8 Ways We Fail With Predictive Analytics in Business

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Eckerson Group

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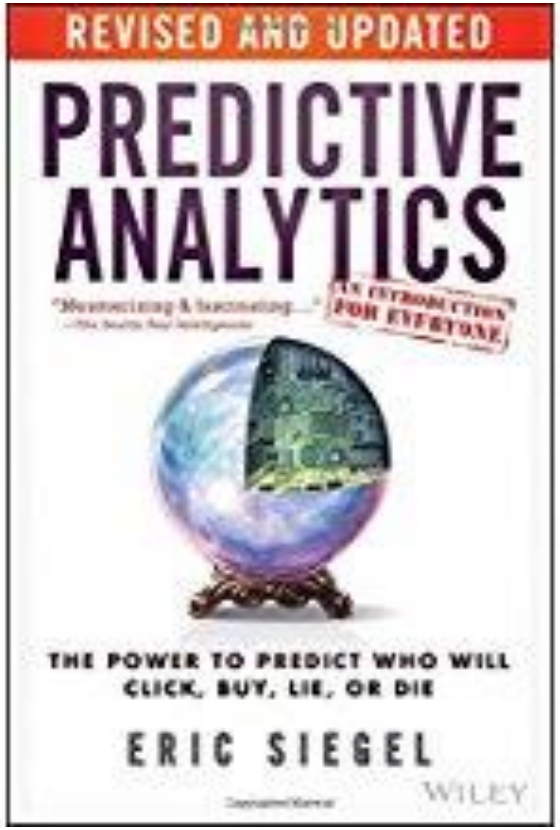
The Promise of Predictive Analytics

- **Best web ad selection**
  - *3.6% more revenue*
  - *$1 million every 19 months*

- **Decreased loss ratio in insurance**
  - *0.5% reduction is loss ratio*
  - *$50 million annually*

Reference: "Predictive Analytics" p.25



Great book!!!

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Research Hypothesis

1. Every business **should be using** predictive analytics

2. Predictive analytics is **not being used** often enough

3. Because it is a bit **complex and dangerous**

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We Interviewed Industry Experts

Research Findings

1. Every business **should be using** predictive analytics
2. Predictive analytics is **not being used** nearly enough
3. Because it is a bit **complex and dangerous**
4. It needs to be **automated and operationalized**

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The Promise

Data

Predictive
Analytics

Predict
the future!

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Reality

Where's My Data?

Predictive Analytics

What do I do with this model?

Business

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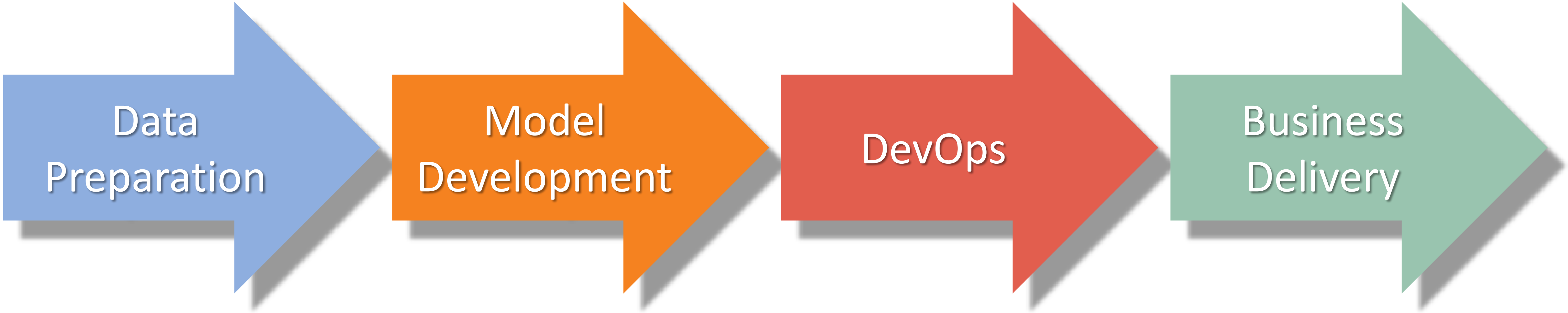
Full Data Science Lifecycle



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Cultural Evolution

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Promise	Fear	Trust	Acceleration
• Expectations of reduced churn, increased cross sell etc. • Hires ‘data scientists’ • First models created	• Model doesn’t work in production • Models are late • Data scientist quits	• Focused projects begin to succeed • Business champions emerge requesting models • Best practices evolve and are enforced	• Hundreds to thousands of active models • Doubling data scientists quadruples number of models • Business users expect to use models

Technical Evolution

Experimentation
- Data discovery
- Non-actionable models
- Data scientist consultants

Artisanship
- Project-based
- Actionable models
- Irreplaceable data scientists

Automation
- Data lake
- Self-service
- Citizen data scientists

Operationalization
- Process-based
- Repeatable, auditable
- Agile teams

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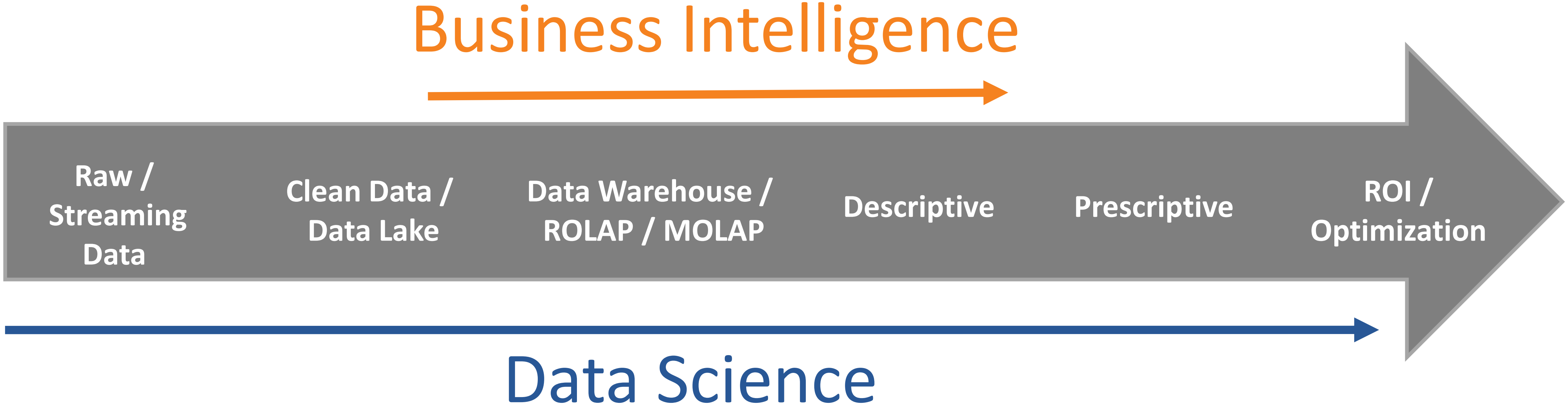
Warning: This Time It's Different



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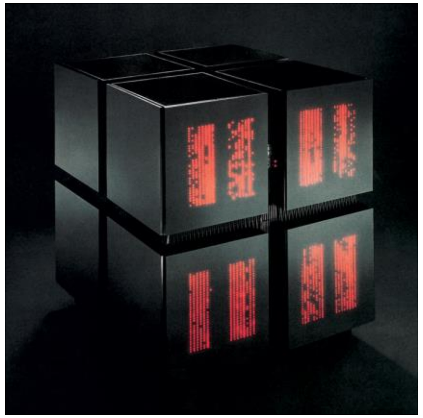
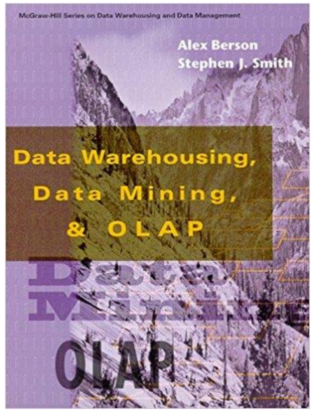
My Journey to Data Science

1990s

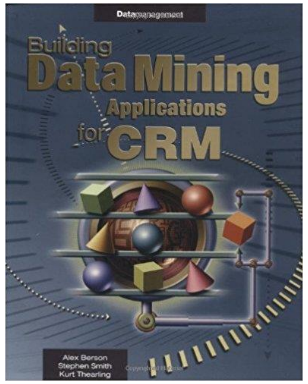
MPP



DW + OLAP



Data Mining



2000

Pharmaceuticals

OPTAS

2010

Education

JogNog

JogNog helps students remember!™

"Data Science"

Eckerson Group

Technology Evolved

• Massively Parallel Processing	=> Hadoop
• OLAP	=> Business Intelligence
• Data Mining	=> Predictive Analytics
• Neural Networks	=> Deep Learning
• Data Warehousing	=> Data Lake (+MDM,DG,ETL…)
• -	=> Data Science

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What we Need Now is…

- ‘Computer Science’ was Born in 1959
- A need to describe the practice of using computers
- Interestingly:
  - *The alternative name proposed for “Computer Science” was “Data Science”*

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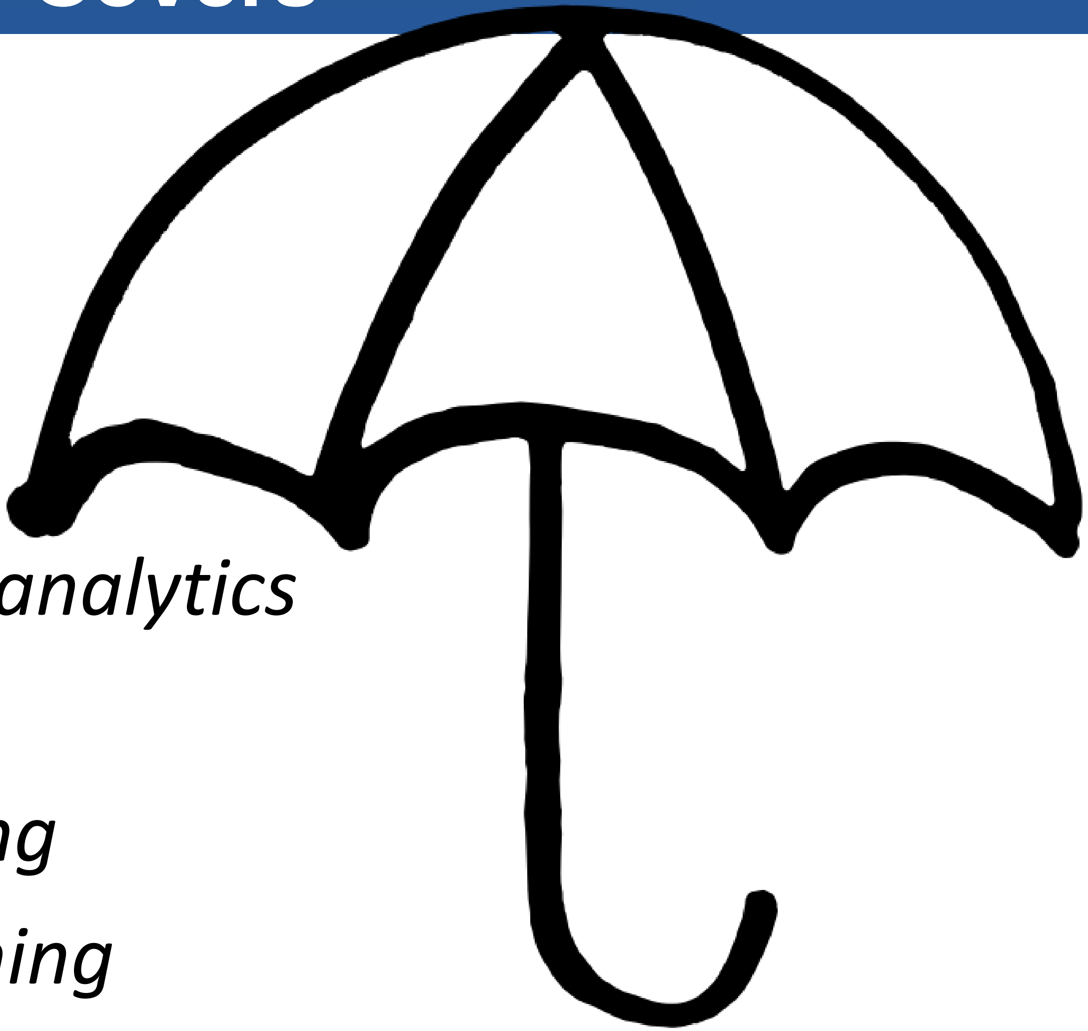
Data Science Covers



- *Predictive analytics*
- *Statistics*
- *Data mining*
- *Deep learning*
- *Artificial Intelligence*
- *Machine Learning*

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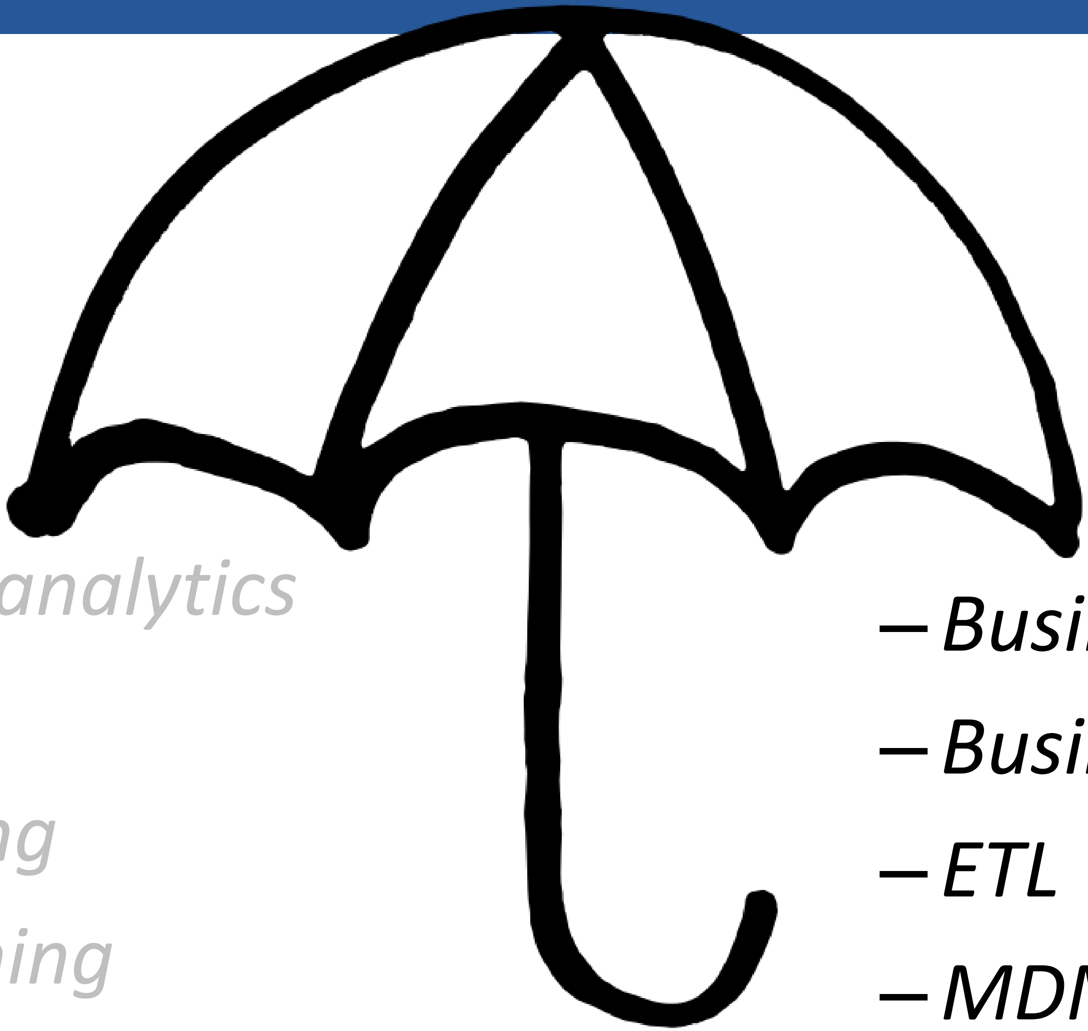
Maybe also



- Predictive analytics
- Statistics
- Data mining
- Deep learning
- Artificial Intelligence
- Machine Learning

- *Business intelligence*
- *Business analytics*
- *ETL*
- *MDM*
- *Data engineering*

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The Elephant in the Room

Why isn't data science used more?

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Question #1

"I have data?"

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Question #2

"Where's my data?"

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Question #237

"What will happen next?"

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Question #238

“What should I **do** next?”

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"How do I start using predictive analytics?"

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WARNING

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“Today we can process Exabytes of data at lightning speed, and this gives us the **potential to make bad decisions** far more quickly, efficiently and with greater impact than we did in the past.”

- **Susan Etlinger**

Ted Talk: What do we do with all this big data?

TED Ideas worth spreading

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Uranium Ore

Uranium Ore = Perfectly Safe

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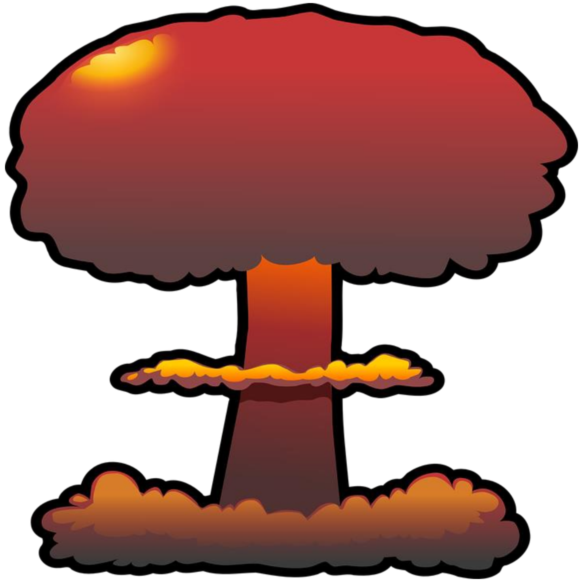
You Make Plutonium from Uranium

Data = Uranium Ore



Data Science = Plutonium

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Careful Process Control Required

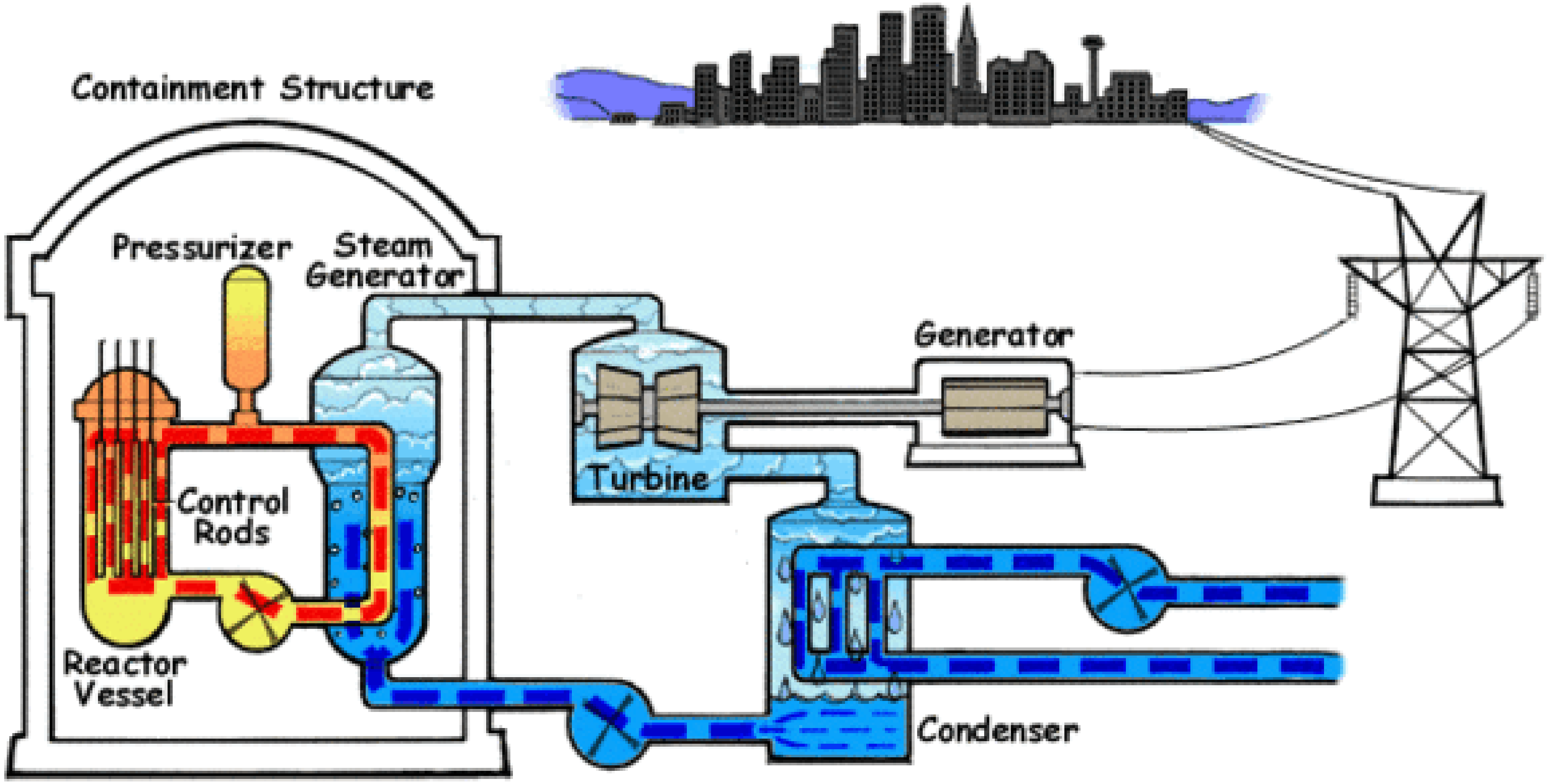

Image: Public domain: http://www.nrc.gov/reading-rm/basic-ref/students/animated-pwr.html

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Predictive Analytics is Like Plutonium

	Plutonium	Predictive Analytics
Powerful	Generates electricity	Drives new revenue with little investment
Dangerous	Explosions	Mistakes can cost hundreds of millions of $$
Handle with care	Requires operationalized processes and tools	Requires operationalized processes and tools

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WHERE DATA SCIENCE FAILS

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How costly are data science fails?

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A Bad Predictive Model Could:

1. Lose all the investment in a hedge fund.
2. Send expensive offers to the wrong customers.
3. Ruin a brand.

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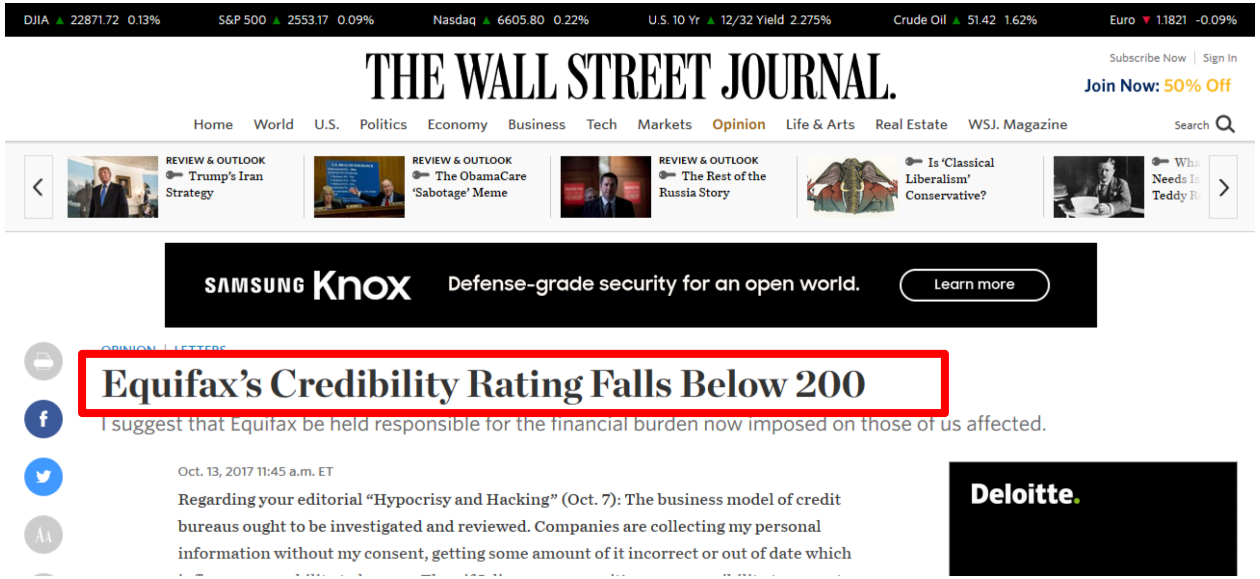
Impact on Brand from Breach of PII

$184-$334 million

TARGET

"Reputation Impact of a Data Breach"

experian™



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Data Preparation → Model Development → DevOps → Business Delivery

#1 Data Drift, Anomalies, Errors

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Example: Hedge Fund

- **Solution**
  - *Proprietary algorithms: radial basis function, Black-Scholes, ANN*
- **Failure**
  - *Model prediction didn't match actual*
- **Why?**
  - *Errors in industry-wide data sets used by all hedge funds*

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- **Challenge**
  - *Input data values can change over time*
  - *Errors can creep into data*

- **Best Practices**
  - *Tools that have automated alerts for data changes*
  - *Algorithms that manage missing or corrupt values*

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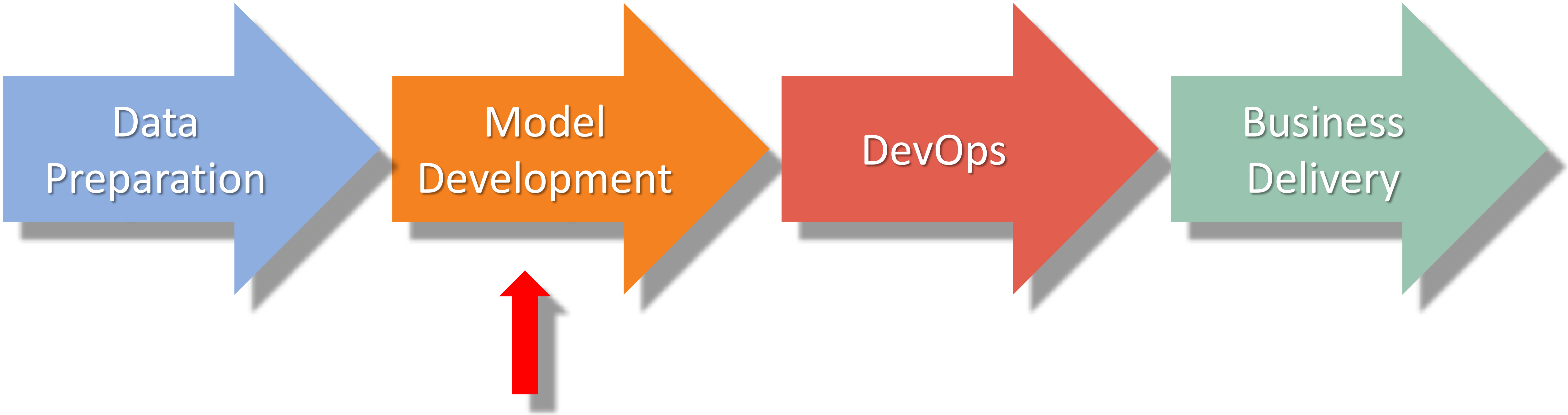

#2 Bad Model Validation

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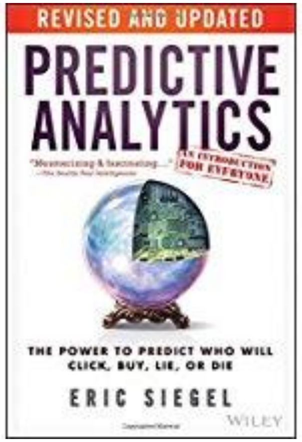
Example: Predict the stock market

- **Solution**
  - *Proprietary time-series algorithms*
- **Failure**
  - *None – error detected before deployment*
- **Why?**
  - *Temporal leakage*
  - *Time window mistakenly shifted by one day*



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- **Challenge**
  - *Concepts like target leakage are too complex for citizen data scientists*

- **Best Practices**
  - *Trial model in non-actionable live environment*
  - *Have 3rd party reverse engineer model*
  - *Be careful!*

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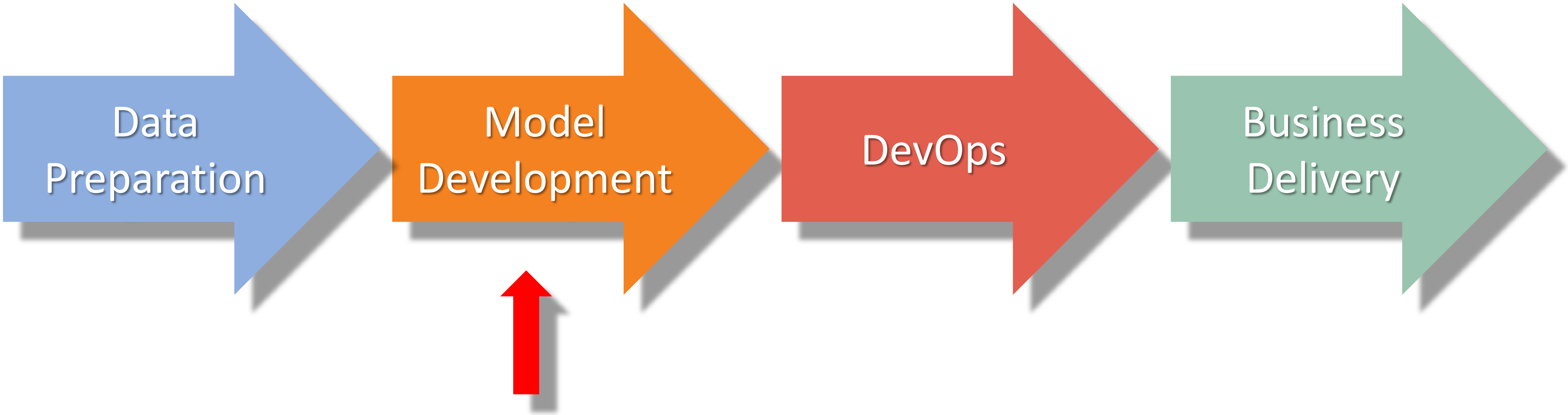

#3 Regulatory Compliance

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Example: Predict pregnancy

- **Solution**
  - *Target looks at market basket analysis*
- **Failure**
  - *Father notices teenage daughter is receiving coupons for baby items from Target*
  - *Uncomfortable conversation with daughter ensues …*
- **Why?**
  - *Dealing with dangerous data*

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- **Challenge**
  - *Privacy violations are complex*

- **Best Practices**
  - *Agile teams with privacy advocate*
  - *Evaluation of risks vs. benefits*
  - *Build processes for CDO/CIO/CPO approval for things that could damage the corporate brand*
  - *Ability to rollback model creation environment*

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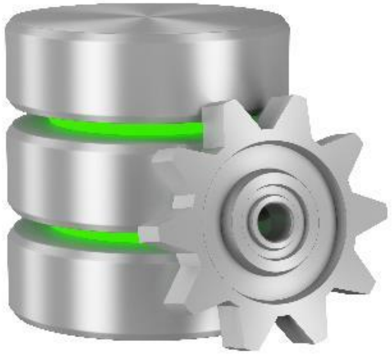
Compliance Architecture

Data Lake / Data Warehouse	Metadata	Predictive Analytics Engine	Business User



- Rollback of data
- Random sampling
- Flagging dangerous data
- Data lineage
- Data governance

- Test and control creation
- Detect highly correlated variables
- Alerts on variable variation
- Model lineage
- Model governance
- Rollback to models
- Model audit trails
- Temporal leakage detection
- Alert on model aging

- Business modeling / ROI
- Workflow
- Collaboration
- Model marketplace
- Model ranking

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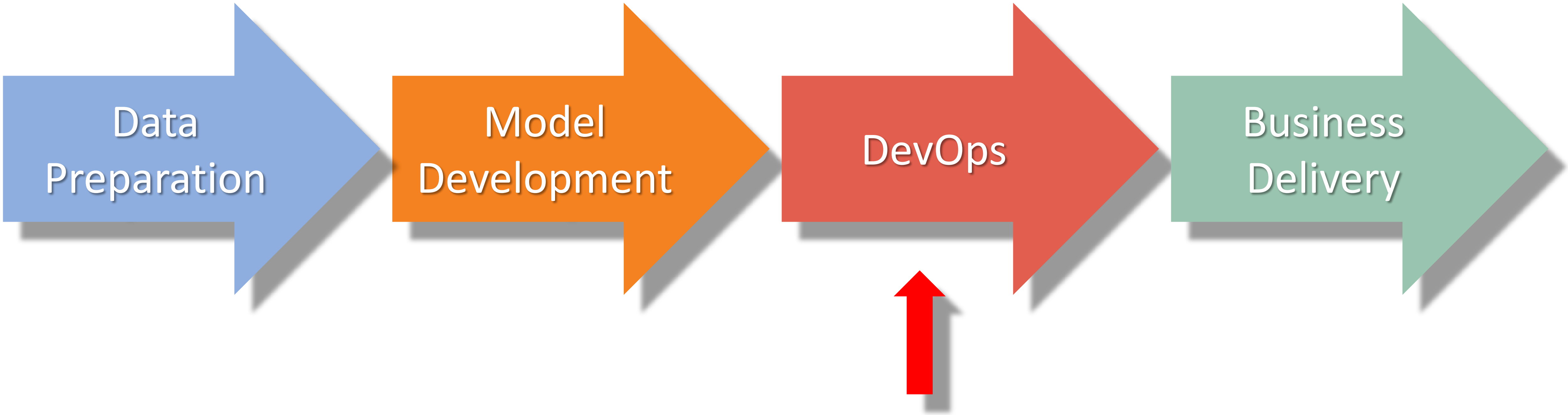

#4 Model Degradation

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- **Challenge**
  - *Models decay in performance*
  - *Data scientists are overwhelmed*
- **Best Practices**
  - *Automate retraining or refreshing a model*
  - *Utilize tools that have alerting systems*
  - *Empower operations to offload data scientists*

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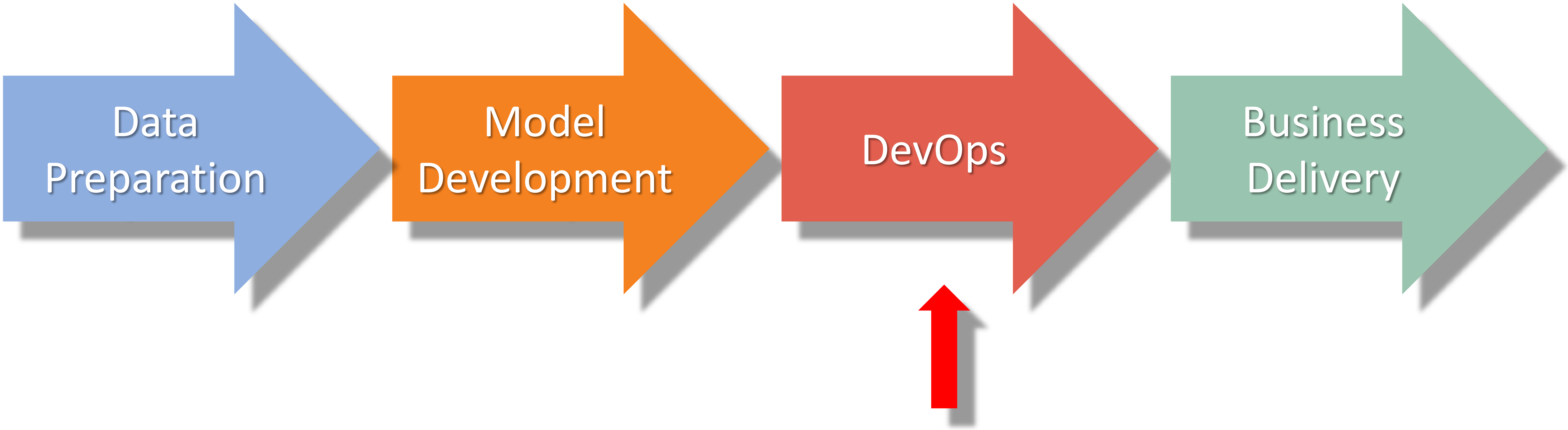

#5 Deployment Disconnect

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- **Challenge**
  - *Model is created in one database and deployed elsewhere*
  - *Must be recoded and tested*
  - *Can delay deployment by 3-6 months*
- **Best Practices**
  - *Use tools that automatically generate code*
  - *Build and deploy in the same database*

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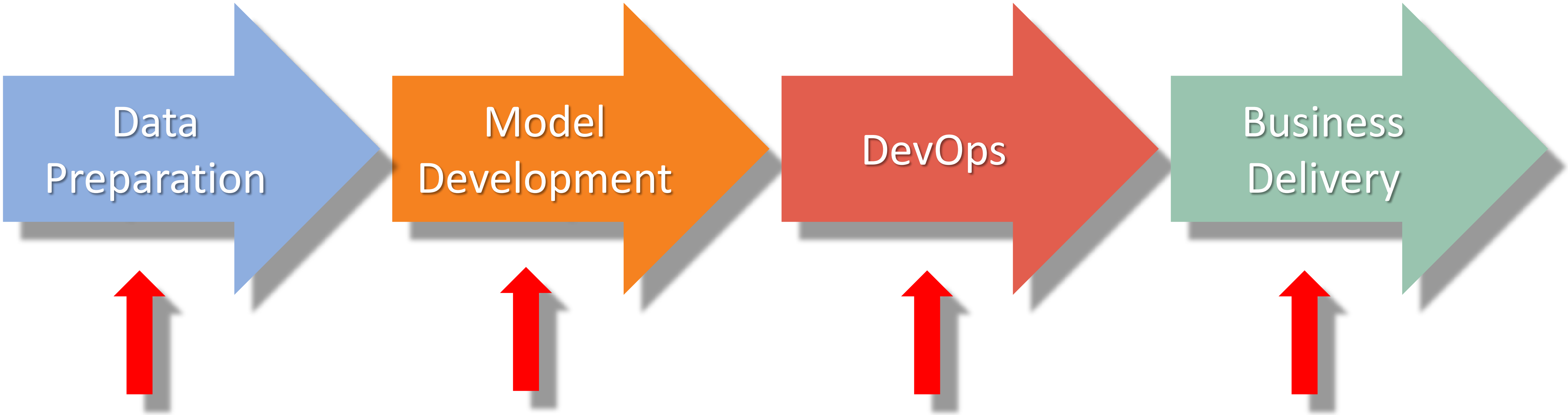

#6 Finding Data Scientists

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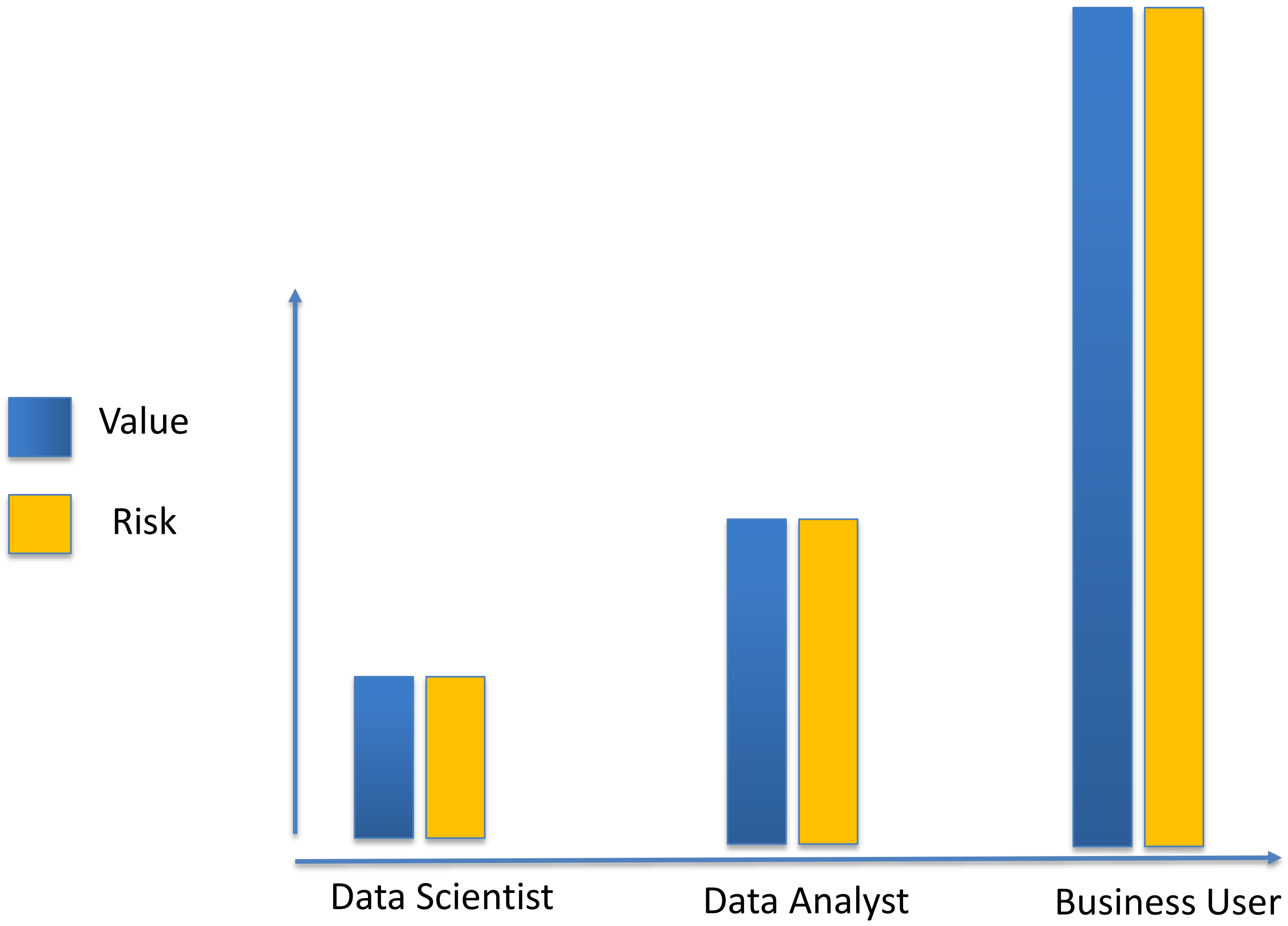
Value and Risk Increase Together



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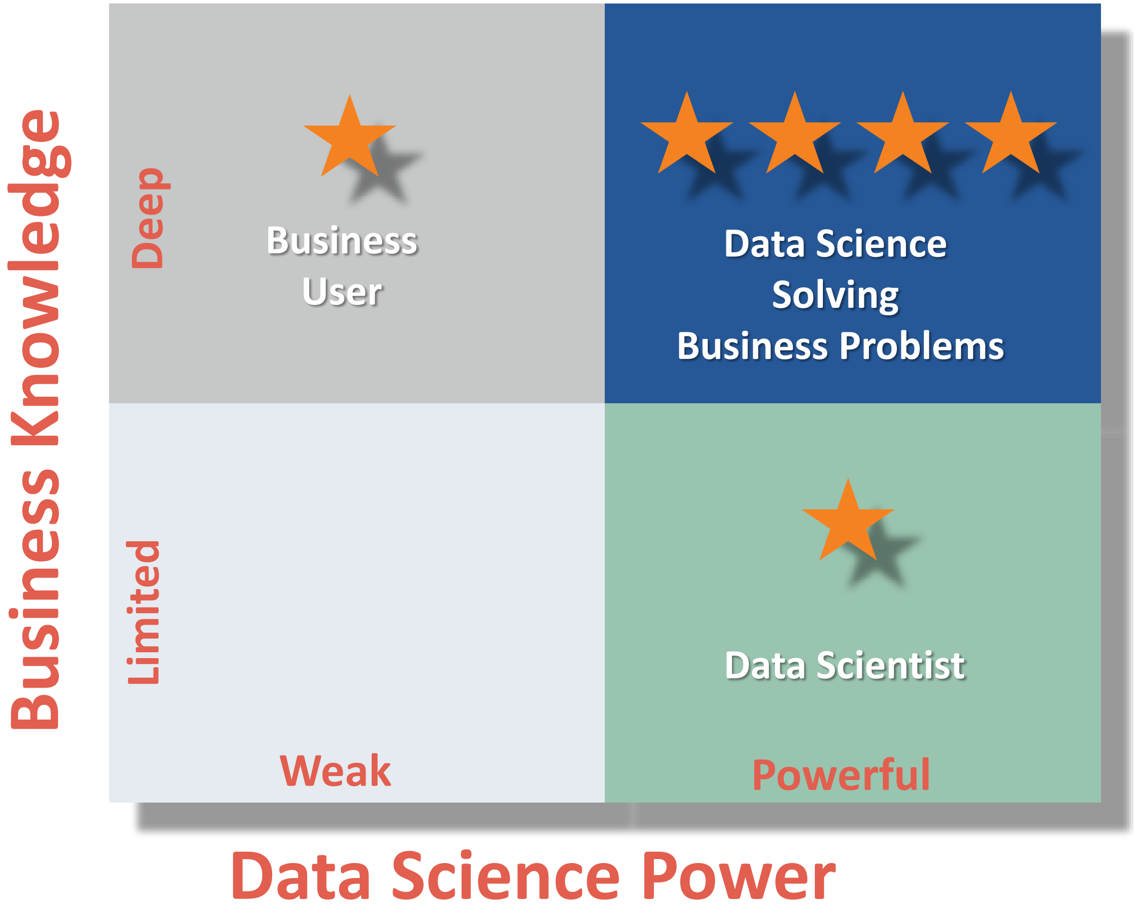
Acceleration = Business + DS



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Data Scientist - Defined

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Mythical Data Scientist

- Data expert
- Data engineer
- Deep learning expert
- Statistician
- Coder
- Cloud expert
- Operations expert
- Parallel processing developer
- Deep thinker
- Good communicator
- Understands business problem
- Business rules expert

Required Skills

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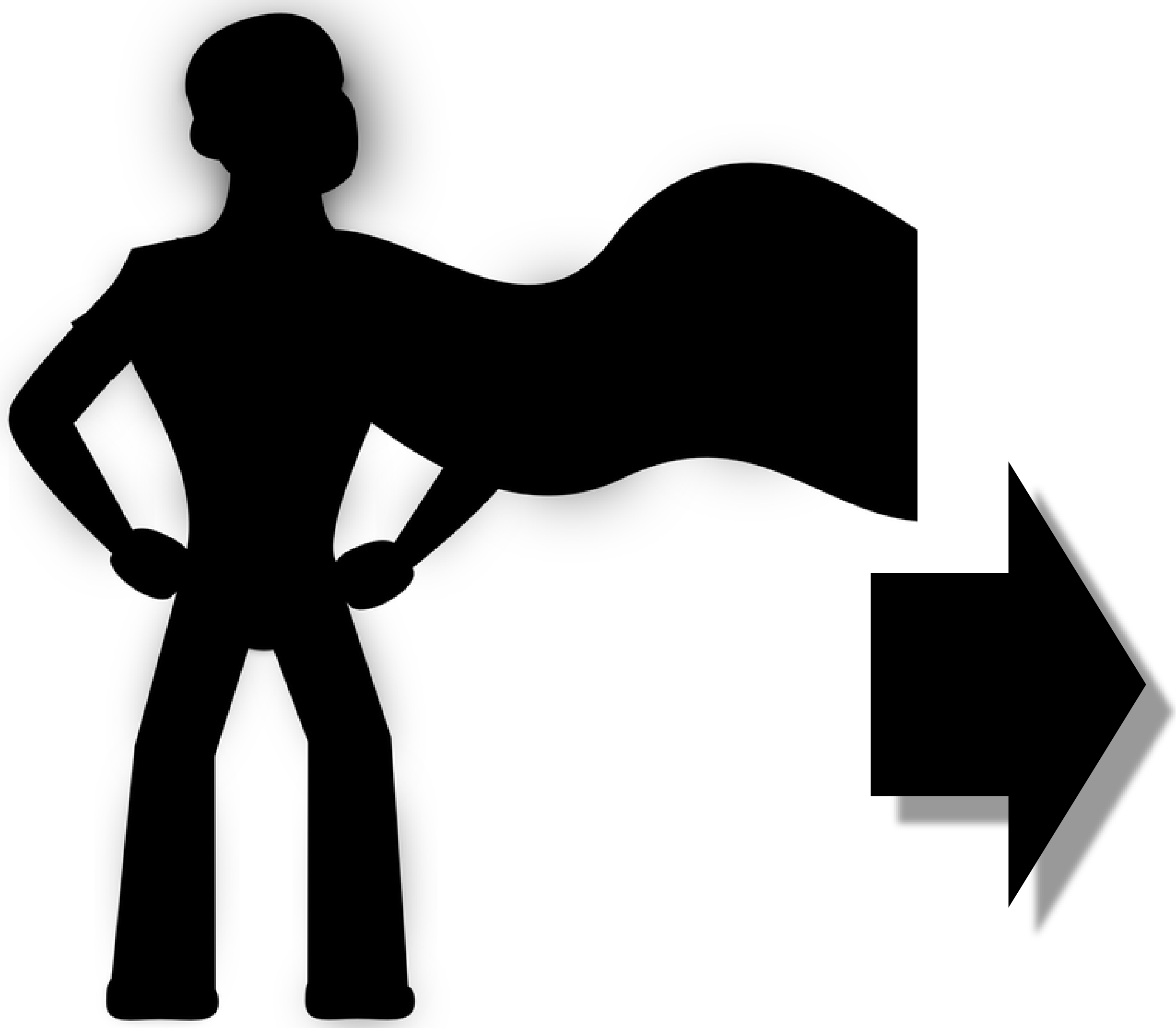
Data Scientist - Deconstructed



Mythical Superman Data Scientist

Multidisciplinary Agile Team

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Data Scientist Has Many Agile User Roles

1. **Data Steward**
   - Knows what data is available, lineage, and governance
2. **Data Engineer**
   - Can access and transform data and optimize database performance
3. **Privacy Advocate**
4. **Data Scientist**
   - Understands predictive analytics, statistics, machine learning
   - Provides high accuracy models and scores
5. **Operational Engineer**
6. **Data Analyst**
   - Can translate between business requests and data realities
   - Provides ad hoc query and report support
7. **Business User**
   - Understands the business problem and responsible for ROI
   - Provides business case and logical validation of causality

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Data Scientist

- **Challenge**
  - *Heroic project-based model creation*
  - *High error rates*
  - *Can't scale*

- **Best Practices**
  - *Agile teams*
  - *Embed DS representative into business*

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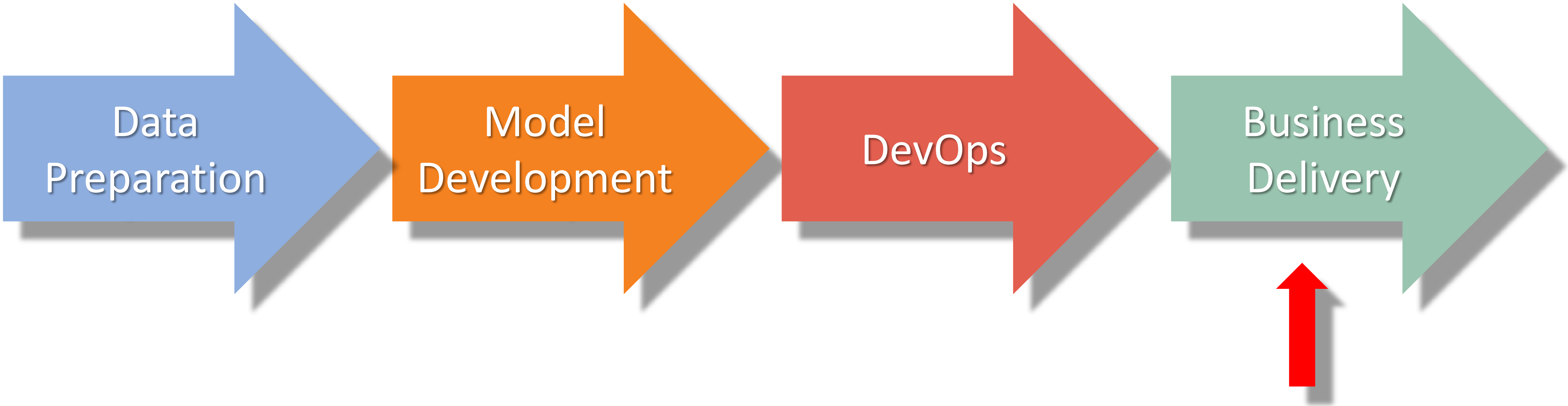

#7 Business Disconnect

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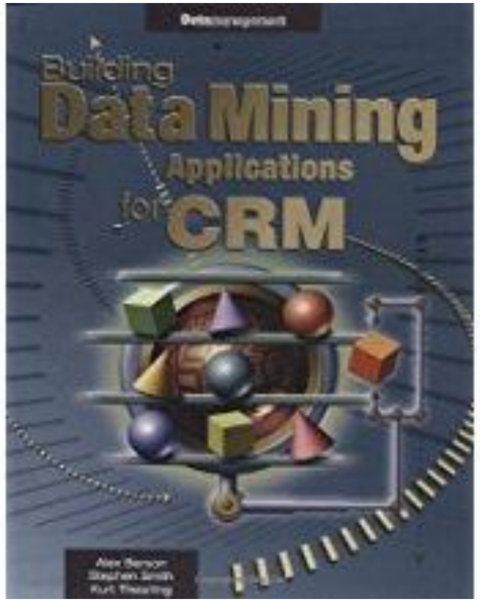
Example: Predict mobile phone churn

- **Solution**
  - *CART model in specialized PA tool*
- **Failure**
  - *Created higher churn than control group*
- **Why?**
  - *Predictive model excellent*
  - *BUT - Offer reminded customers of their anniversary*



Great book!!!
(completely biased)

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- **Challenge**
  - *Possibility of large errors*
  - *Gun shy business users*
  - *Frustrated data scientists*
- **Best Practices**
  - *Predict offer effect with small trials*
  - *Include business user in top down design*

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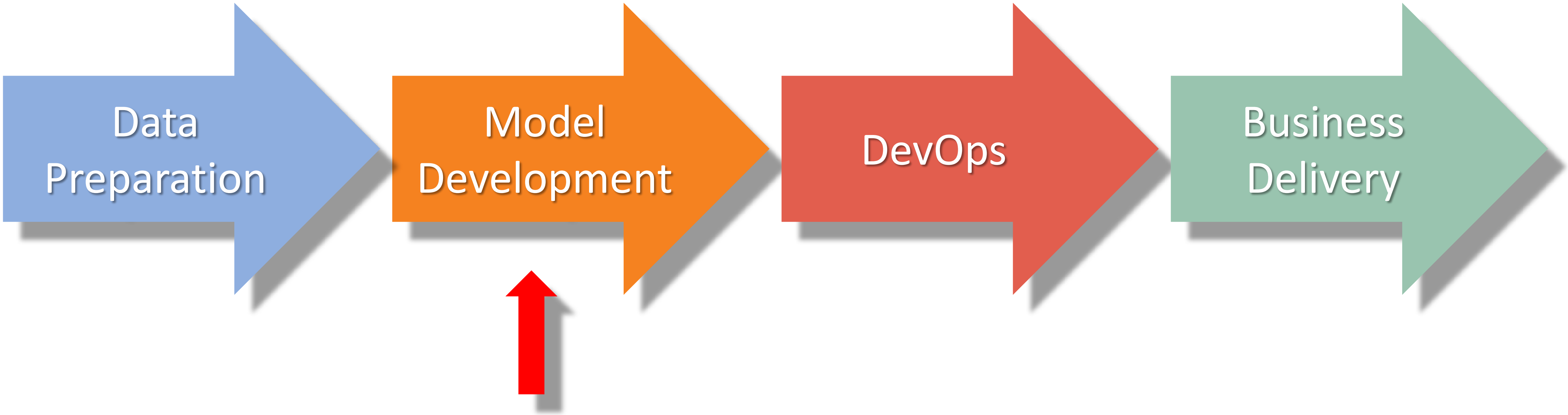

#8 Lack of a Data Science Platform

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Data Science Platform

- **Challenge**
  - *High error rates*
  - *Long delivery cycles*
  - *Can’t scale*
- **Best Practices**
  - *Centralize and focus on building a ‘platform’*
  - *Deliver like an internal software company*
  - *Plan for scale but execute for success today*

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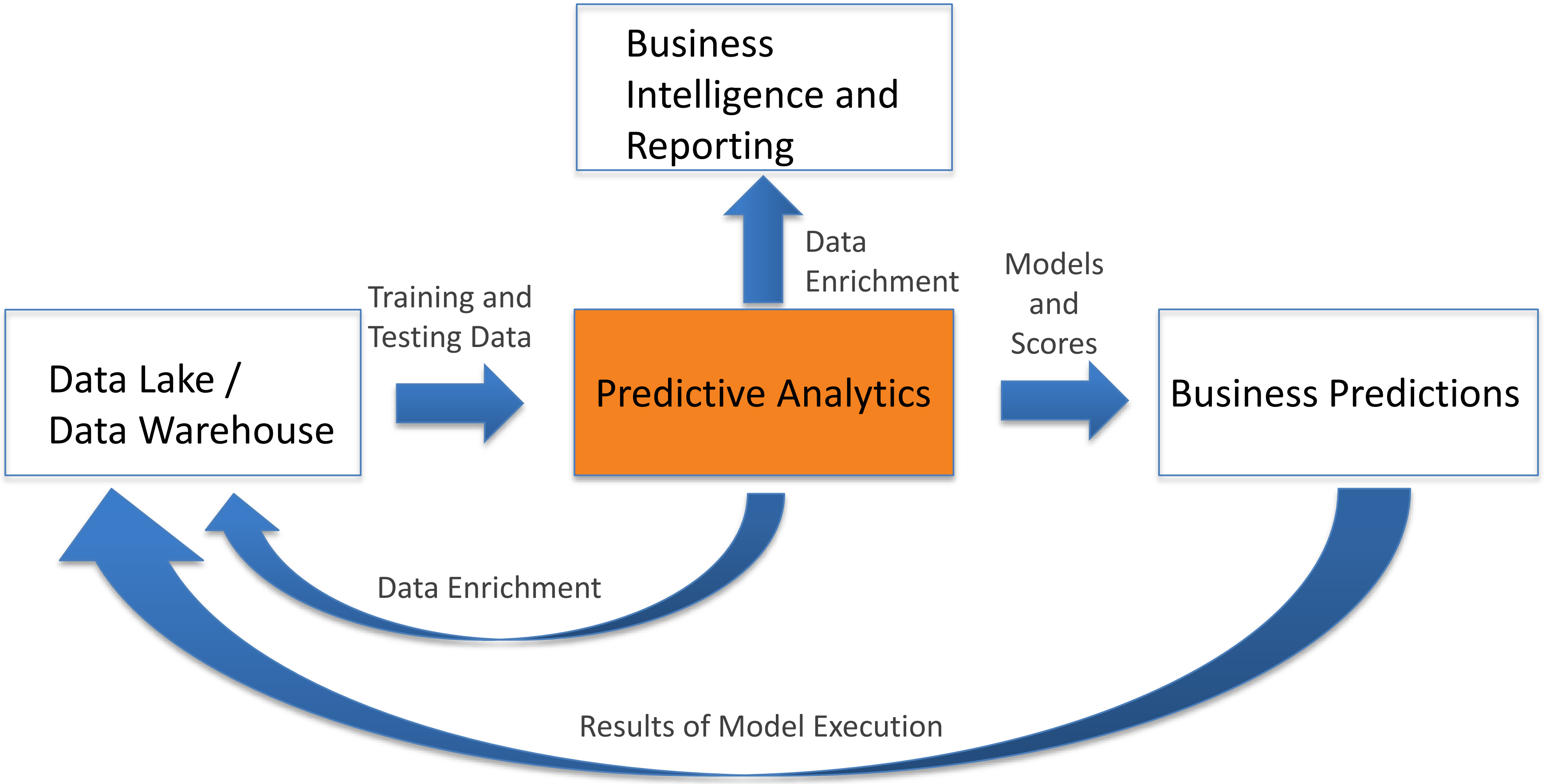
Data Science Platform



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Top 8 Challenges to Data Science

1. Bad Data
2. Bad Validation
3. Regulatory Compliance
4. Model Degradation
5. Deployment Disconnect
6. Finding Data Scientists
7. Business Disconnect
8. No Platform

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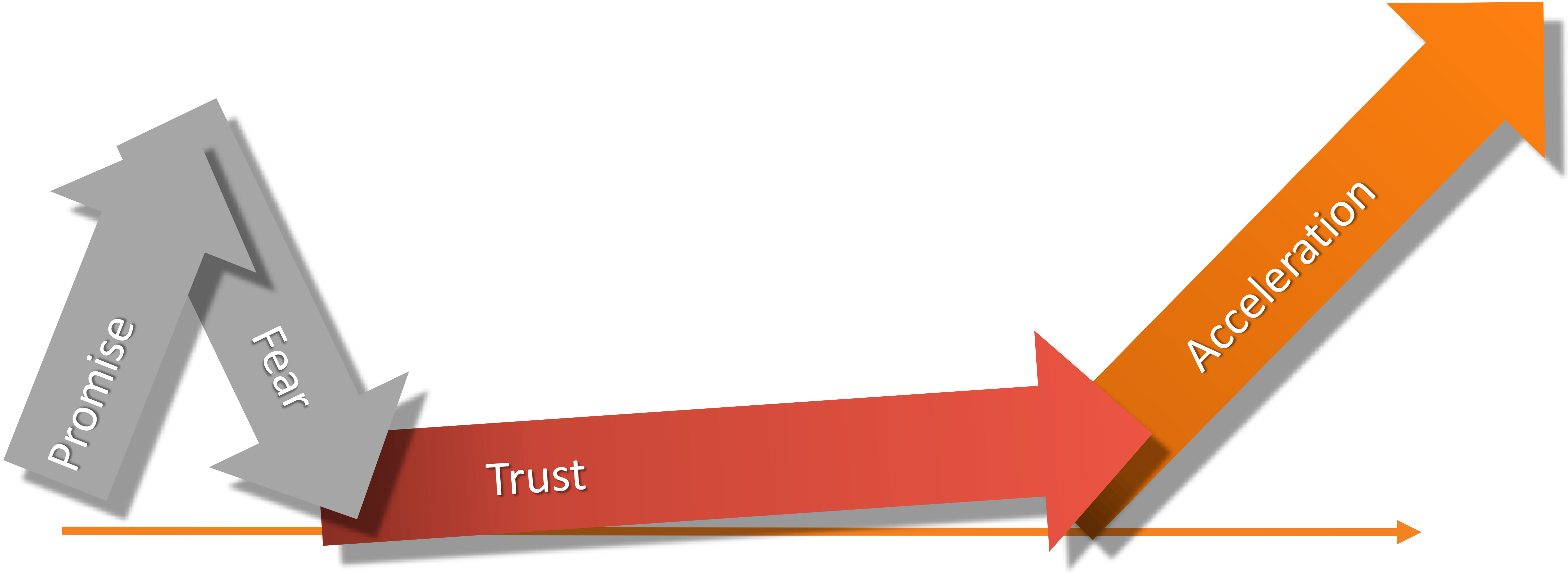

Path to Digital Transformation

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Four Years from Now

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1. **Self-service data science** will be the dominant lifeform

2. **Citizen data scientists** will be effective

3. Data scientists will be **more effective**

4. Data science best practices will look a lot like **computer science best practices**

5. Operationalized data science will provide a **strategic competitive advantage**

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Questions?

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Resources

Papers on www.Eckerson.com

- **Best Practices in Data Science : Ten Keys**
- **The Demise of the Data Warehouse**
- **Eckerson Eight Innovations in Data Science**
- **Data Science is Plutonium**

Books

- **"Building Data Mining Applications for CRM"** – Stephen Smith, Alex Berson, Kurt Thearling
- **"Data Warehousing, Data Mining, & OLAP"** – Stephen Smith, Alex Berson
- **"Predictive Analytics"** - Eric Siegel
- **"Data Science for Business"** – Foster Provost, Tom Fawcett

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