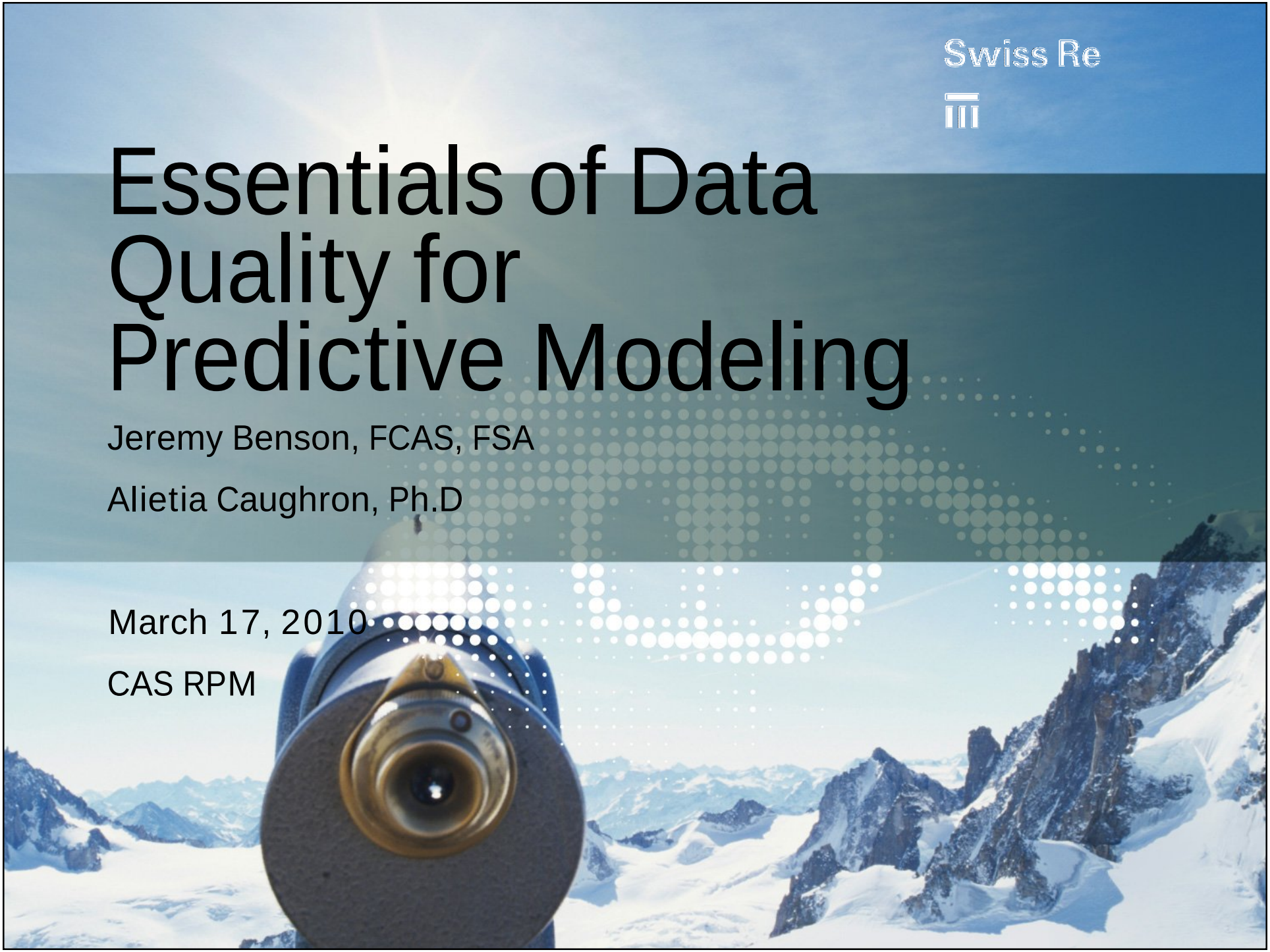

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Essentials of Data Quality for Predictive Modeling

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CAS RPM

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Agenda

- Structure
- Goals of Data Quality
- Process
- Benefits of Data Quality
- Knowledge Transfer
- Lessons Learned

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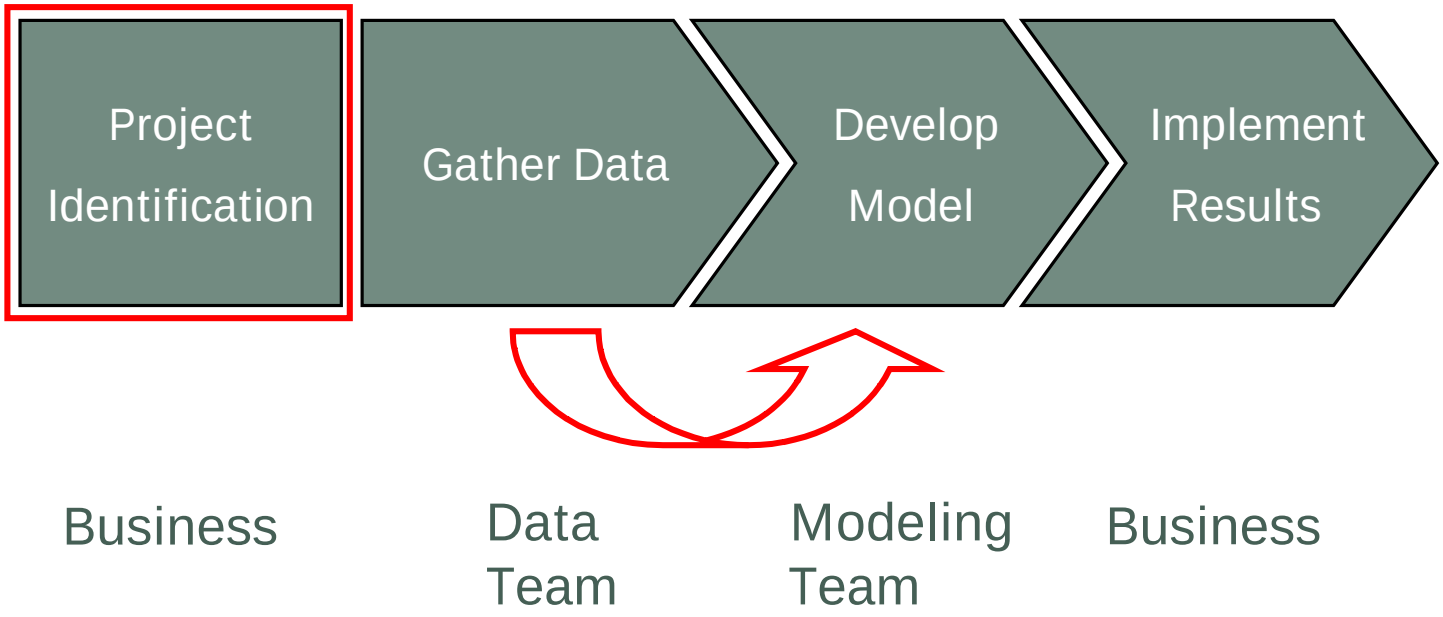
Project Structure, naïve version



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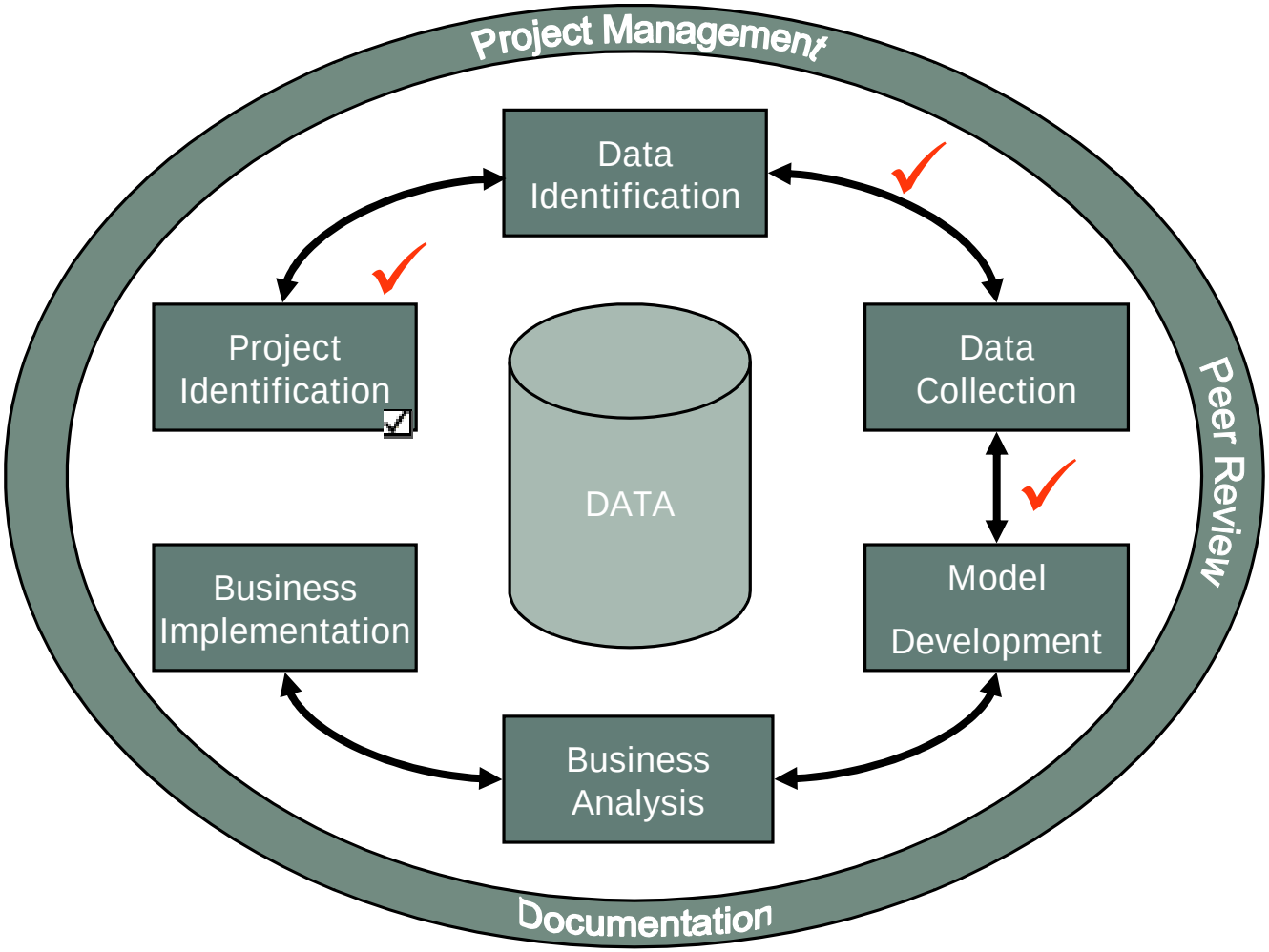
Project Structure, more realistic

- Iterative process
- Data stages are the most time consuming.
- Data Quality focus is part of the Data Collection stage.



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Separate Data and Modeling Teams

- Advantages
  - Increased focus on data quality
  - Different skills sets are needed for data management than for modeling
  - Data quality issues go beyond modeling
  - Data quality team can start next project earlier
- Disadvantages
  - Modeling team is not as knowledgable about the data, its strengths and weakness
  - Data team may have ‘cleaned’ the data introducing modeling bias
  - Knowledge transfer to the modeling team may be incomplete

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Overall Goals of Data Quality

- Accurate, Consistent, Complete Data
- The data should be appropriate for the purpose of the analysis
- Improved ability to explain and defend decisions
- Better decisions result from better data
- Actuary's time is freed up to focus on core professional responsibilities, decision and analysis

Goals of Data Quality for Predictive Modeling

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- Data – Fundamentally a statistical exercise that requires data

  Require there to be a Data Collection Plan.

  – "Clean" data – If data is missing, potential for lack of convergence, internal / external aliasing, biased results.

    Cleaning the data potentially introduces bias.

  – "Good" clean data – Quality of the data impacts models' predictive accuracy.

    Need to balance quality, materiality, and business needs.

- Documentation – Supports repeatability (model updates) & buy-in from others.
- Communication – Feedback loop improves Knowledge Transfer & assists in prioritizing efforts.

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Data Collection Process

- Data Profiling
- Data Preparation and Integration
- Data Quality Testing
- Data Scrubbing
- Documentation
- Communication

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Steps in Data Profiling

- Determine the Context of Data (Scoping)
- Define the Data (Operational Definitions)
- Determine the Types of Statistics
- Get the Data
- Profile and Document
- Interpret the Results
- Discuss with Functional/Business Experts
- Repeat
- Adjust Scope, Timelines or Resources

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Data Profiling

- Types of Data Profiling Statistics
  - Fill Rates, Min/Max, Frequency Distributions, Uniqueness
- Purpose
  - Understand data challenges early in the project so late surprises are minimized.
  - Use to prioritize data to use for analysis.
  - Assess the risk involved in integrating the data.
  - Help to prepare meaningful questions to ask subject matter experts.
  - Identify potential mapping issues between or within fields.

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Data Preparation and Integration

- Data Preparation
  - Get the Data
  - Primary Key Analysis
  - Aggregation/Duplication
  - Initial Data Scrubbing
  - Data Manipulation
  - Mapping
- Data Integration
  - Merge Data
  - Data Integration Tests
  - Reconciliation

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Data Quality Testing

- Data Profiling on Integrated Data
  - Fill Rates
  - Frequency Tests
  - Min/Max
- Business Rules
  - Loss Date should be after Effective Date
  - Claims should have a matching Policy
  - Tests for Negative Premium/Loss

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Data Scrubbing

- Normalizing Data
  - If fields are required to add to a certain value, adjusting the data so that they do.
- Imputations
  - Filling in of Missing Data
- Translations
  - Changing the value of a Data point to make it Consistent with other values that have the same meaning
- Cleaning
  - Correction of Erroneous Data
- Mapping
  - Process in which similar data is merged together and the values in the datasets are translated to become consistent with each other
  - Redefining the segmentation of data

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Documentation

- Clear and concise so that someone else can re-create the process
- Modeler should be able to understand the what each data element represents and any data scrubbing that took place for that element
- Any justification for changes to the dataset should be clearly documented
- Helps provide the modeler with a comfort level about the data.

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Communication Process

- IT – Determine how to access the data and obtain permission to the data
- Actuarial, Underwriting, Claims, Operations
  - Understand the intended uses of the data
  - Determination of the Scope of Records and Fields to use for Modeling
  - Input and Feedback on Results of Data Quality Testing
  - Drilldown into Root Cause Analysis of Data Quality Issues
- Project Sponsor
  - Set Overall Direction for Predictive Modeling Project

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Communication Process, predictive modeling team

- Provides direction for data collection & quality review, e.g. identifying “must-haves”, “nice-to-have”, “wish list”, and “not needed”
- Timeline management
- Facilitates Knowledge Transfer and mitigates concerns about separating the two functions (data collection/quality & modeling)

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Knowledge Transfer

- Identify issues that need to shared with the modeling team
- Know data issues and how they have been resolved
- Deepen understanding of what is meant by “data quality”
- Able to articulate specific requirements needed for data quality with respect to modeling projects
- Have a general sense of the data’s quality in order to identify strengths and weaknesses (of the model)

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Benefits of Data Quality for Predictive Modeling

- See the impact of Pre and Post Data Quality
- More time to focus on building the models
- Improvements in data that measurably impact the business can be taken care of because there are resources focused on the data
- Obtain early buy-in from the business

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Benefits of Data Quality

- Retrospective
  - Fixing Data Errors in Systems
  - Documentation of cleanup for other Actuarial Analysis
- Prospective
  - Involvement in System Architecture when setting up new system
  - Fix processes that caused data errors
  - Find errors before they adversely affect results
- Communication
  - Business Awareness of Data Quality Issues

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Lessons Learned

- Data Quality affects everyone – it is not just a business or IT issue
- Communication with Business experts is essential to understanding why there are errors in the data
- Time spent up-front on Data Profiling will save you time on the rest of the Data Collection
- Formalized Process for Data will produce both better data and data sooner
- It is important to have operational definitions
- If pulling from multiple datasets, mapping the datasets is HUGE
- Process and Communication are just as, if not more, important than the Data Quality Tests and Results.