxxx xxxxxxxxxxxx xxx xxxxxx xxxxx

Use visualizations like matrices and mappings to go beyond the linearity of a data table.

A Trailer is Visually Exciting

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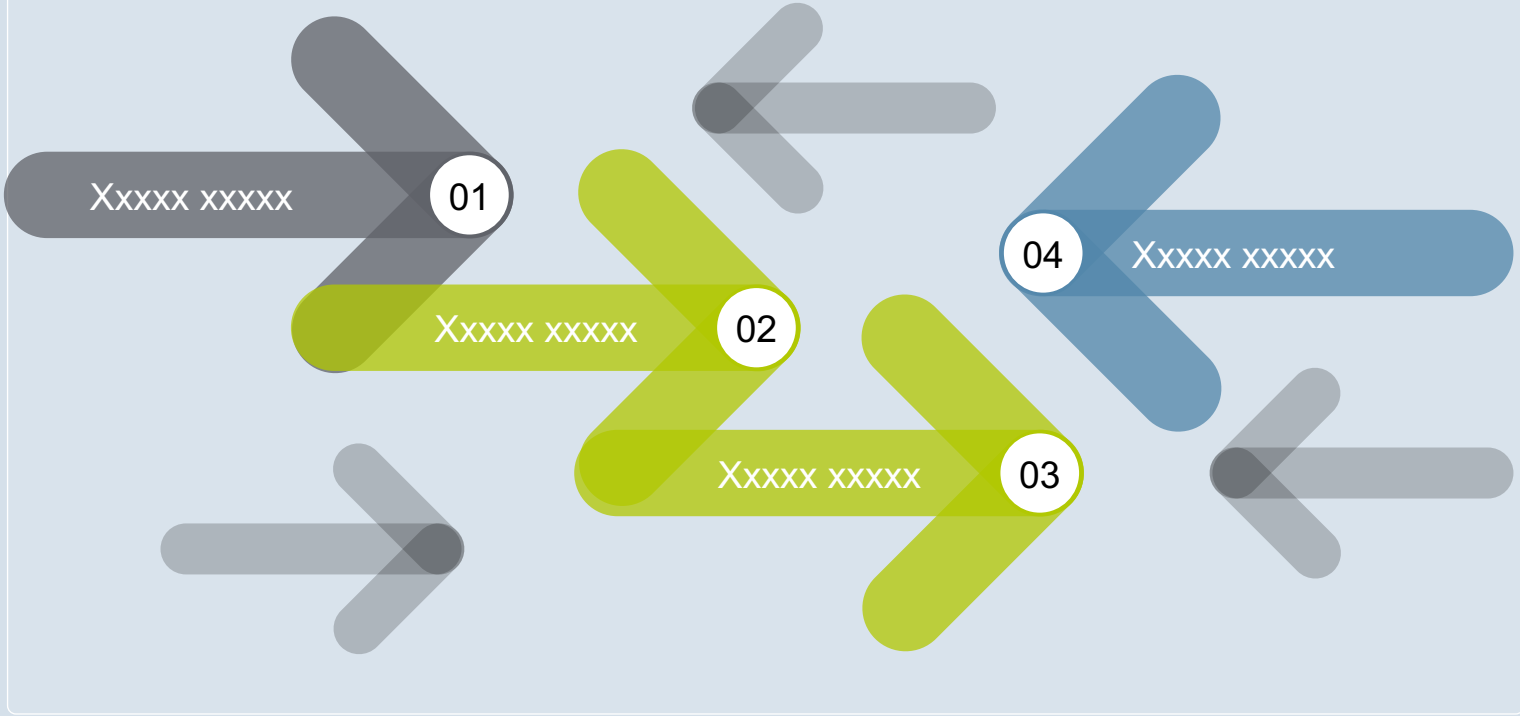
Format is king



Less is more when it comes to the use of colors, animations, fonts, etc.

A Trailer Conveys Key Points of the Story

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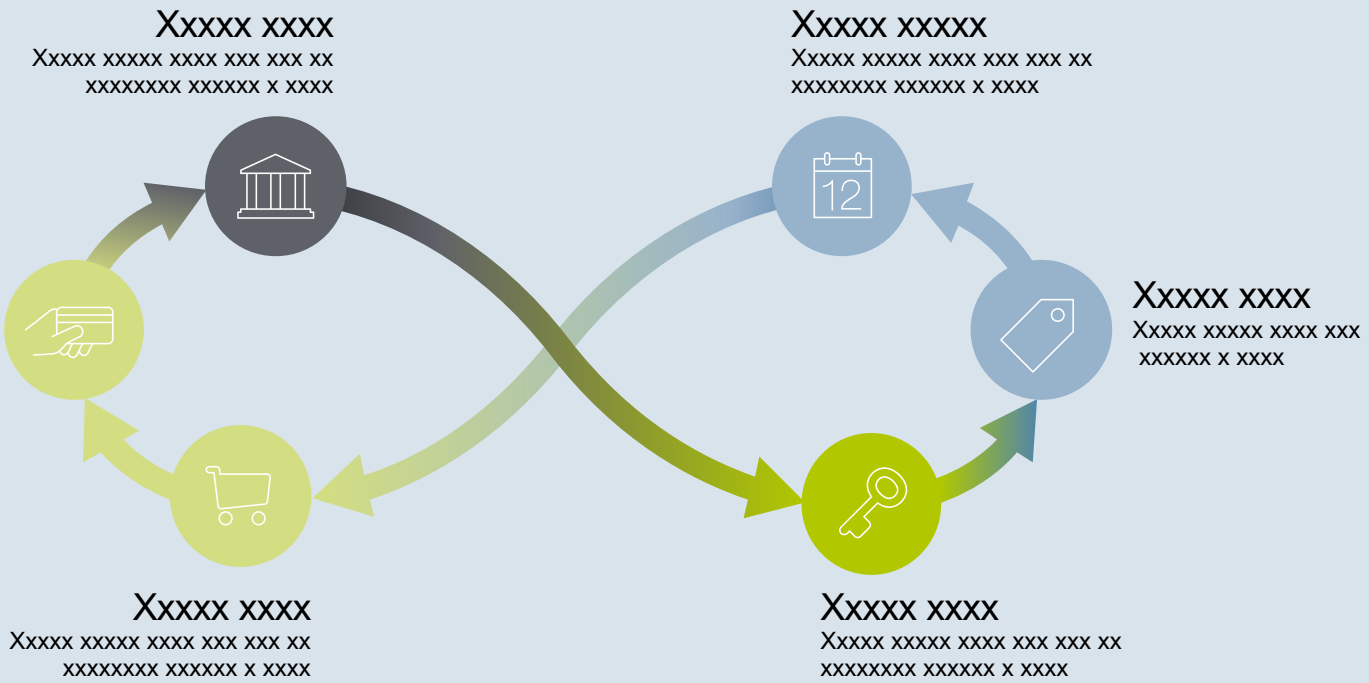
Format is king



A slide show uses symbols to tell a story visually. It should be understood without explanations, but also leave room to elaborate and tell a story.

Audience Focus

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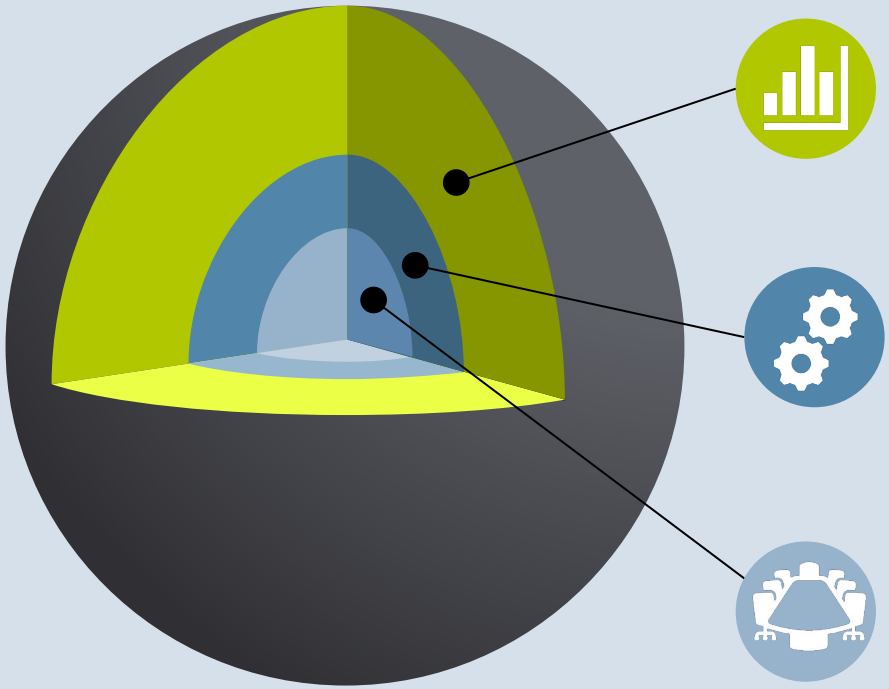
Format is king



Your Analysis Team
› Show them everything you did
› Bury them in data

Operations
› Deliver excitement for your results
› Go into a bit more detail

C-Level Management
› Give them a feel of your results
› Show the big picture
› Present key conclusions

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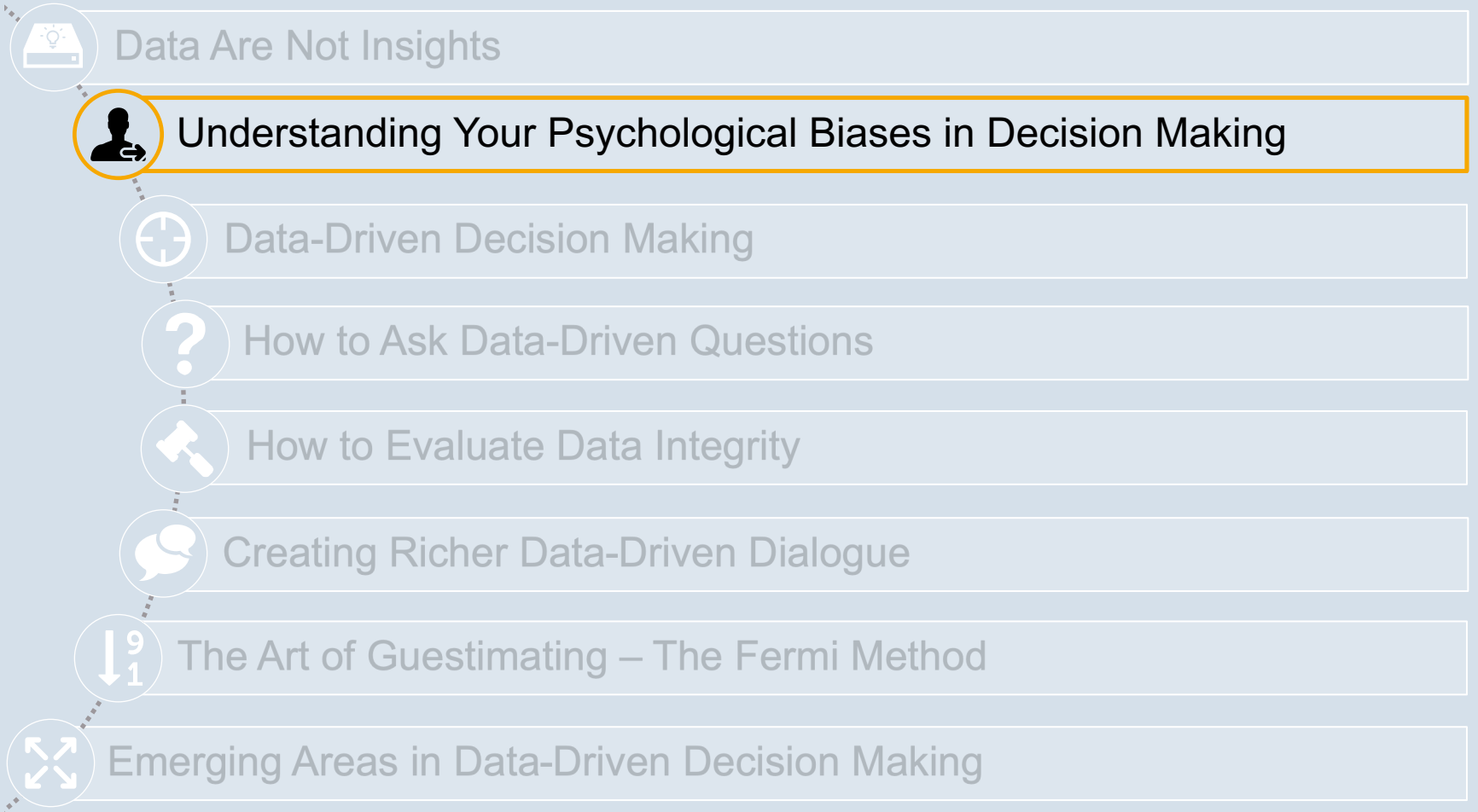
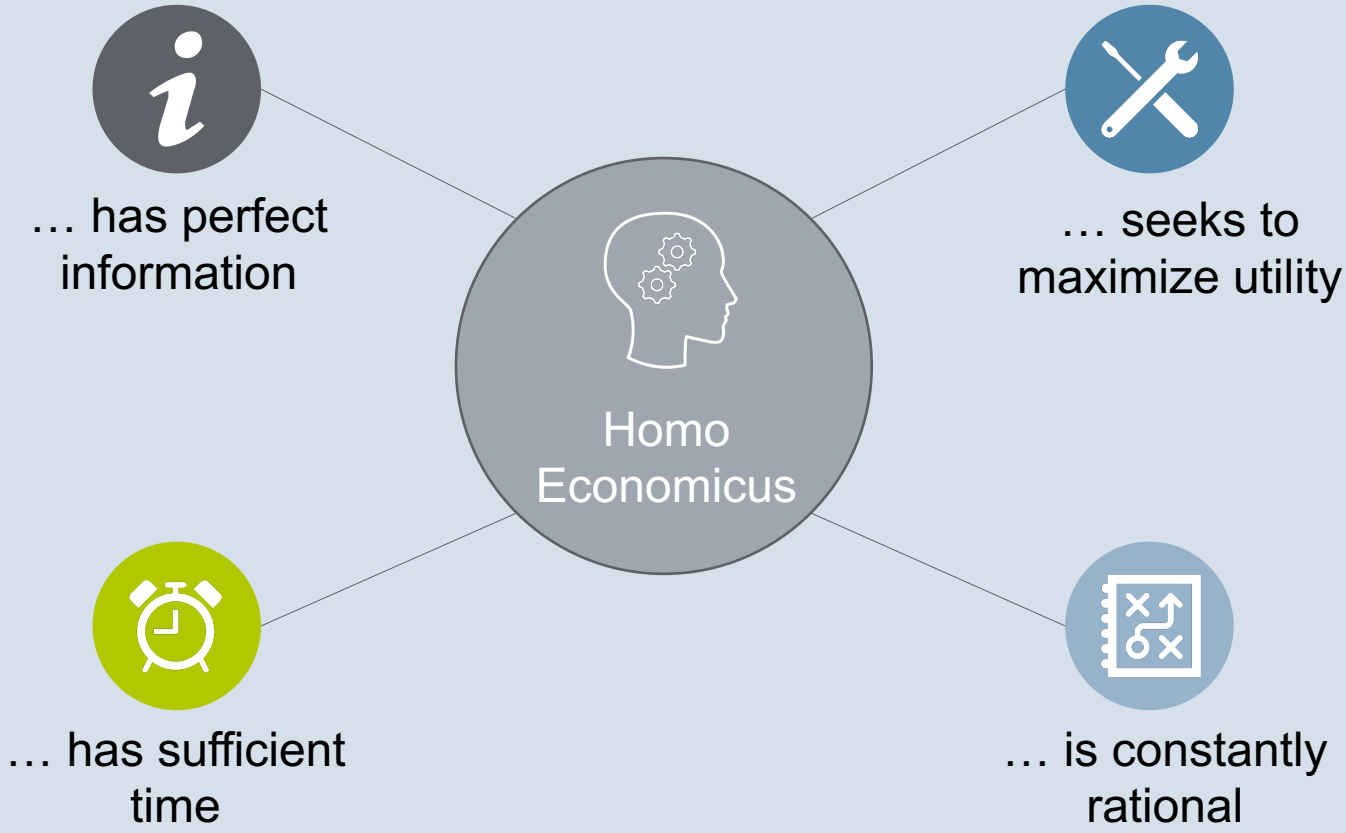


Rational Decision Making



A Quick Test:

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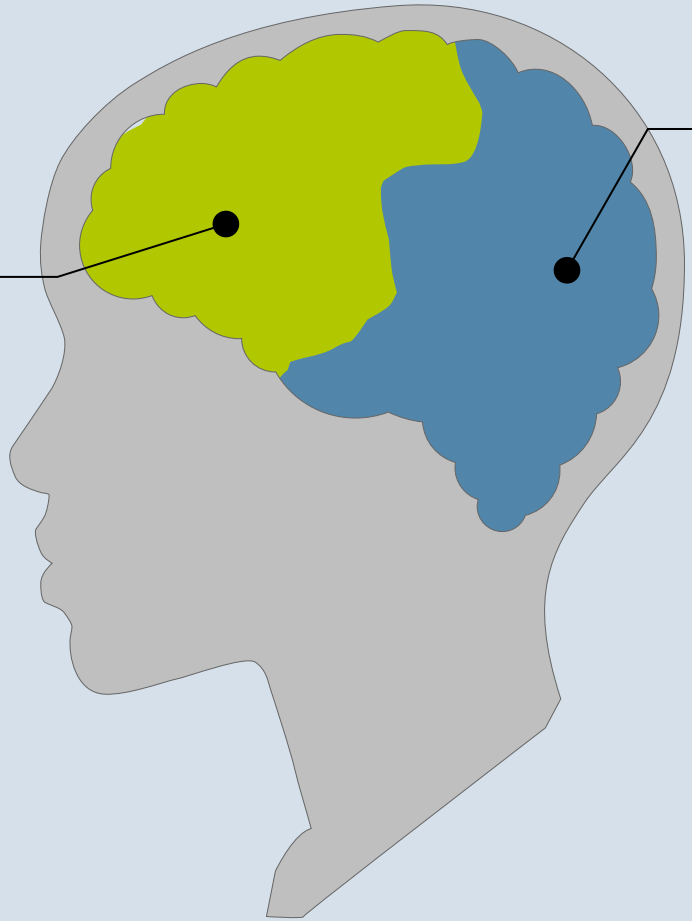
$$17 \cdot 24 = ?$$

Dual Process Cognition

System 1

- "Fast"
- Unconscious
- High Capacity
- Error-prone



System 2

- "Slow"
- Conscious
- Low Capacity
- Predictable

Cognitive Biases

Cognitive Biases

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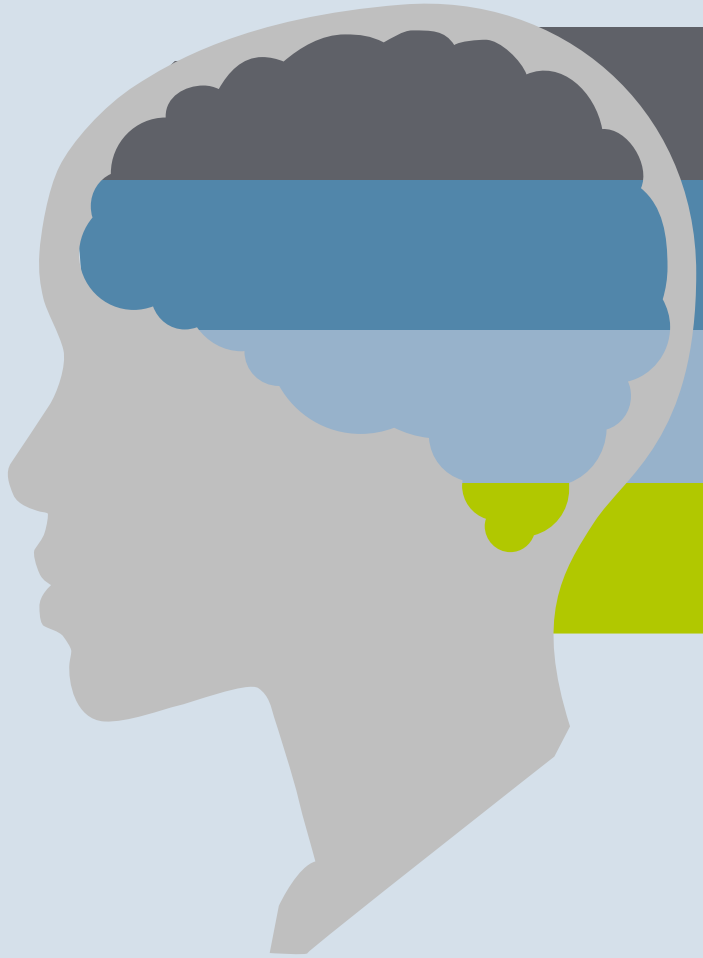

01 Framing Effect
› Our choices depend on how different options are framed

02 Overconfidence
› Overestimation of one's actual performance

03 Confirmation Heuristic
› Tendency to search for information in a way that confirms one's prior beliefs

04 Self-serving Bias
› Habit to take credit for positive effects, but blaming outside factors for negative events

Cognitive Biases

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Cognitive Biases: Framing Effect

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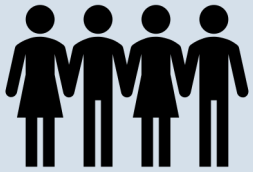
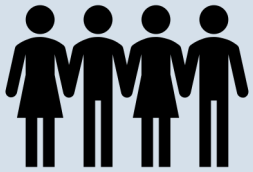
Program A:		Program B:
200 people will be saved	 Group 1	1/3 chance all 600 people will be saved, 2/3 chance no one will be saved
400 people will die	 Group 2	1/3 chance nobody will die, 2/3 chance all 600 people will die

Cognitive Biases: Framing Effect

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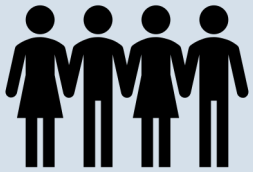
	Program A:		Program B:
Group 1	200 people will be saved		1/3 chance all 600 people will be saved, 2/3 chance no one will be saved
	72%		28%
Group 2	400 people will die		1/3 chance nobody will die, 2/3 chance all 600 people will die
	22%		78%

Cognitive Biases

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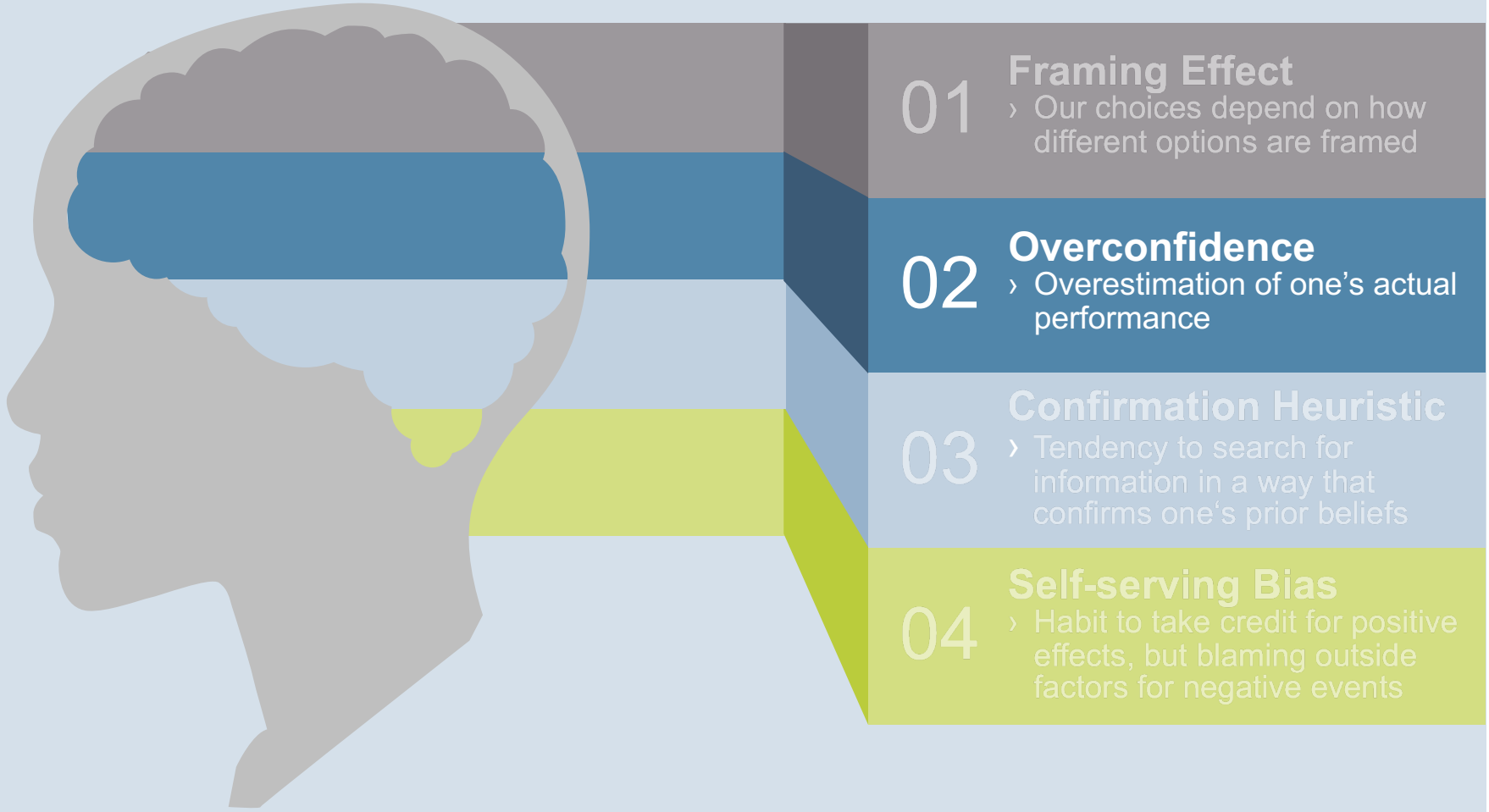

Cognitive Biases: Overconfidence

Cognitive Biases: Overconfidence

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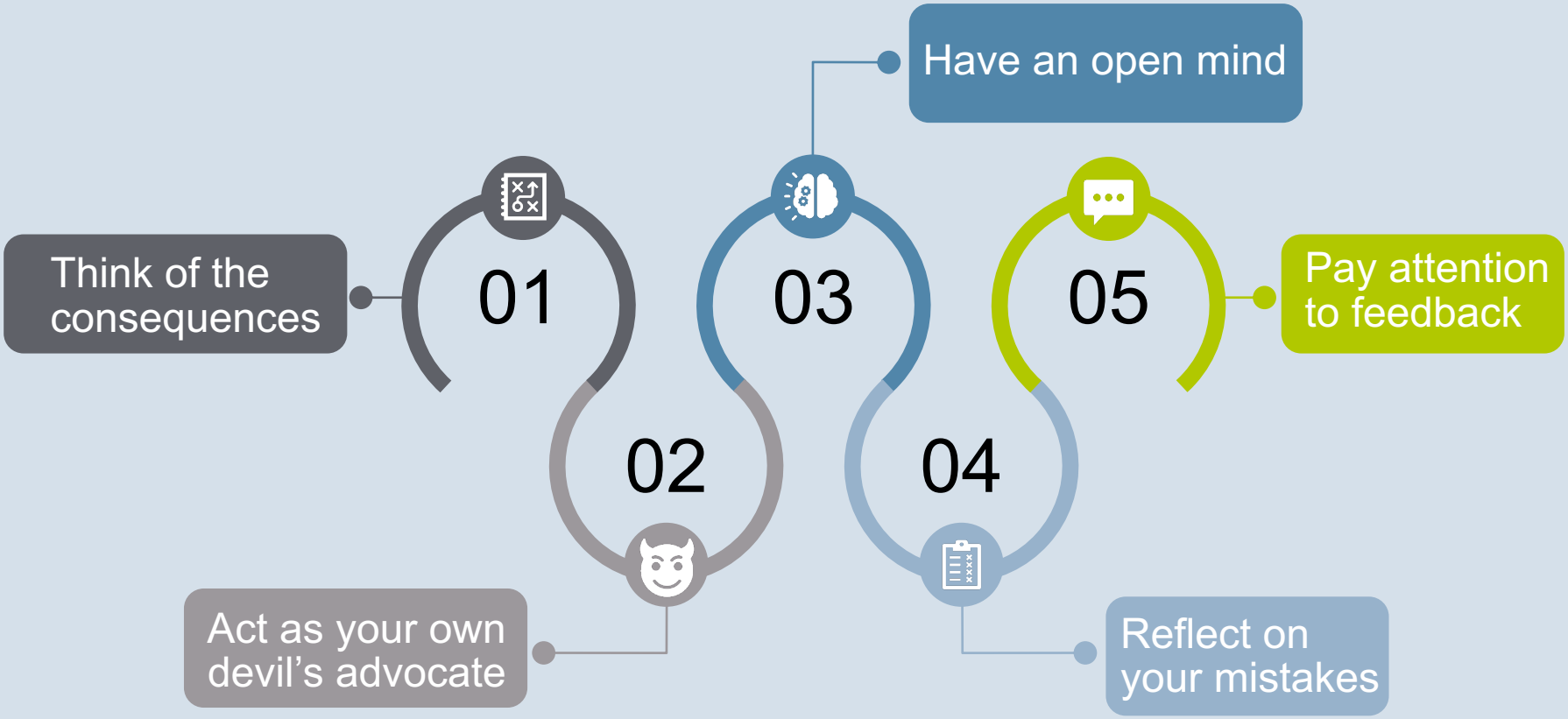

Cognitive Biases

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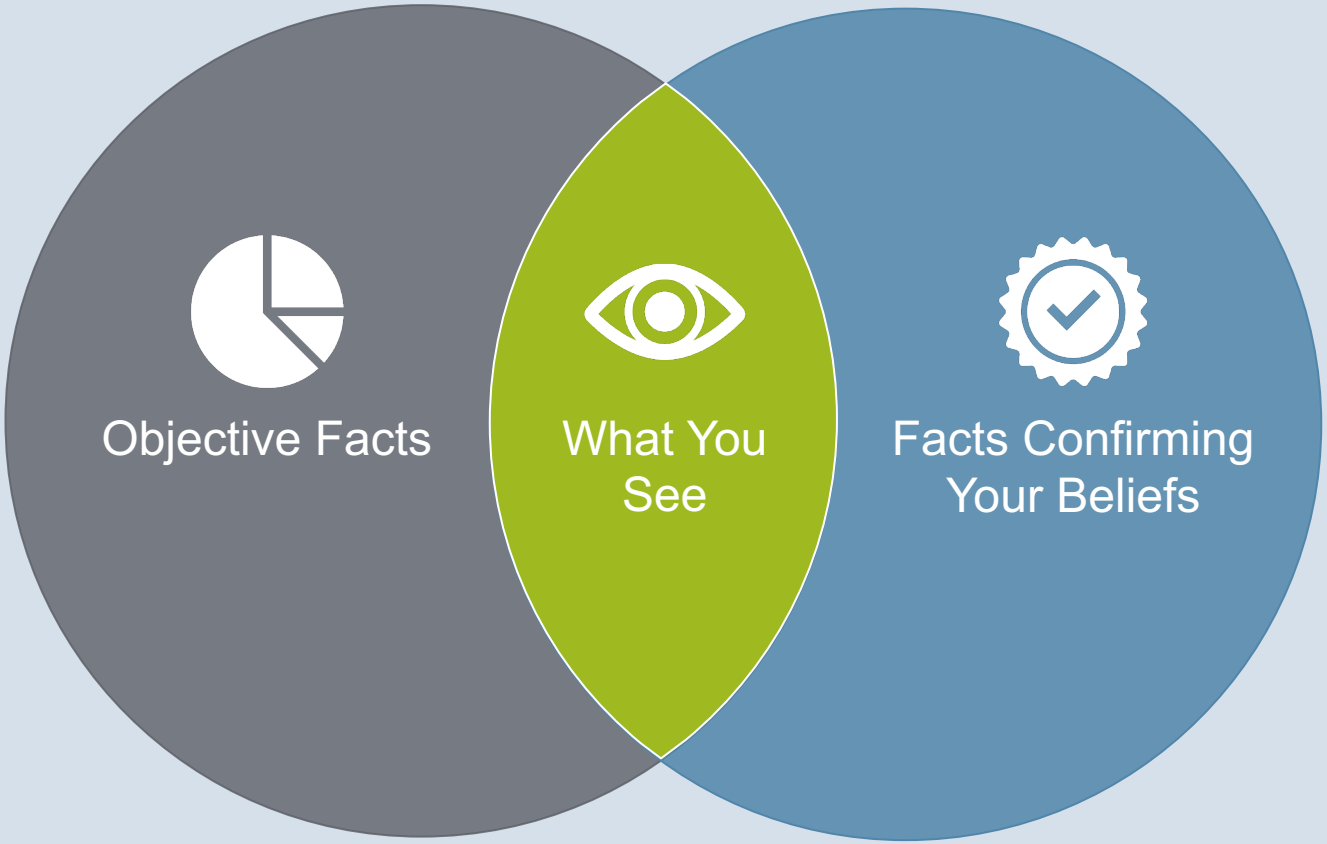
03 Confirmation Heuristic
› Tendency to search for information in a way that confirms one's prior beliefs

04 Self-serving Bias
› Habit to take credit for positive effects, but blaming outside factors for negative events

Cognitive Biases: Confirmation Heuristic



Cognitive Biases

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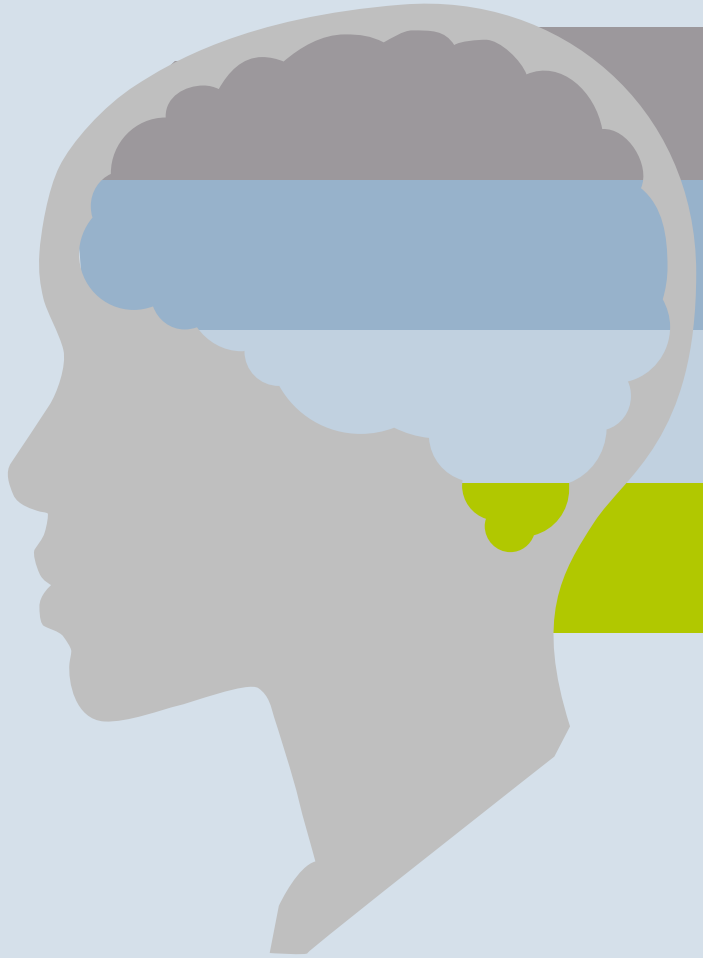


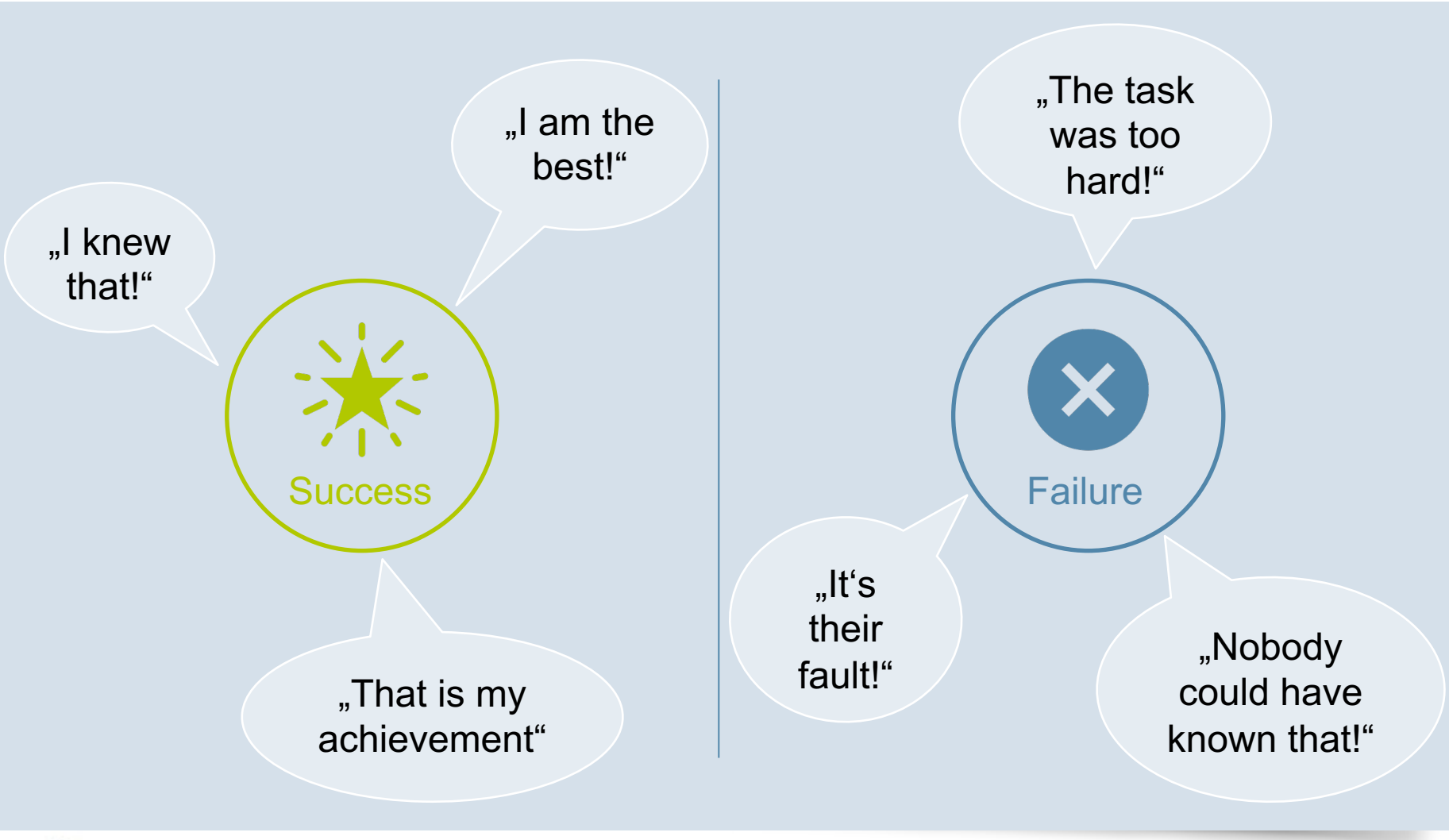
01 Framing Effect
› Our choices depend on how different options are framed

02 Overconfidence
› Overestimation of one's actual performance

03 Confirmation Heuristic
› Tendency to search for information in a way that confirms one's prior beliefs

04 Self-serving Bias
› Habit to take credit for positive effects, but blaming outside factors for negative events

Cognitive Biases: Self-serving Bias



Implications for Data-Driven Decision Making

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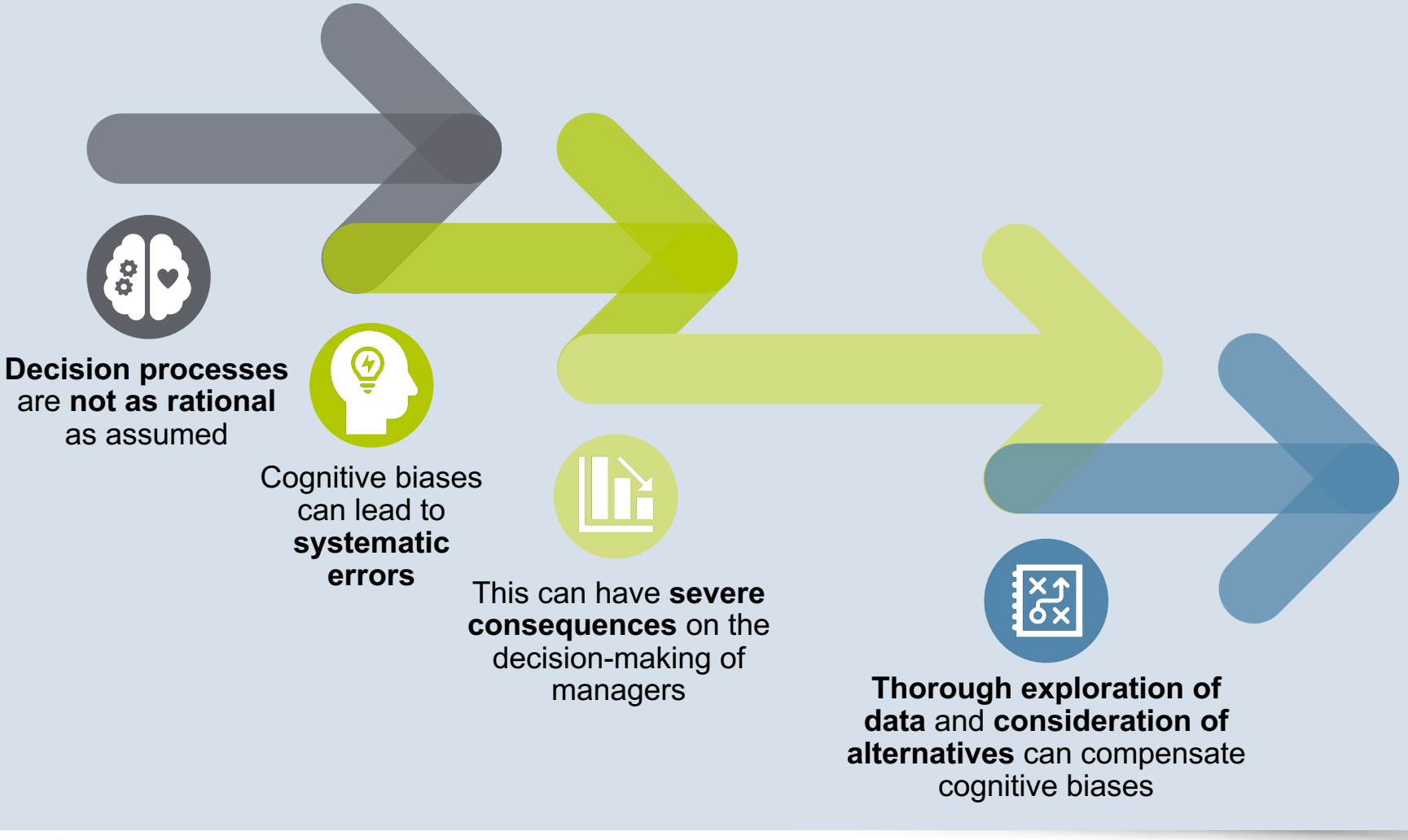

Data Literacy & Data Intuition

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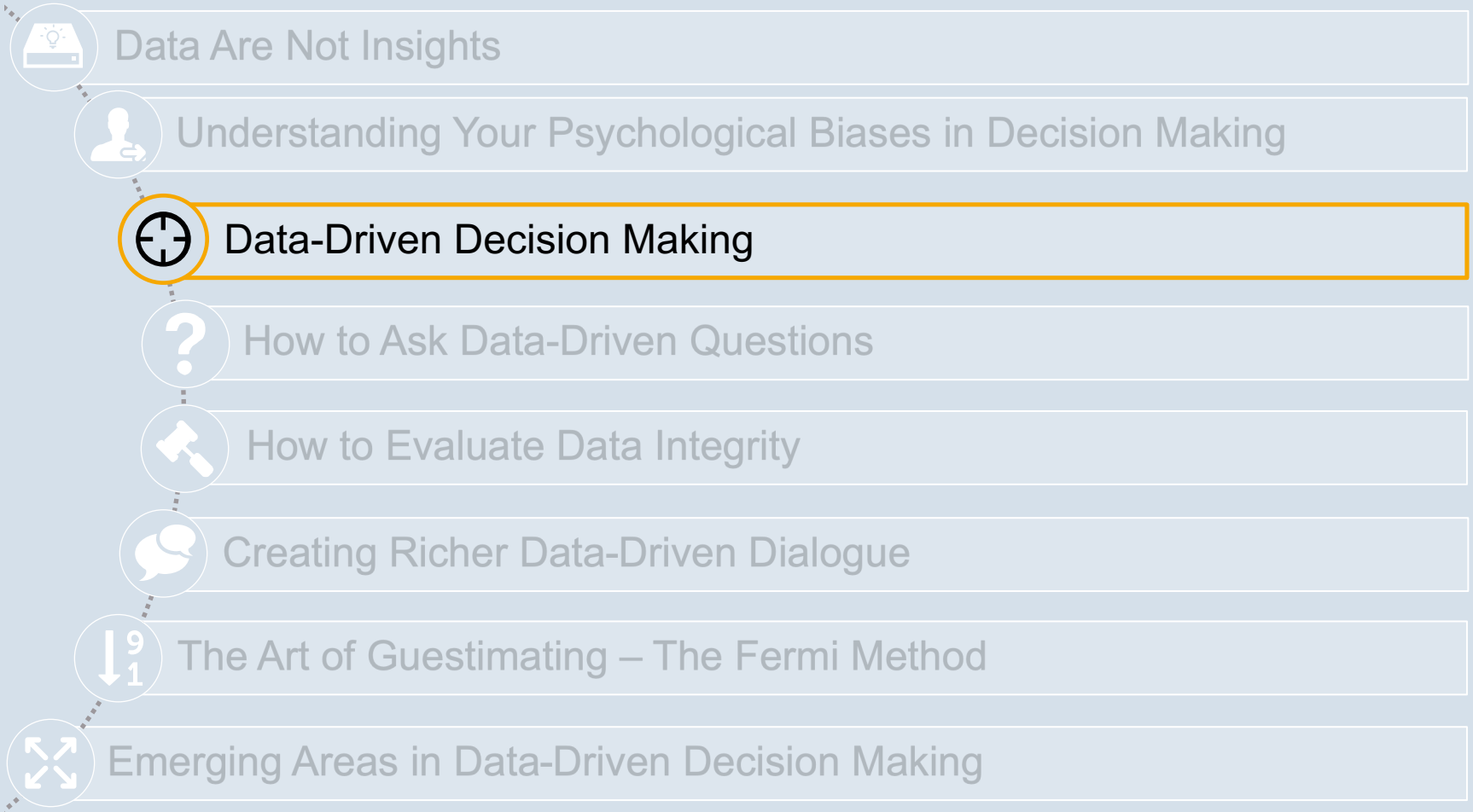

What is Data-Driven Decision Making (DDDM)

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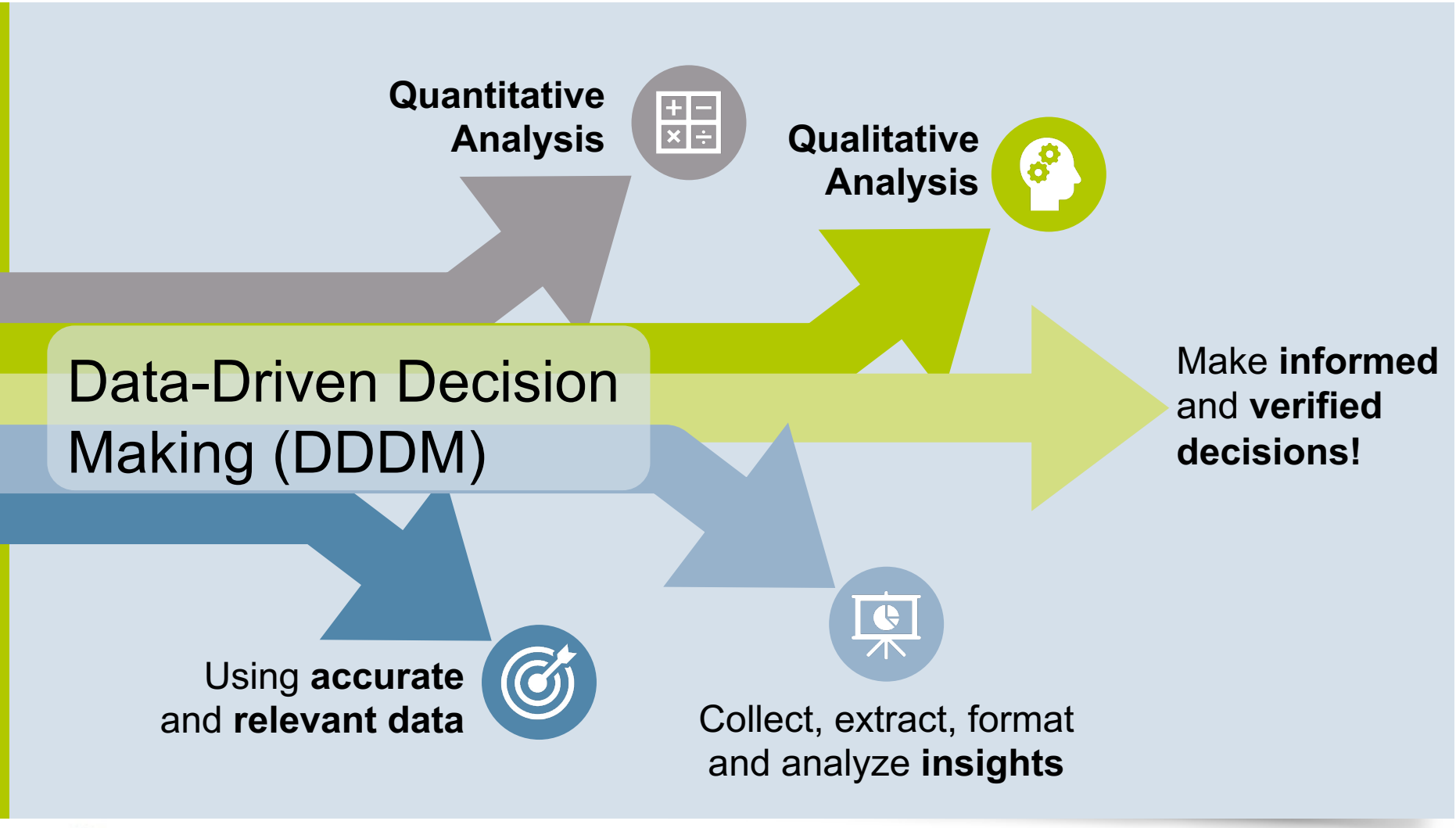
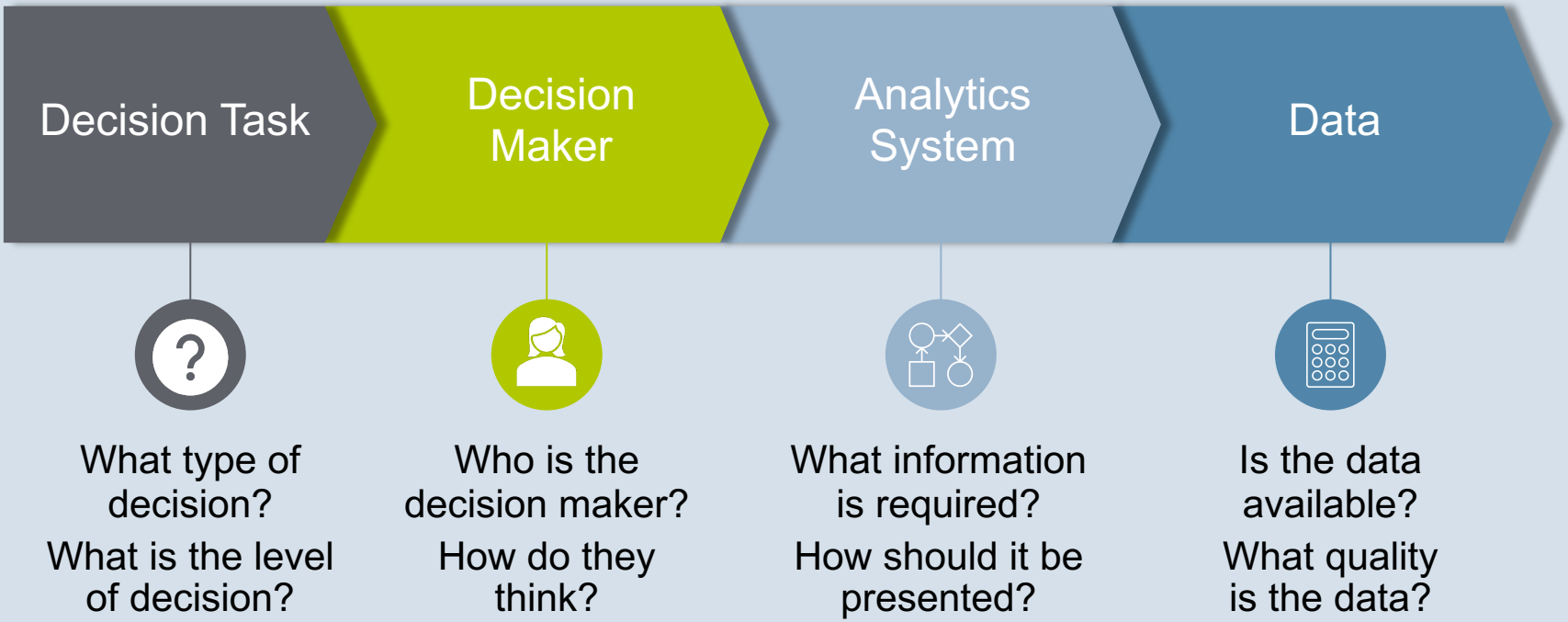


Why Data-Driven Decision Making Is Important?

The Decision-Centric Approach



14 Tips & Takeaways For An Enhanced Data-Driven Decision Making Strategy

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Data Driven Decision Making Mistakes You Should Avoid

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01

Quality of the data

- Data should fit its intended use
- Collecting and gathering are only good if well managed

02

Over-Reliance on past experience

- Environments and markets change
- Crises are becoming more complex

03

Going with your gut and cooking the data

- Making decisions with your gut
- Searching for data to confirm the decision

04

Cognitive biases

- Confirmation bias
- Over-confidence
- …

Successful Data-Driven Decision Making Example: Google

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Question: Does having a manager actually matter?

- Looked at managers' performance reviews
- Conducted various analyses
- Researched behaviors of good managers

Google

› https://upload.wikimedia.org/wikipedia/commons/4/4a/Logo_2013_Google.png
› https://www.leadingedgegroup.com/hubfs/2909513/Managers.jpg

Successful Data-Driven Decision Making Example: Walmart

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Question: What do consumers buy before a hurricane?

- Reviewed purchasing behavior during last hurricane
- Adapted their product portfolio
- Generated profit

Walmart

› https://www.designtagebuch.de/wp-content/uploads/mediathek//2008/07/wal-mart-logo.png
› https://i5.walmartimages.com/asr/c1db639e-93e9-4447-ac1c-1ae65217518f.5e595d9afe36b30684c01fe8eed45532.jpeg
› https://media.istockphoto.com/photos/six-pack-of-brown-beer-bottles-in-blank-carrier-3d-render-isolated-picture-id949611712?k=20&m=949611712&s=612x612&w=0&h=hTOwKA720ELH23CGjMUbgr5h6bdC77G3Ek7AADLkrvk=

Successful Data-Driven Decision Making Example: Southwest Airlines

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Question: Which customers should we target?

- Observe consumer behavior
- Segment customers
- Target specific customers

› https://logotaglines.com/wp-content/uploads/2022/01/Southwest-Airlines-Logo-Tagline-Slogan-Founder-Owner-Motto-480x480.jpg

› https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQpGd3EXeoj21HY86II2LD6DxMJ5tx9zkXydw&usqp=CAU

The Role of Dashboards for Data Driven Decisions

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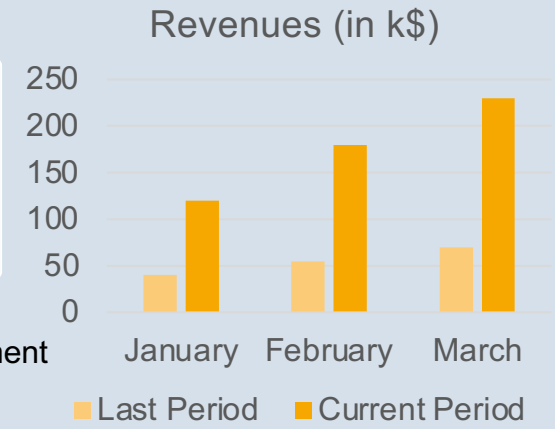
Executive Management

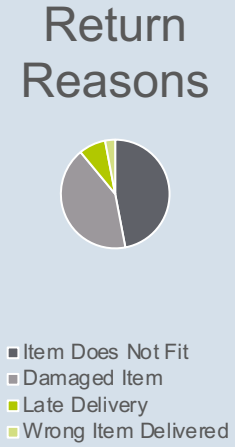
€ 557.185 Actual Revenue

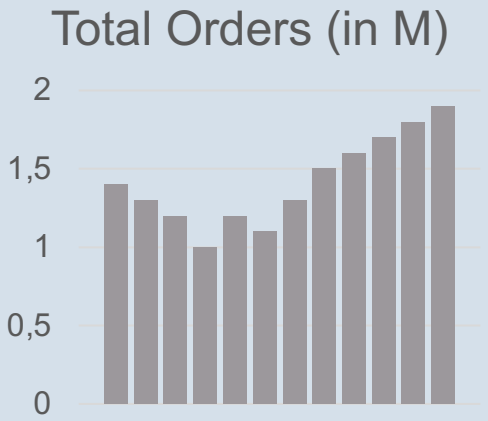
€ 471.360 Target Revenue

118% Target Achievement



Retail





Finance

Current Assets	$129,000
Cash	$34,000
Accounts Receivable	$59,000
Inventory	$31,000
Pre-Paid Expenses	$5,000

Sales

NUMBER OF SALES
115
- 4% +5%

PROFIT
$39,709
- 1% -11%

REVENUE
$150,009
- 9% -4%

COST
$110,300
- 12% -1%

Data Literacy & Data Intuition

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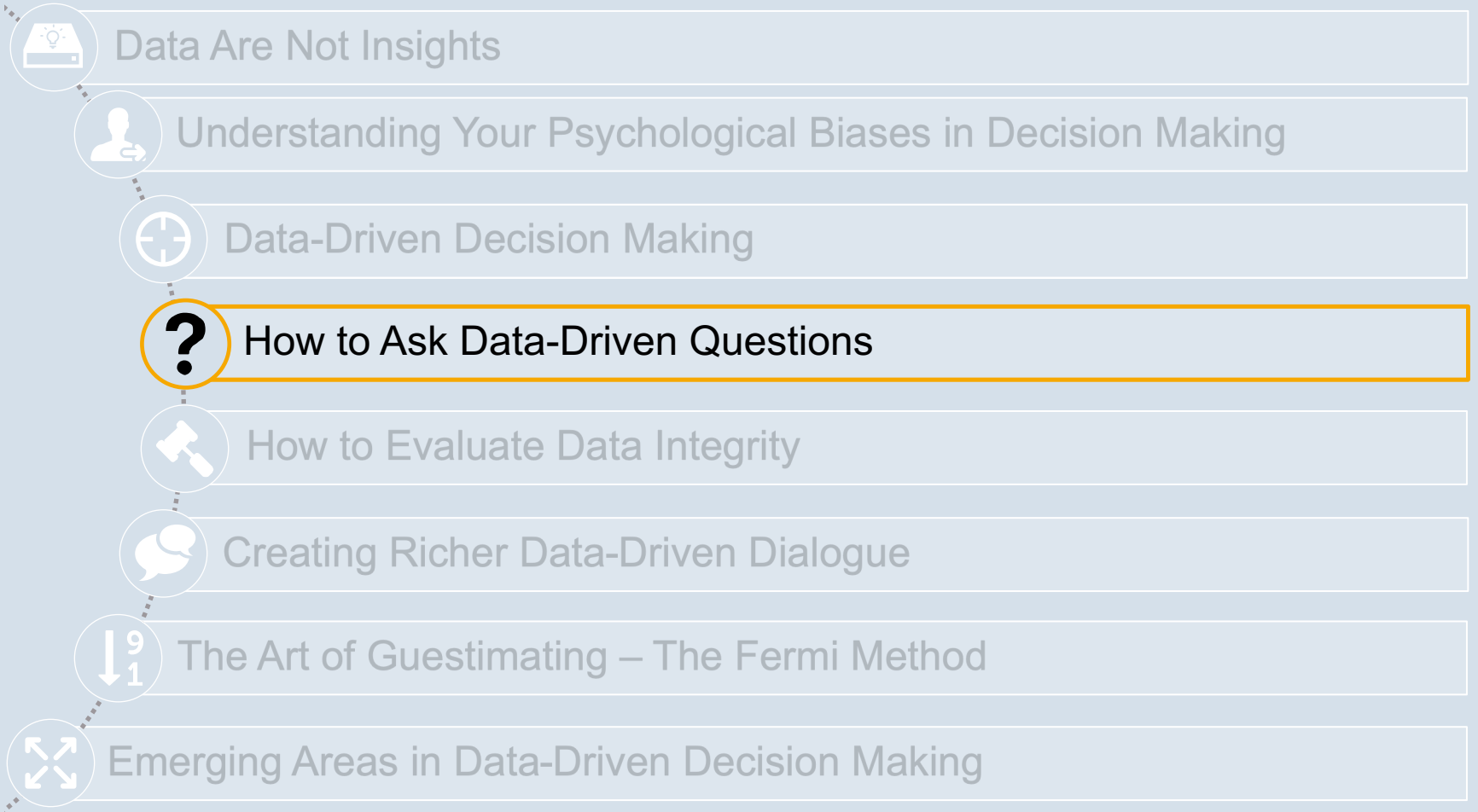

What makes a great data-driven question?

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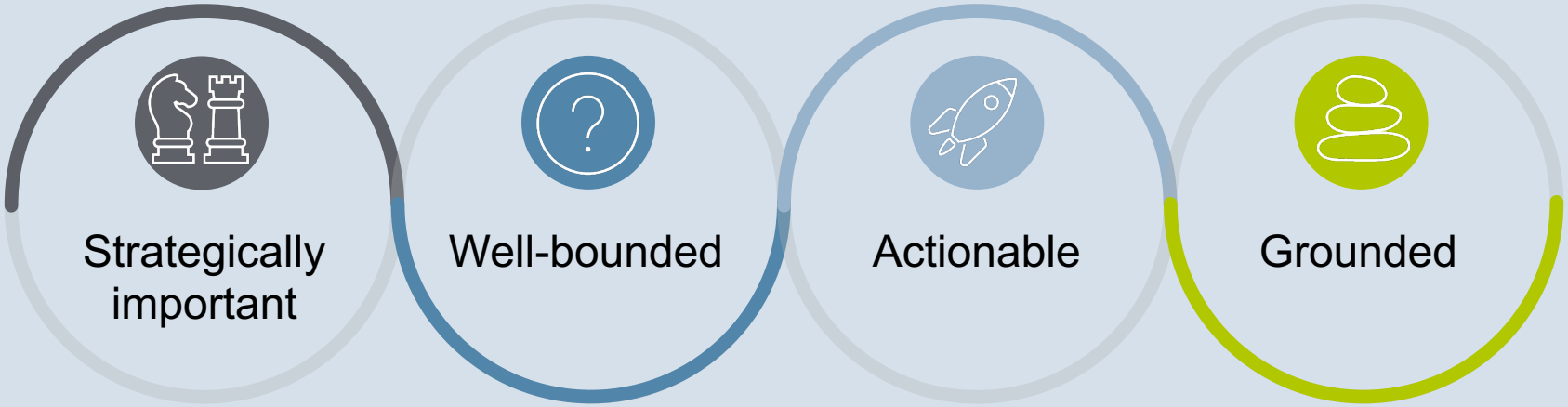
The **quality** of **analytical output** can be vastly improved by asking the right questions at the outset of a project. These should be:



How to prioritize data-driven questions?

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What is often considered:

What you should consider:

Stakeholder Enthusiasm

Time Horizon

Data Analysis Questions to Improve Your Business Performance

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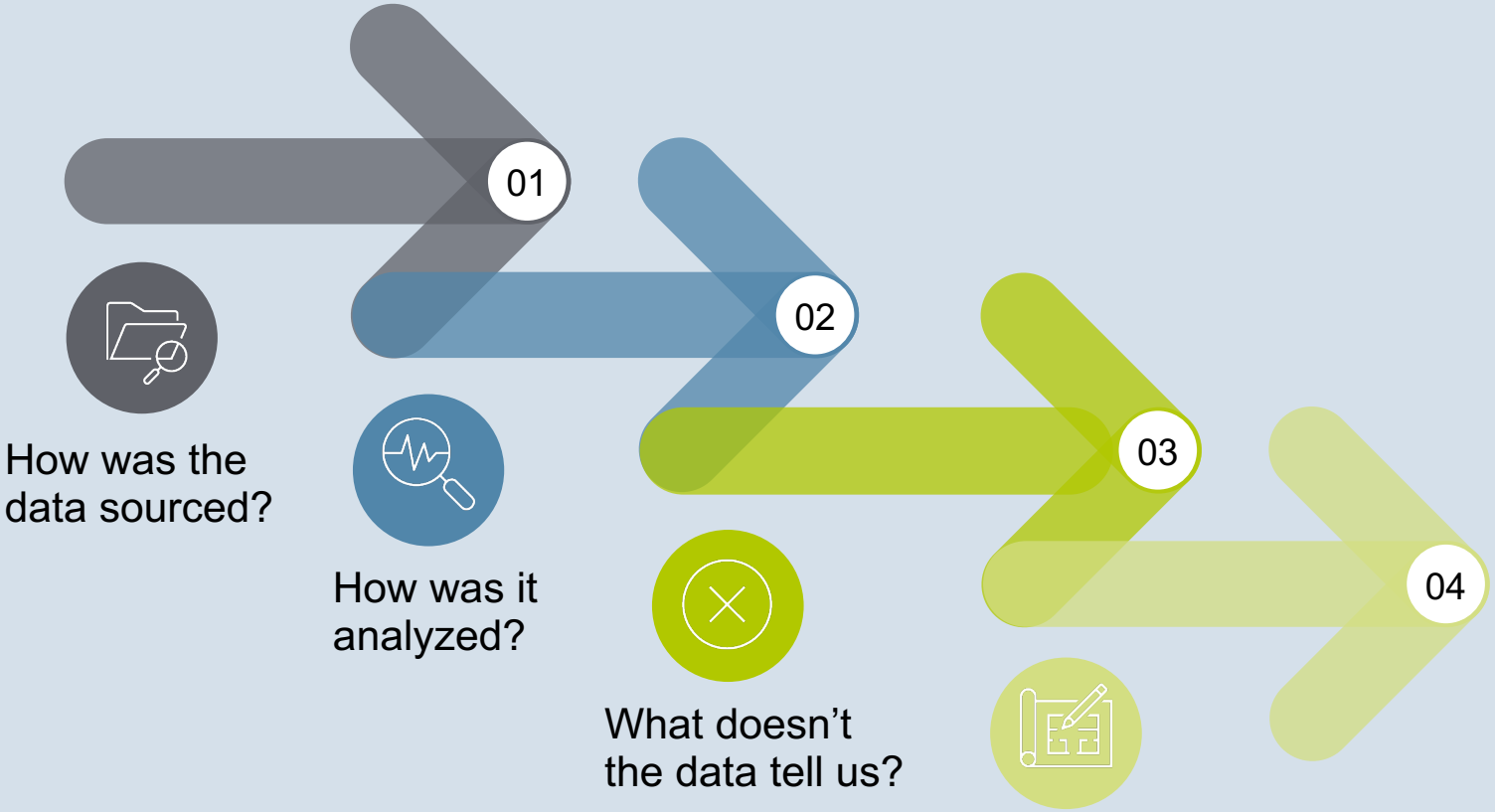
https://www.datapine.com/blog/data-analysis-questions/

Data-driven decisions – Start with these questions



Data Literacy & Data Intuition

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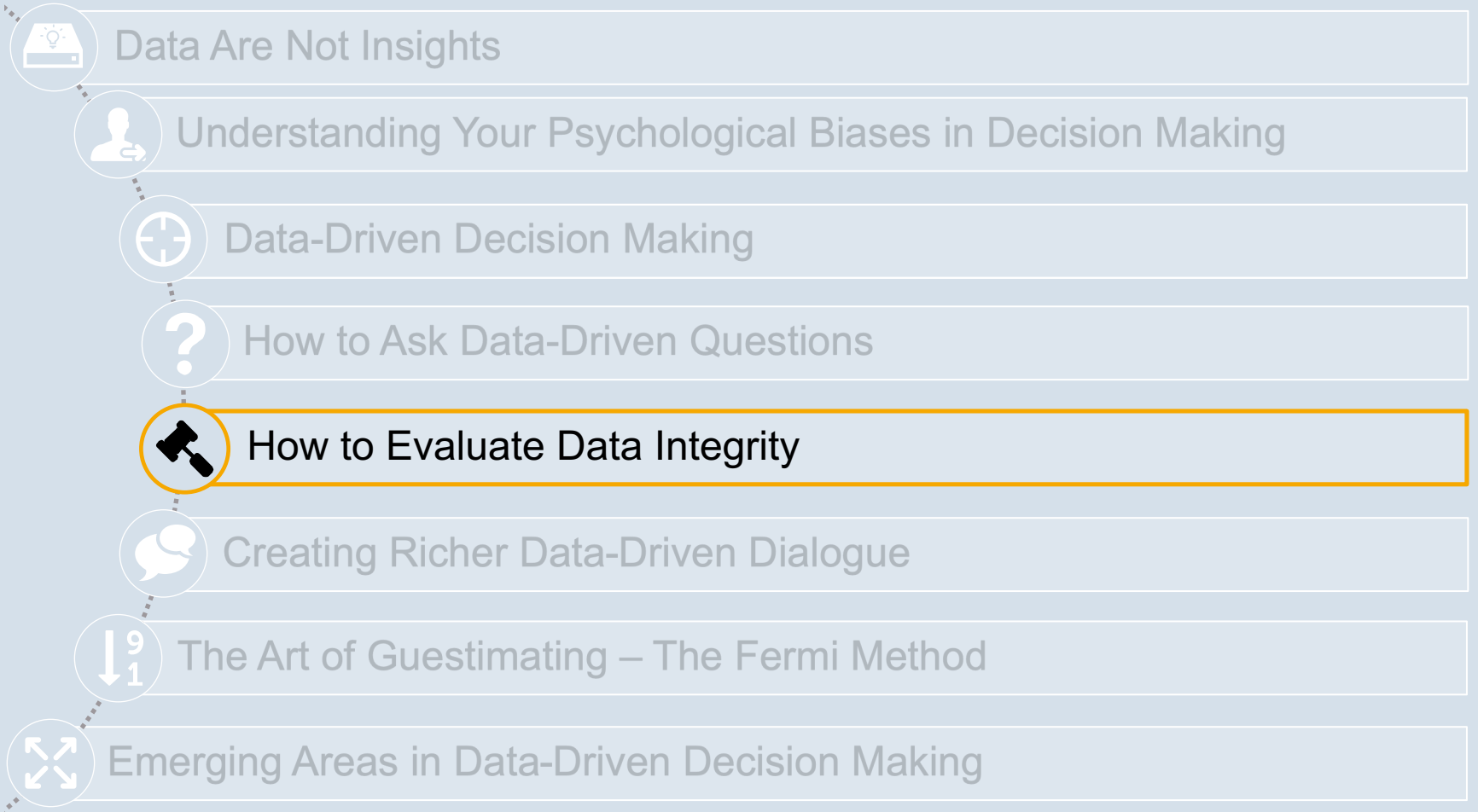
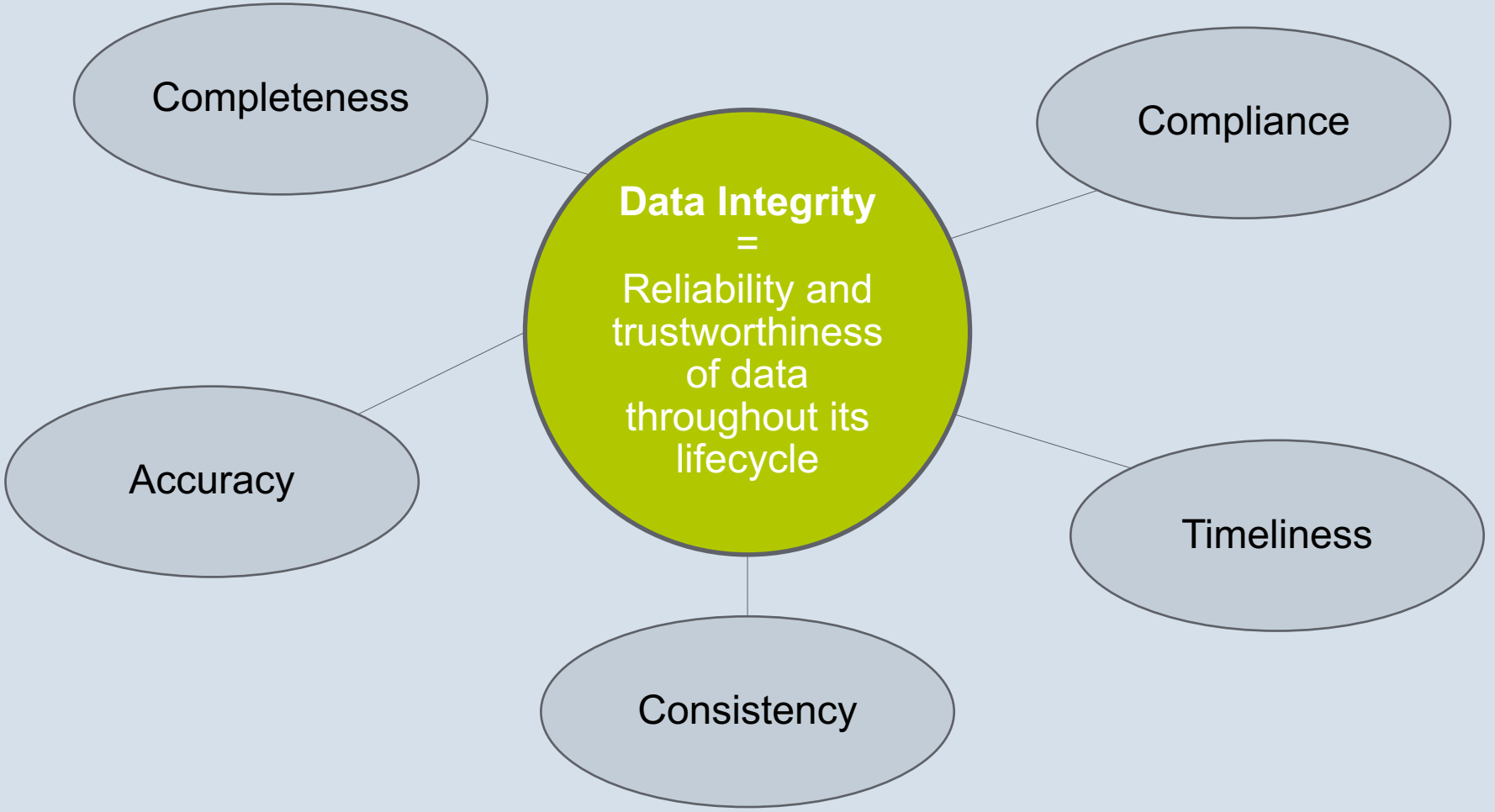
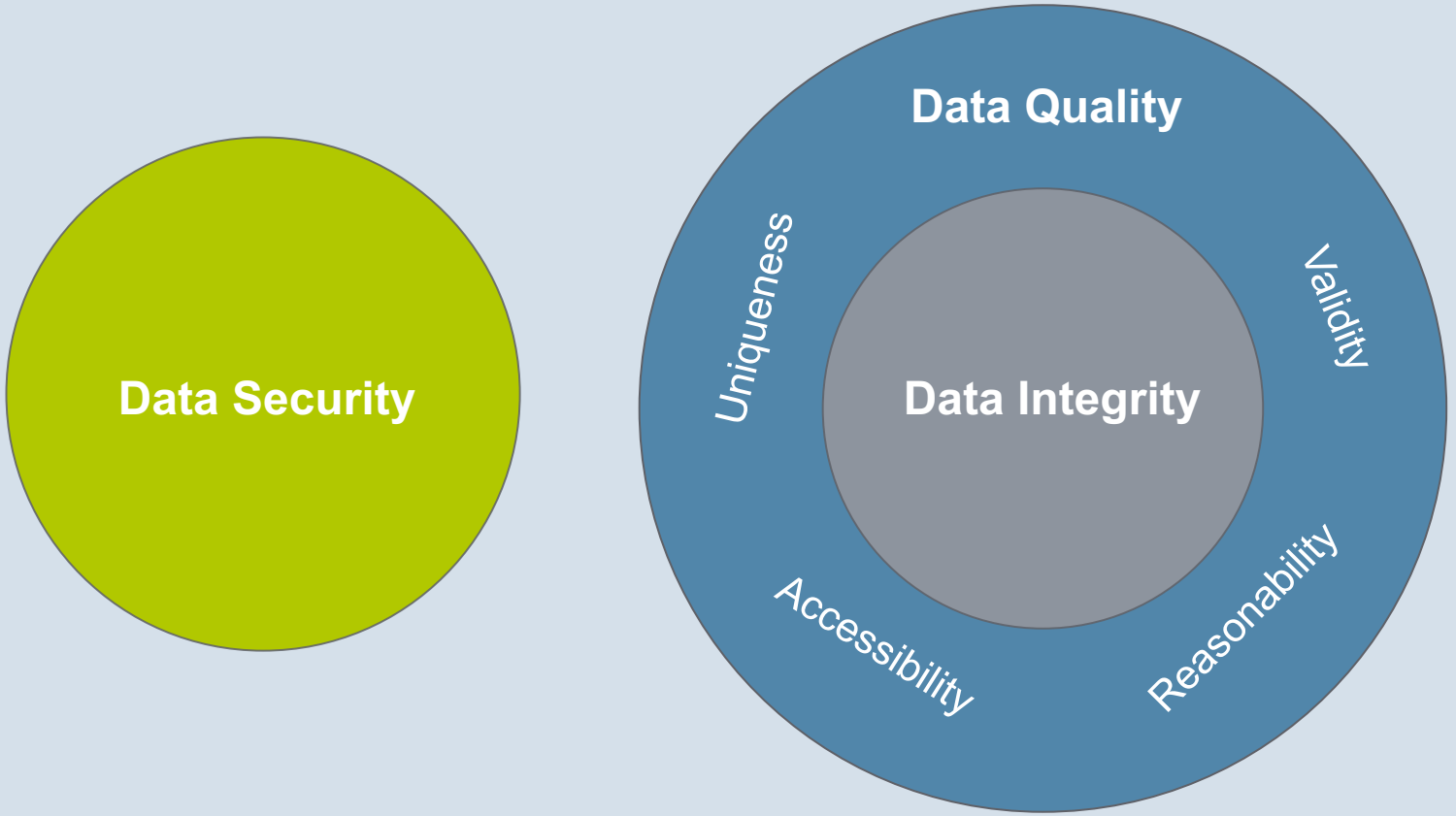


What is Data Integrity?

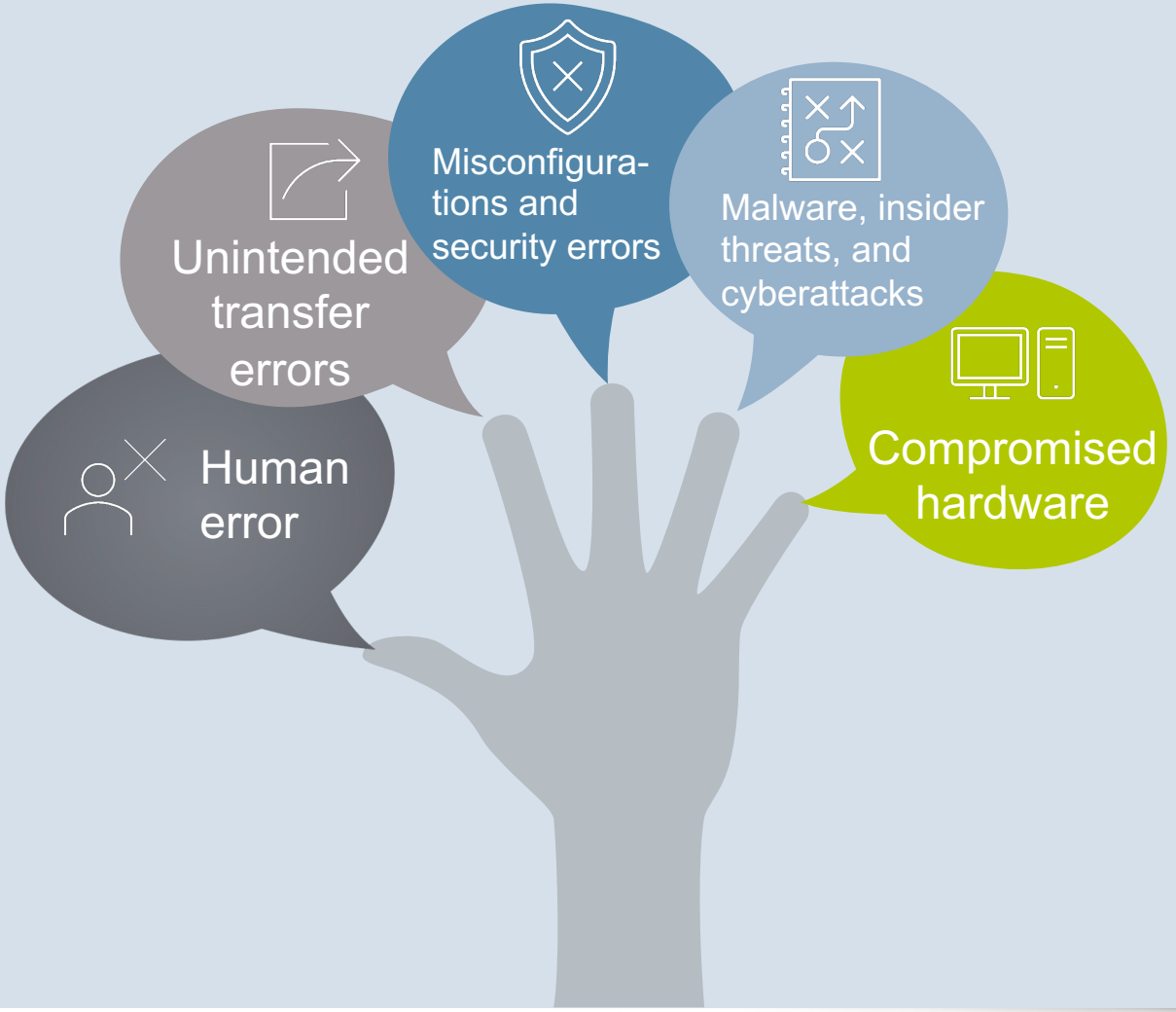
What is Data Integrity?



Data Integrity vs Data Quality vs Data Security



Threats to Data Integrity



How to Evaluate Data Integrity

How to Preserve Data Integrity

Data Literacy & Data Intuition

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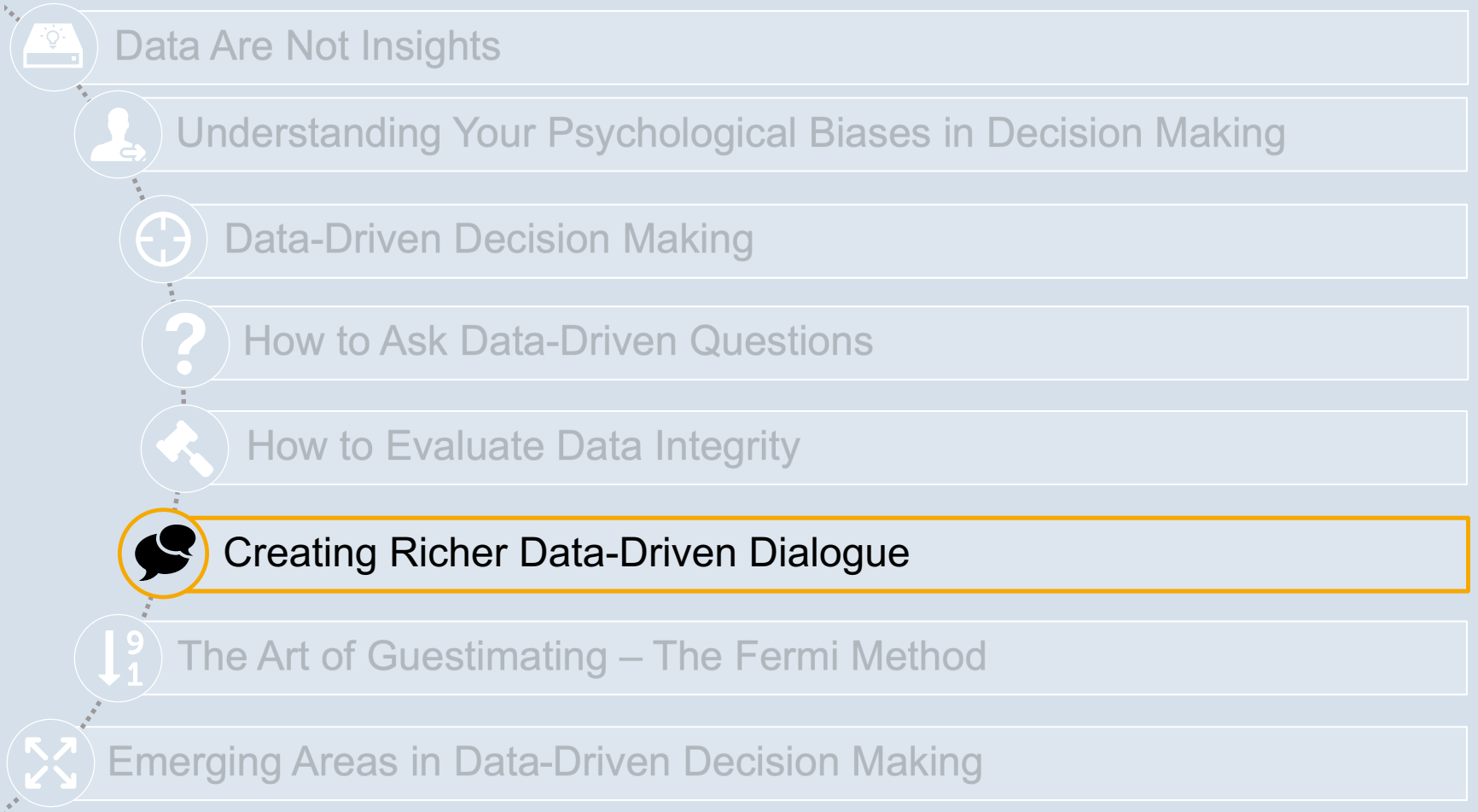
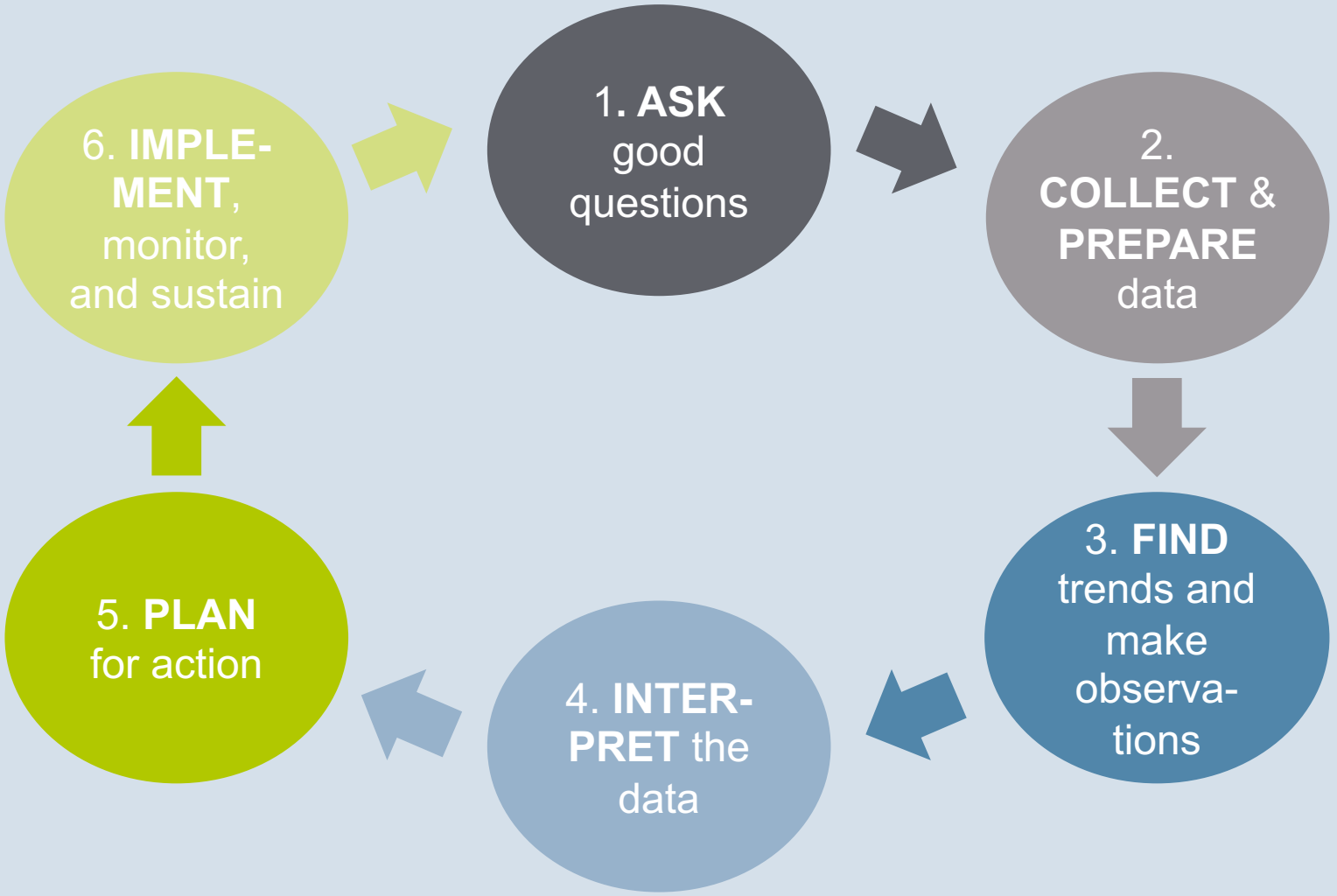


Data Driven Dialogue – an Overview



Data Driven Dialogue – What is Needed?

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The Three Phases of Data Driven Dialogue

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Phase I – Predictions

- Surfacing assumptions
- Making predictions
- …

Phase II – Observations

- Engage with actual data
- Note only the facts

Phase III – Inferences

- Generate explanations for your observations

Data-Driven Dialogue – Phase 1

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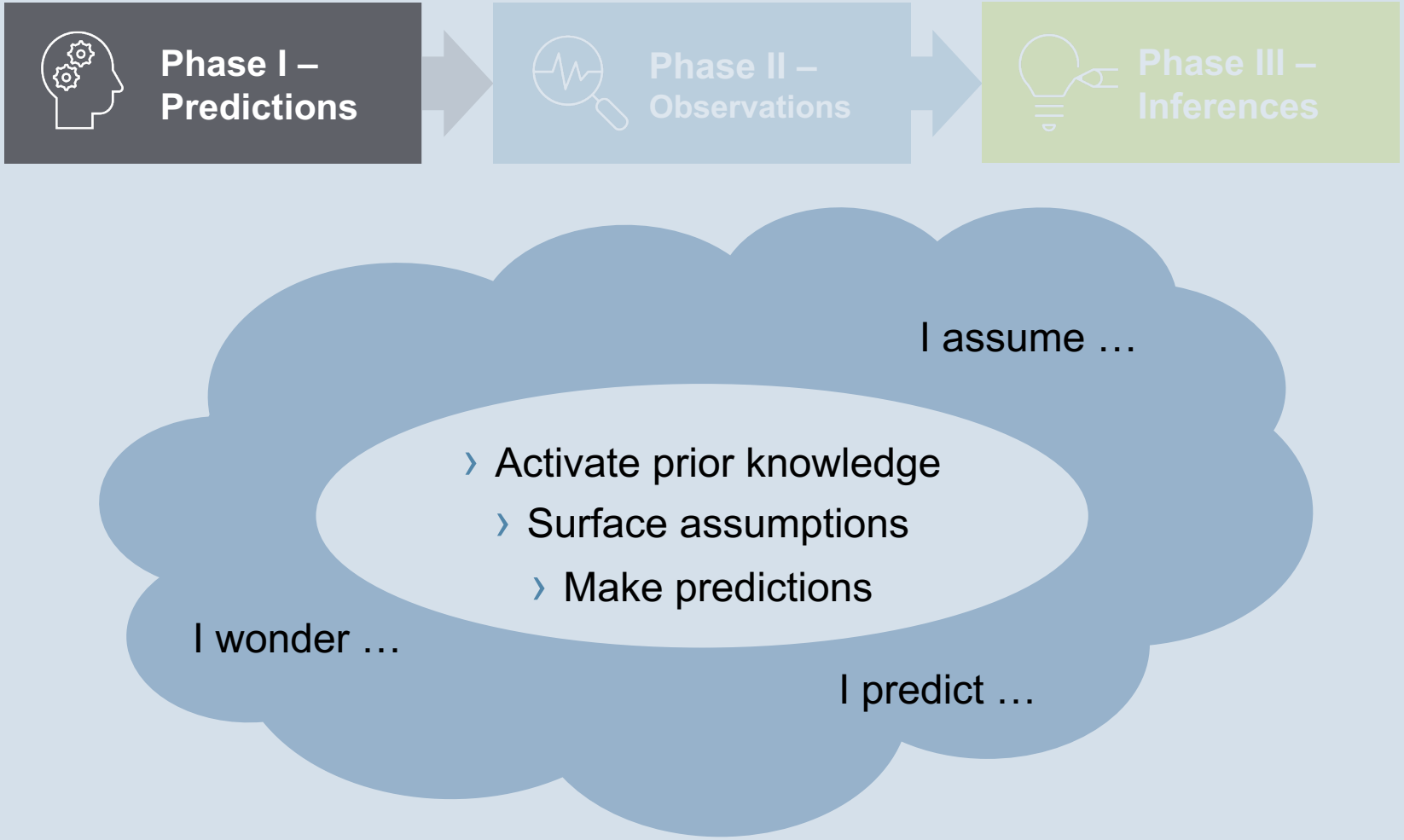

Data-Driven Dialogue – Phase 2

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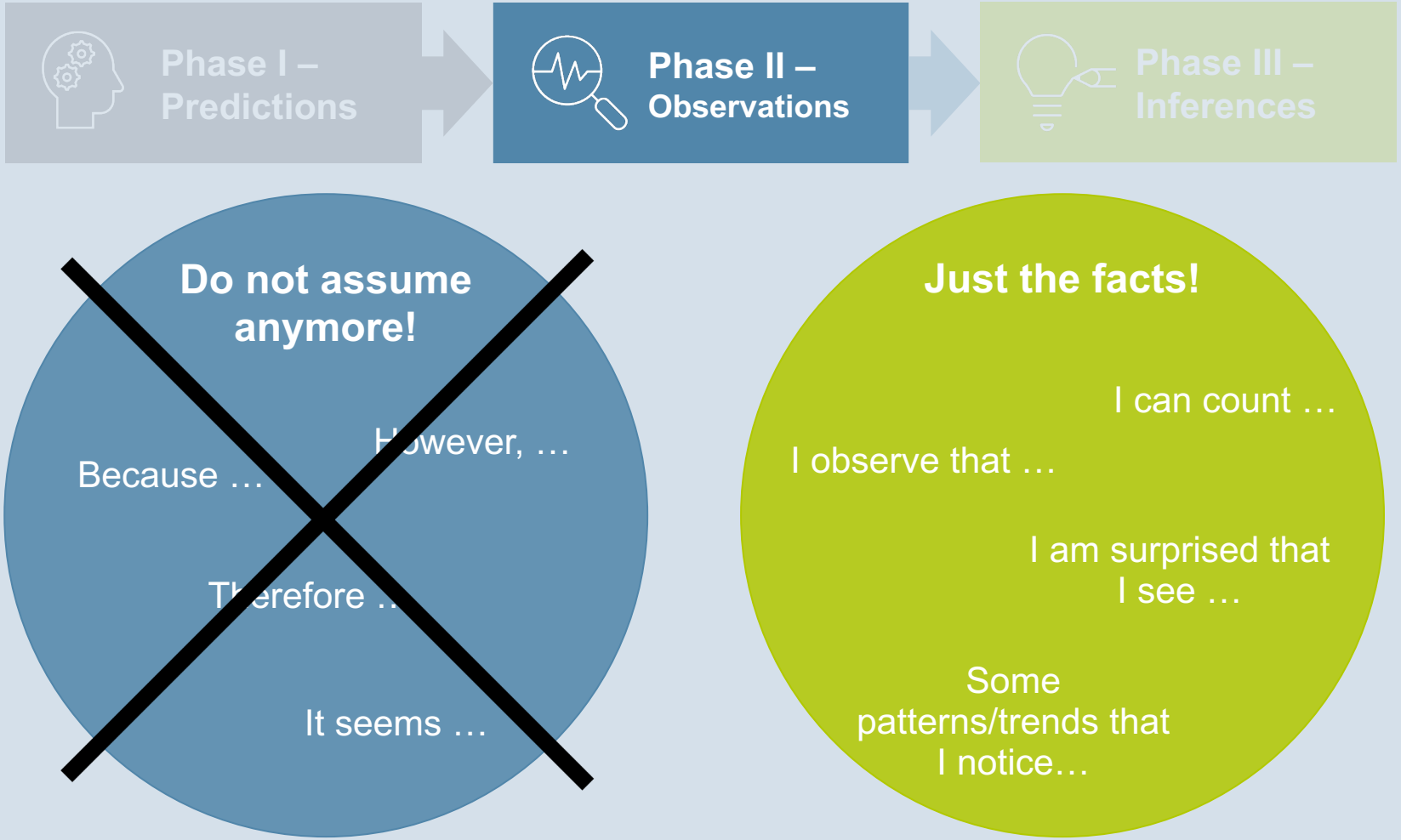

Data-Driven Dialogue – Phase 3

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Phase I – Predictions

Phase II – Observations

Phase III – Inferences

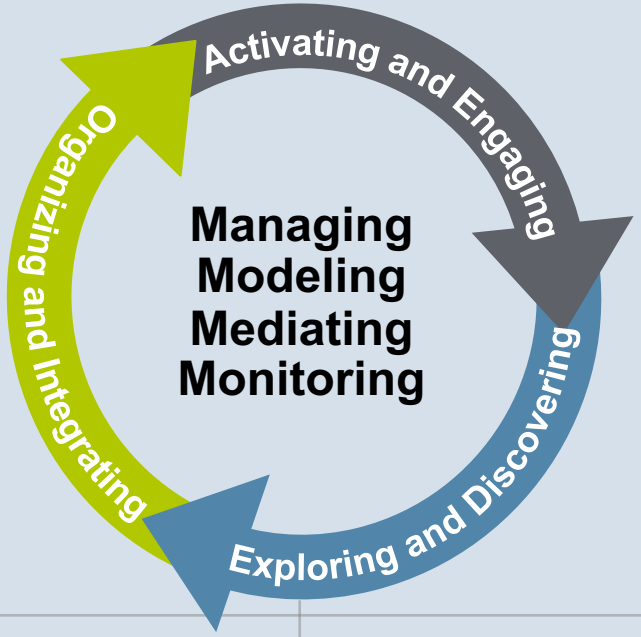
Generate multiple **explanations** for your observations

Identify additional data to **confirm or contradict** your explanations

Propose **solutions/responses**

Identify data needed to **monitor implementation** of your solutions/responses

The Collaborative Learning Cycle



Activating and Engaging

Surfacing experiences and expectations

Exploring and Discovering

Analyzing the data

Organizing and Integrating

Generating theory

The Collaborative Learning Cycle – Phase 1: Activating and Engaging

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Tips for success:

Distinguish between predictions and assumptions.

Develop predictions and related assumptions concurrently.

Record predictions and their related assumptions.

Record predictions on a facsimile of the data display.

If group members do not agree on their predictions or assumptions, record more than one set of predictions and their related assumptions.

The Collaborative Learning Cycle – Phase 2: Exploring and Discovering

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Tips for success:

Provide time to orient to the data displays before talking.

Develop a sequence for exploration and designate a starting point.

Apply structures and protocols to balance participation.

Establish a public recording protocol.

Chart observations in language that is concise and specific.

The Collaborative Learning Cycle – Phase 3: Organizing and Integrating

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Tips for success:

Study success.

Generate multiple theories of causation.

Seek calibrating data that are in existing archives.

Generate multiple theories of solution.

Make sure goals are clear and measurable.

Data Literacy & Data Intuition

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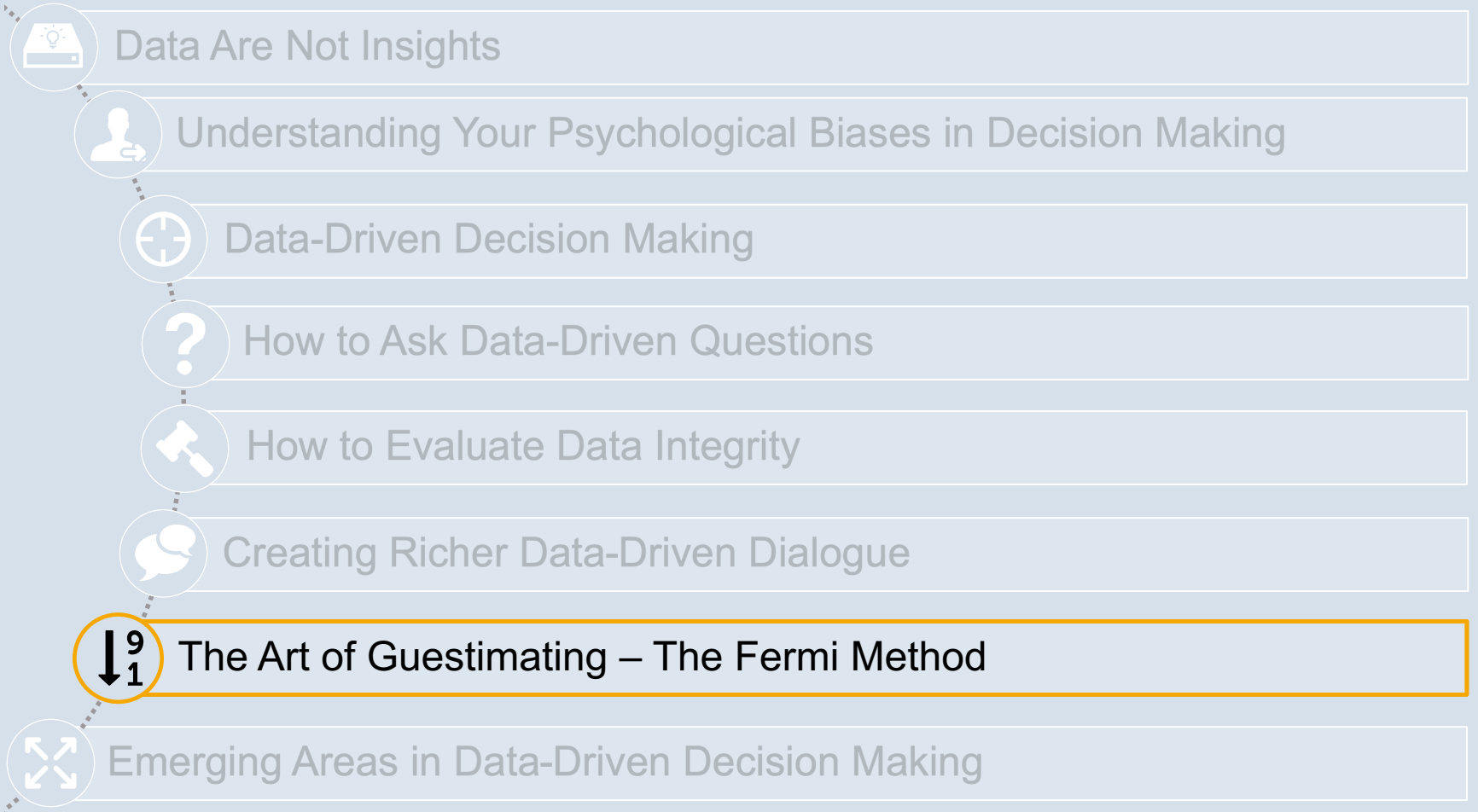

Enrico Fermi and the Fermi-problems

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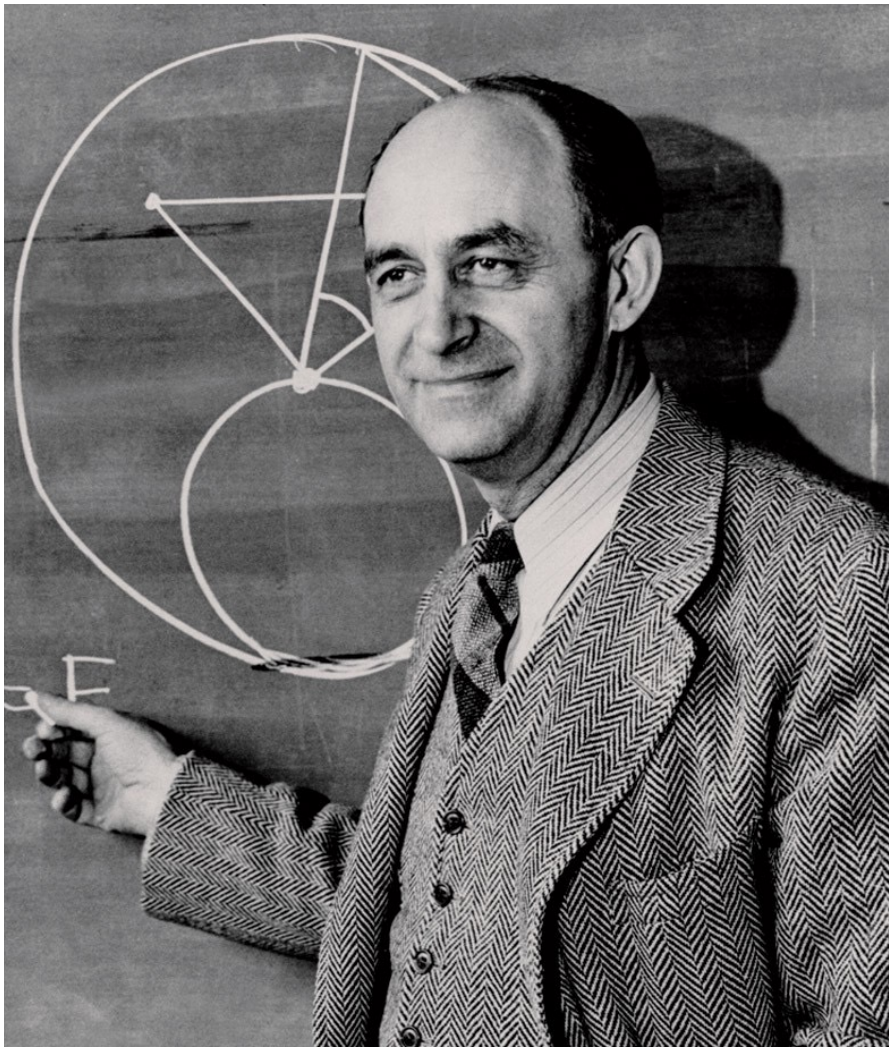
Enrico Fermi

- Italian-American physicist
- Creator of the world's largest first nuclear reactor
- Known for his **ability to make good approximate calculations with little or no actual data**

Fermi problems

- Making **justified guesses** about **quantities** and their **variance** or **lower and upper bounds**



https://miro.medium.com/max/1400/1*MmJMUjQsTPFGMyPDCtxyBg.jpeg

“How many piano tuners are there in Chicago?” – a Fermi Problem

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We make the following **assumptions/estimations:**

Approximately **5,000,000** people living in **Chicago**.

On average, **two persons** in each household in **Chicago**.

Roughly **one household in twenty** has a piano that is tuned regularly.

Pianos are tuned on average about **once per year**.

It takes a piano tuner about **two hours** to tune a piano

Each piano tuner works **eight hours** in a day, **five days** in a week, and **50 weeks** in a year.

“How many piano tuners are there in Chicago?” – a Fermi Problem

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Number of pianos tunings in Chicago in a single year:

(5,000,000 persons in Chicago) / (2 persons/household) × (1 piano/20 household) × (1 piano tuning per piano per year)
= 125,000 piano tunings per year in Chicago.

The average piano tuner performs:

(50 weeks/year)×(5 days/week)×(8 hours/day)×(1 piano tuning per 2 hours per piano tuner)
= 1000 piano tunings per year per piano tuner.

This gives us:

(125,000 piano tuning per year in Chicago) / (1000 piano tunings per year per piano tuner)
= 125 piano tuners in Chicago.

„How many hairs are present on your head?“ – a Fermi Problem

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150 hairs per **square cm**

50% of our head is **covered** with hear

Radius (head) ~ 10 cm
- 0.5 * (4*π*r^2) = 200* π = 628 cm^2

Calculation:
- 628 * 150 = 94,200

The Fermi Method – How Does It Work?

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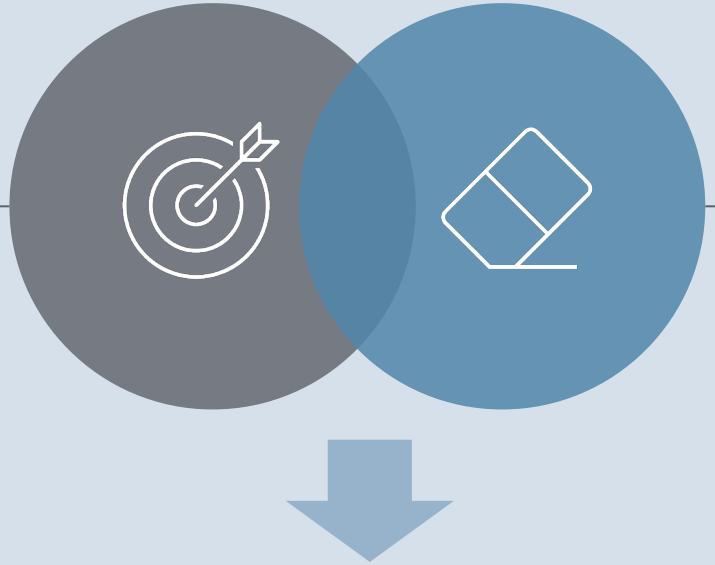
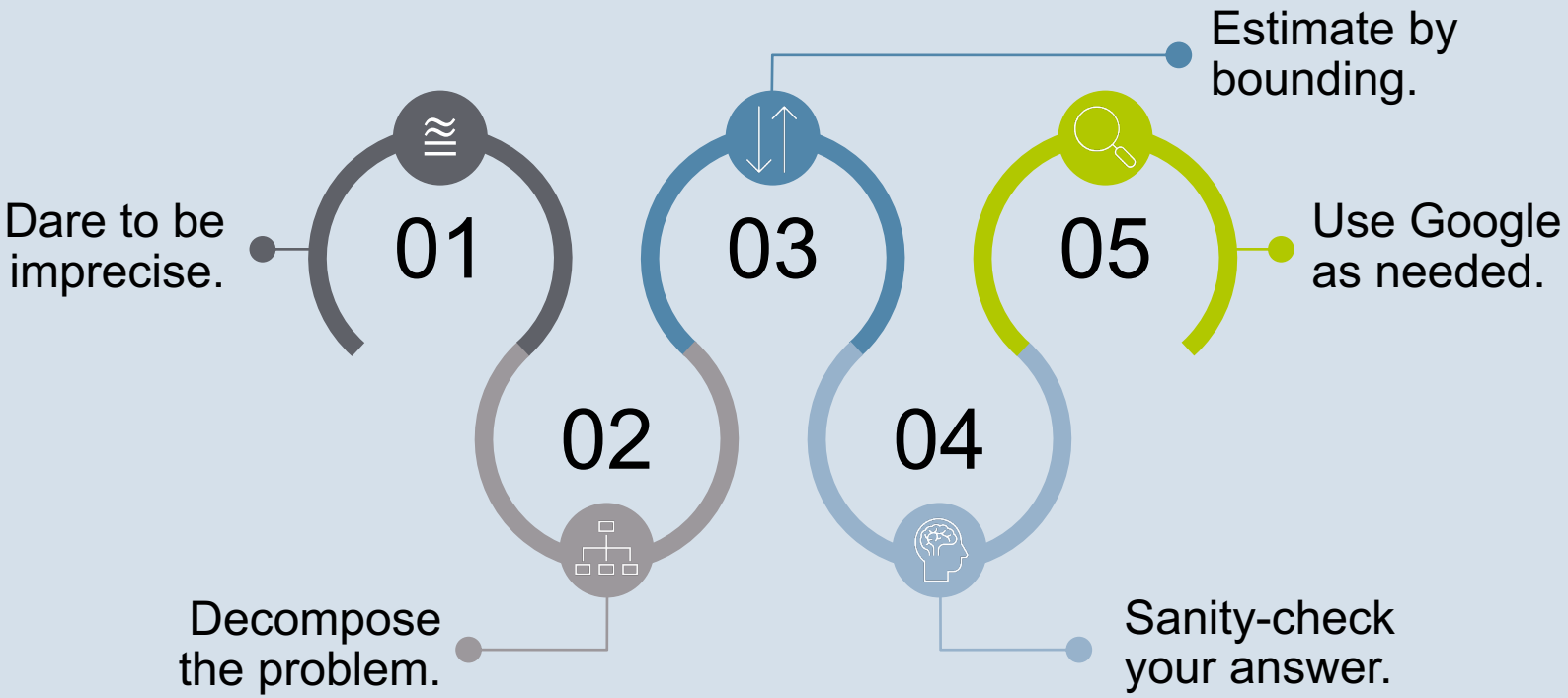
Estimations of individual terms are often **close to correct.**



Overestimates and underestimates **cancel each other out**.

There is **no consistent bias.**

The Fermi Method – Estimation Tips



The Fermi Method – Estimation Tips: Estimate by Bounding (Example)

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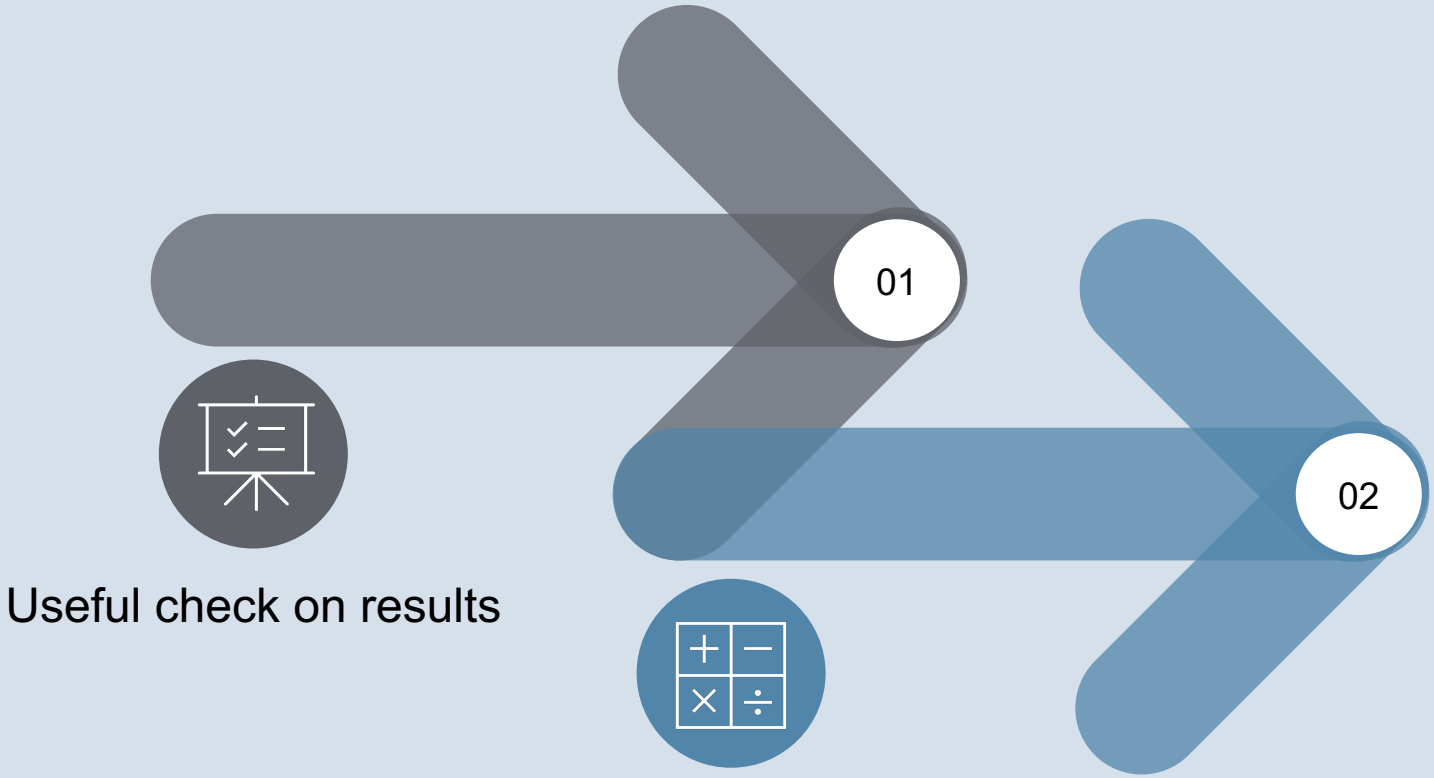
How much time per day does the average 15-year-old watch TV?

- Rough estimation: Between 2 minutes and 400 minutes
- Use the **approximate geometric mean (AGM)** (approximate square root of the product of the upper and lower bounds)
- What is the AGM of 2 and 400?
  - → $2 = 2 \times 10^0$ and $400 = 4 \times 10^2$
  - Average of the coefficients (2 and 4) is 3
  - Average of exponents is (0 and 2) 1
  - **AGM = $3 \times 10^1 = 30$** *(precise geometric mean 28.28)*

If the sum of exponents is an odd number: Round the resulting exponent down and multiply the final answer by three.

Fermi Estimation Failure Modes

The Fermi Method – Advantages



„How many new passenger cars are sold each year in the USA?“ - Exercise

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Approach #1: Car dealerships

1 How many new cars does a dealership sell per month?
- More than 5, less than 50
- AGM is 15

2 How many counties are there in the US?
- More than 300, less than 20,000
- AGM is 2,500

3 How many towns of 10,000 people or more are there per county?
- More than 10, less than 5,000
- AGM is 300

4 How many car dealerships are there in cities of 10,000 or more people?
- More than 2, less than 30
- AGM is 7.5

→ (15 x 12) x 7.5 x 300 x 2,500 = 1,012,500,000

?

„How many new passenger cars are sold each year in the USA?“ - Exercise

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Approach #1: Population in the USA

~ 330 million people live in the US

~ 110 million people own cars

Lifetime of a car ~ 15 years
1/15 bought a car in the last year

110 million / 15 = 7.33 million new cars sold

Actual number (Google 2021) = 3.34 million

Data Literacy & Data Intuition

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The Pandemic and Its Effects on Decision Making Processes

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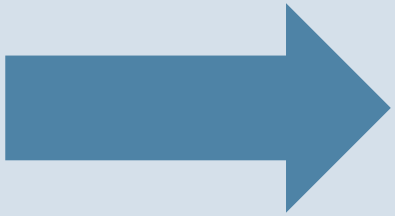
Data-driven decision making is based on…

PAST

Historical data



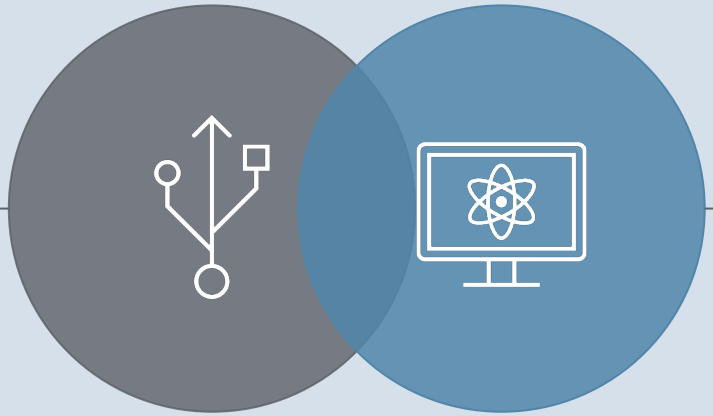
TODAY

“What if” simulations
with more dynamic data
and much less of it

The Pandemic and Its Effects on Decision Making Processes

The viability of organizations adopting these new types of simulation-based tools to make decisions depends on the following characteristics:

How digitally do you operate?



What is your data science capability?

Data-Driven Decision Making – Status Quo

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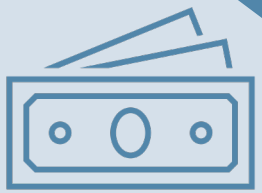
BUSINESSES USING DATA-DRIVEN DECISION-MAKING EXPERIENCED A…

Profit increase of

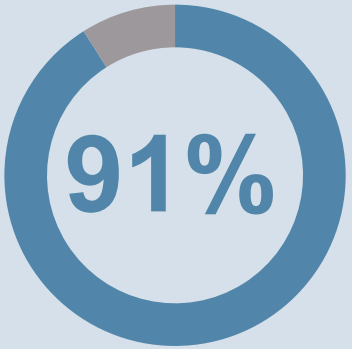
8-10%

10%

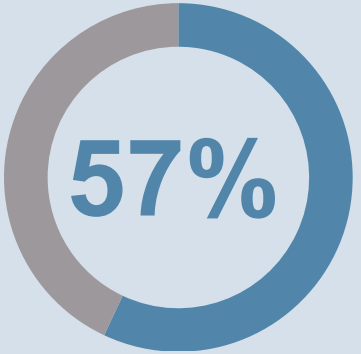
Reduction of overall costs



"DATA-DRIVEN DECISION MAKING IS IMPORTANT TO MY BUSINESS"



"WE ARE USING DATA TO MAKE DECISIONS IN OUR BUSINESS"



https://www.superoffice.com/blog/data-driven-decision-making/

Transforming Your Workforce into Data Professionals

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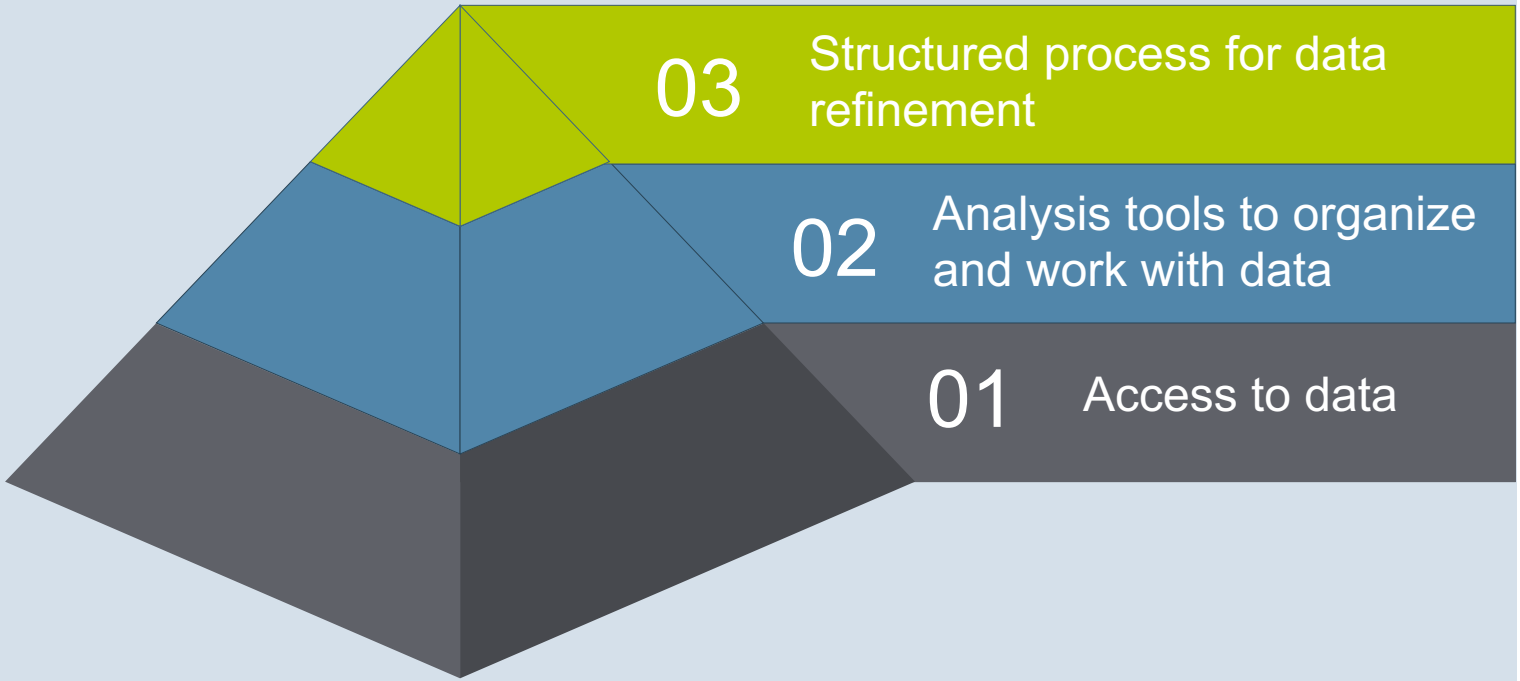
Developing employees into data professionals:



Ways to Integrate Data in Daily Workflows

Data curiosity and regular use by all

Eliminate business and data silos to increase collaboration

Leader-modeled data behaviors that translate to the front lines

Data Curiosity and Regular Use by All

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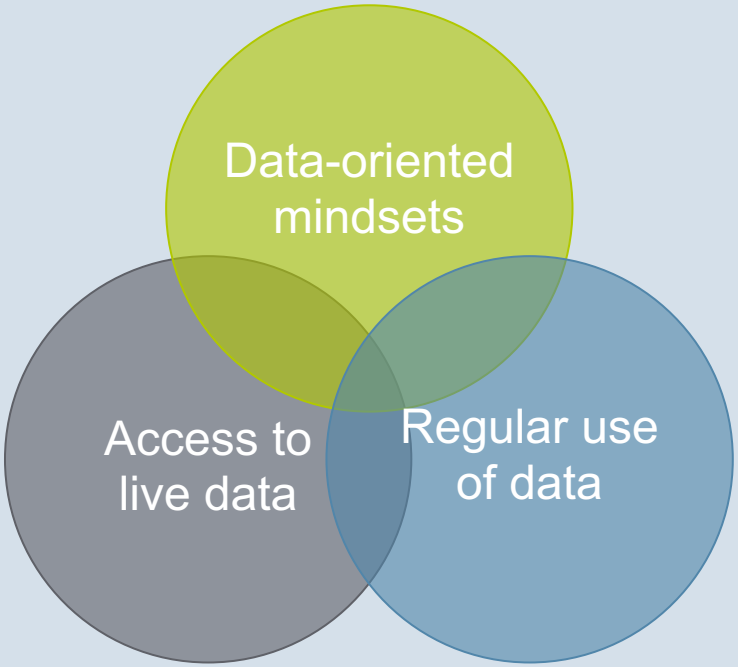

Tips:

- Leaders should commit to using analytics solutions as well
- Establish formal trainings
- Build internal communities
- Support data skills

Eliminate Business and Data Silos to Increase Collaboration

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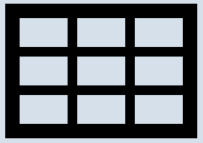
Data just sitting on desktops …



… or in spreadsheets …

… or with data scientists disconnected from the business.

Tips:

- Create governed, self-service data sources
- Build a community of data champions
- Share data in common, accessible spaces

Leader-Modeled Data Behaviors That Translate To The Front Lines

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Make decisions at every level

Intervene with cost-intensive projects

Listen to feedback, communicate with data

Tips:

- Open up data access
- Empower employees with data
- Develop opportunities for customer-focused innovation

How to Navigate the New Normal Using New Data-Driven Approaches

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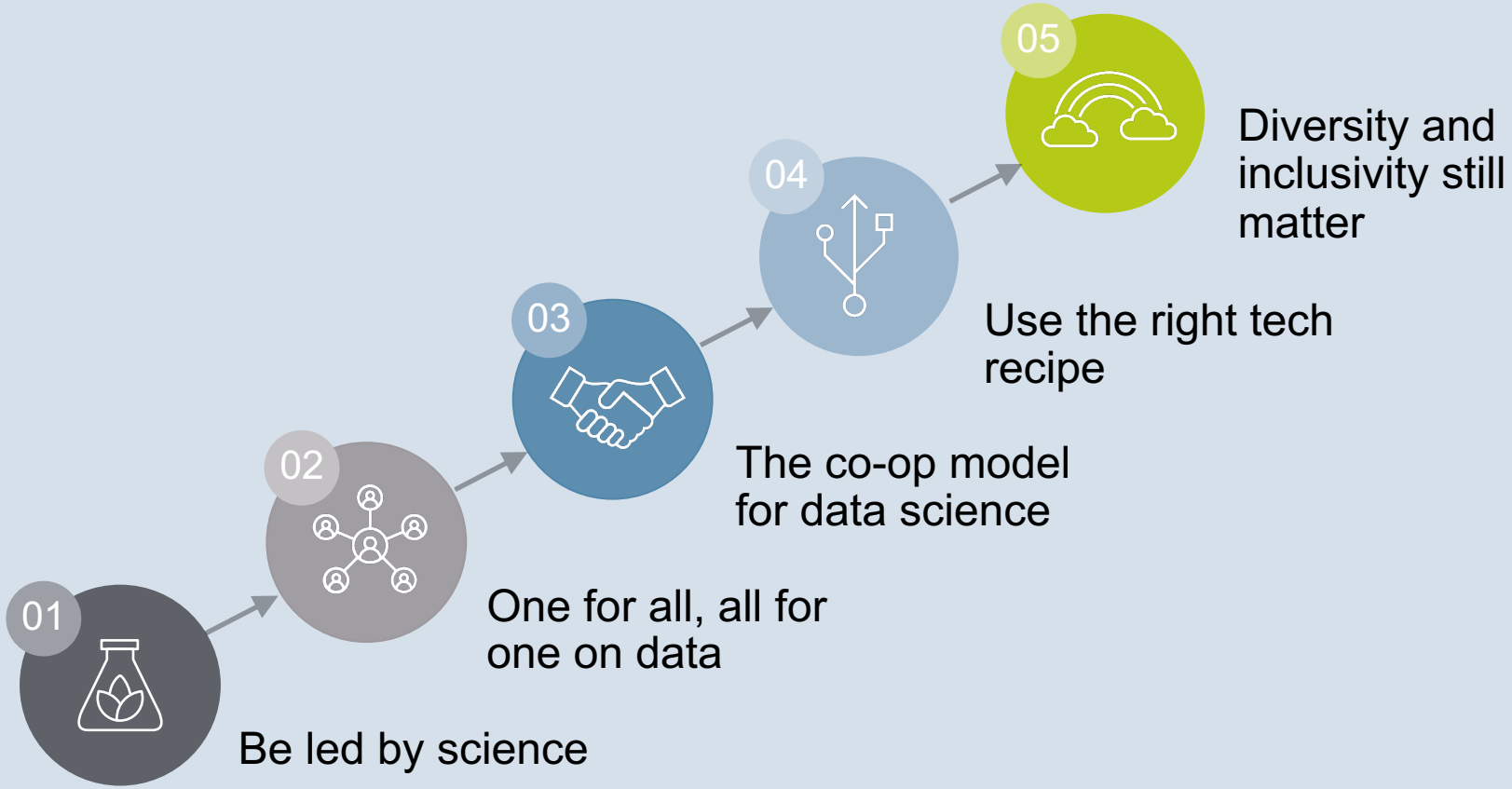

The Shift:
Strategic Influences of a Data Culture

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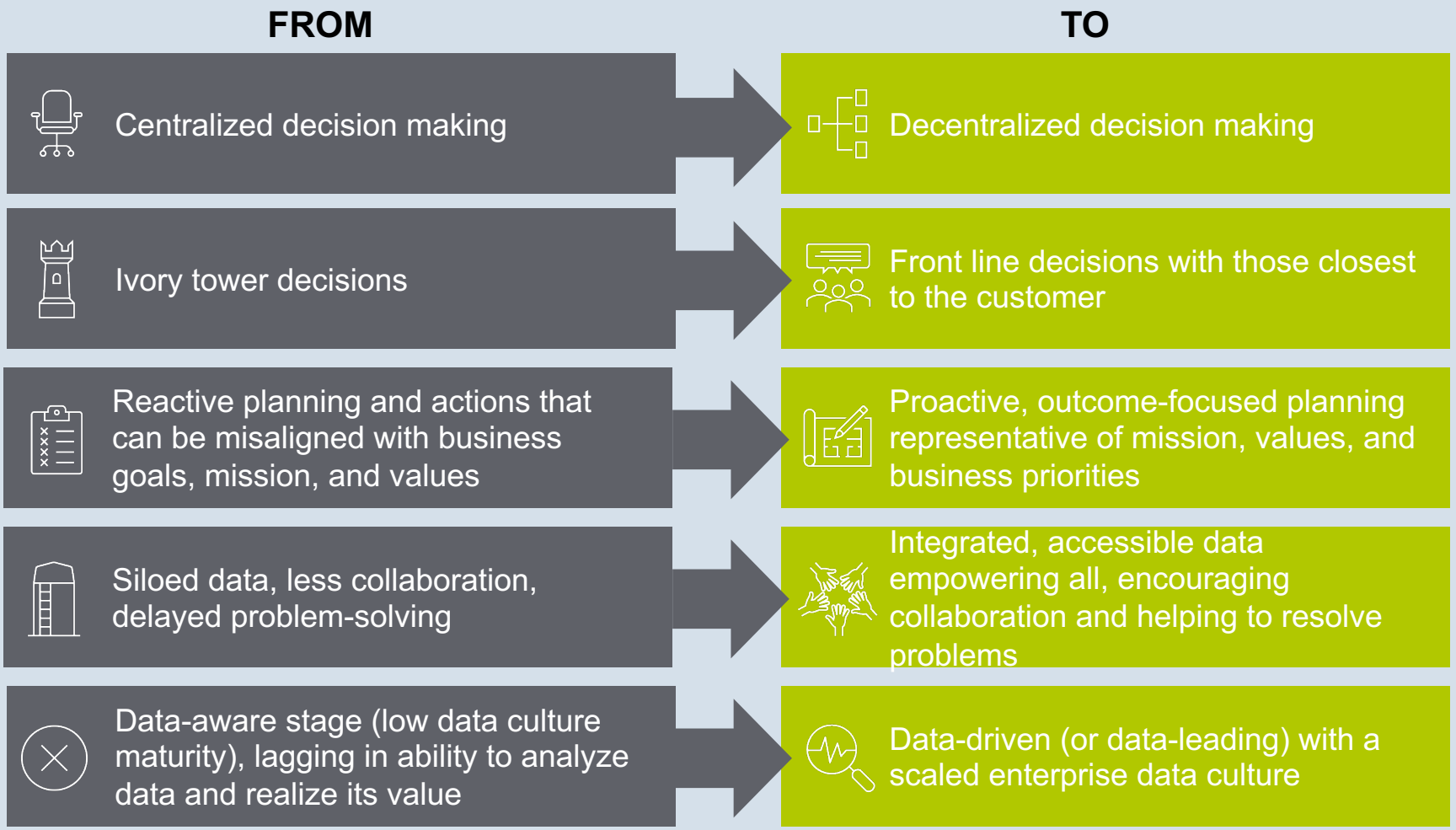

Key Takeaways

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01 Remember that data are not insights!

02 Understand that you are victim to psychological biases!

03 Data-Driven Decision Making is about making informed and verified decisions based on the analysis of accurate and relevant data!

04 Only asking the right, relevant, and actionable questions will create value from your data!

Key Takeaways

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05 Data integrity, so the reliability and trustworthiness of your data throughout time, is key to create value from your data!

06 Create richer data-driven dialogue by first making assumptions, then objectively observing your data and last, building inferences by combining both steps!

07 The Fermi-method is a good way to establish rough estimates when you do not have sufficient data!

08 Only firms who realize that data-driven decision making is the future and establish a data culture in their organization, will be able to be successful!

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