

# MODELING TECHNIQUES PRINCIPLES-BASED RESERVING (“PBR”) AND BEYOND

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# **MODELING TECHNIQUES PRINCIPLES-BASED RESERVING (“PBR”) AND BEYOND**

Valuation Actuary Symposium | Virtual Session

Katie van Ryn, FSA, MAAA  
August 31, 2020

# AGENDA

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**01** Model efficiency techniques



**02** Modeling simplifications under PBR



**03** Key takeaways



# 1

## MODEL EFFICIENCY TECHNIQUES

# WHAT IS MODEL EFFICIENCY?



## Accuracy

VS



## Runtime

- **In force:** Model your policy inventory on a seriatim basis to capture to characteristics. Allows for analysis of results at the most granular level.
- **Scenarios:** Use of a larger scenario set to assess results across a robust range of outcomes
- **Calculation frequency:** More frequent reserve calculations to reduce reliance on interpolation

- **In force:** Use compression techniques to group records with similar characteristics
- **Scenarios:** Use scenario reduction techniques, such as the Academy's scenario picking tool, to reduce the number of scenarios
- **Calculation frequency:** Limit revaluation frequency

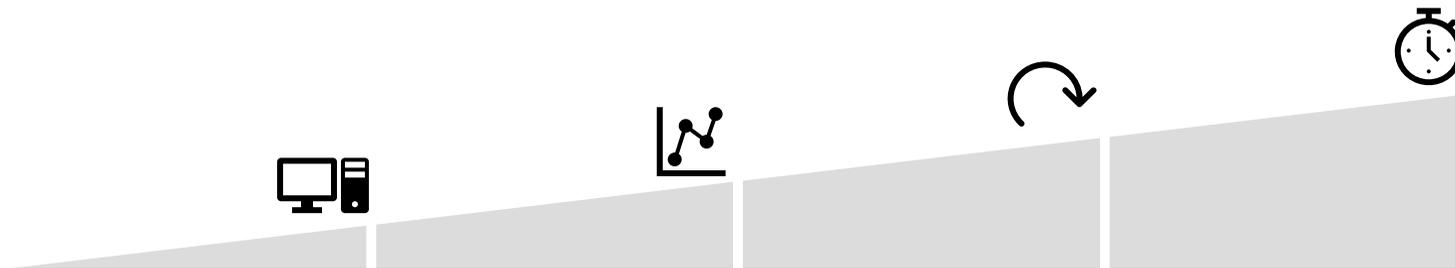
OR

## Computing power

- Leverage advances in technology (e.g. grid or cloud computing) to find efficiency gains without sacrificing current modeling methodology

# WHY DOES PRINCIPLES-BASED RESERVING (“PBR”) SPARK THE CONVERSATION FOR MODEL EFFICIENCY?

The switch to PBR introduces several new challenges to life statutory reserving models, including multiple scenario processing, asset modeling, and nested projections.



## Number of model points

Runtime will vary with the number of liability model points and the variety of asset and reinvestments modeled

## Number of future revaluations

Projection of PBR reserves requires inner/outer loop functionality and runtime is dependent on the # of future valuation dates

## Number of iterations

Segment earned rates are calculated through an iterative approach. Stochastic reserve (“SR”) starting assets are iterated to be within 2% of the modeled reserve.

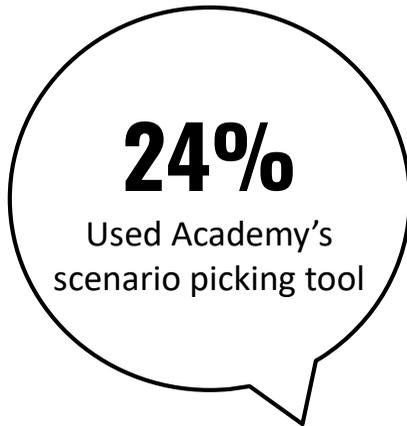
## Number of scenarios

The full SR scenario set contains 10,000 scenarios

# MODELING EFFICIENCY IN A PRE-PBR WORLD

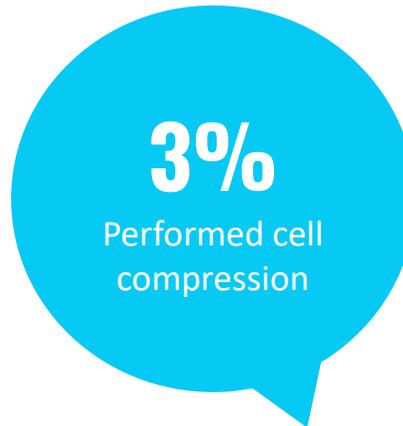
The Modeling Efficiency workgroup led a voluntary survey<sup>1</sup> in 2012 to assess model efficiency practices. Select results for non-VA writers are shown below.

## Scenario reduction



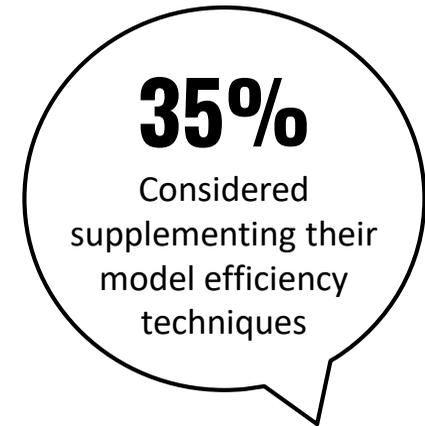
The size of the company did not influence the popularity of using reduction techniques. These techniques were more common among VA writers and some companies indicated using other tools to reduce their scenarios.

## Cell compression



When determining if compression is appropriate, some considerations include reserve accuracy, the need for aggregate vs. seriatim calculations, and other use cases within the same model

## Other techniques



Other techniques discussed include: mapping smaller blocks of business to representative blocks, varying time steps used in the model, and use of efficient software techniques

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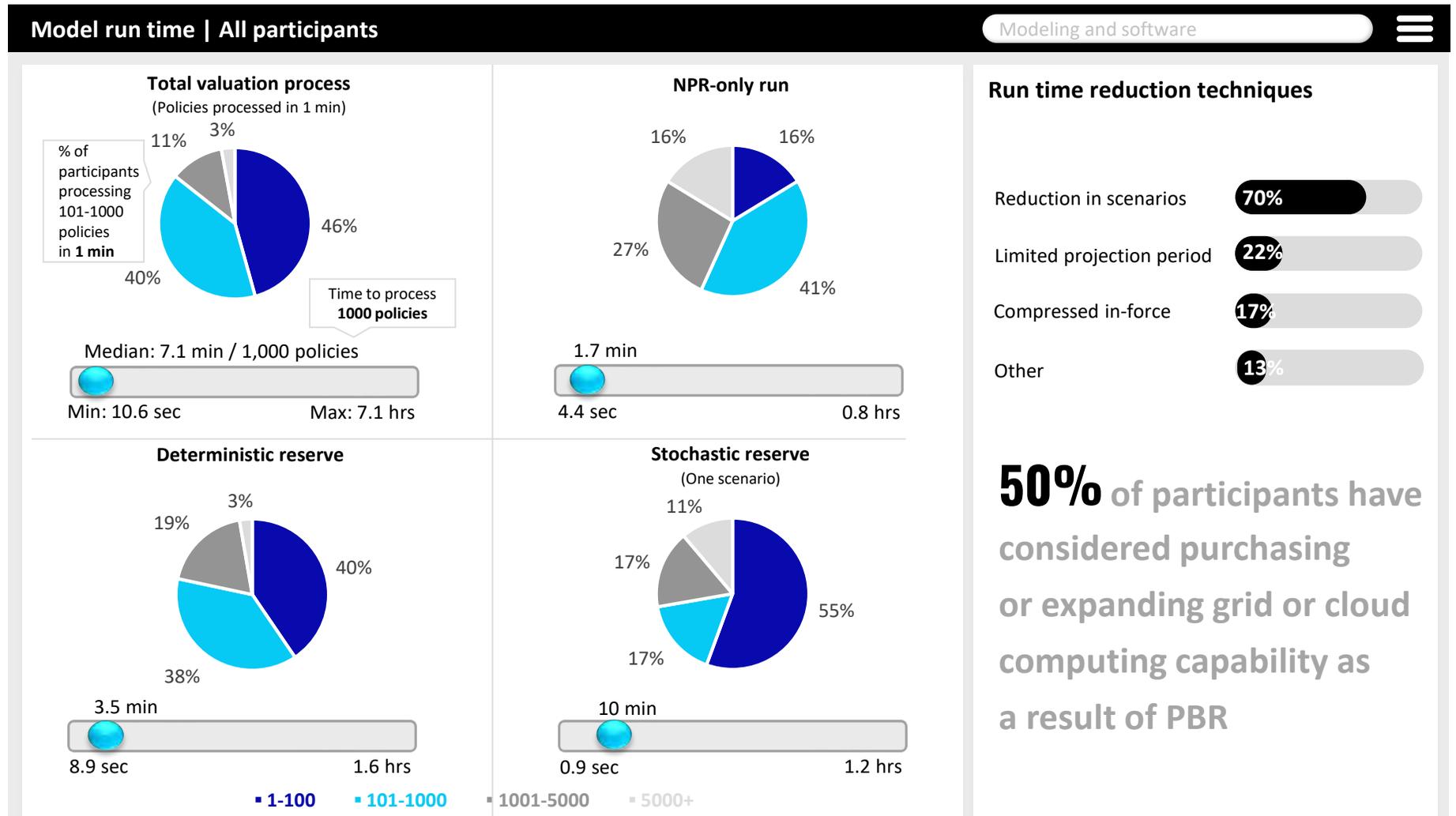
**“Some of the calculations envisioned by a principles-based approach to the determination of reserves and capital may be onerous”**

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1. [https://www.actuary.org/sites/default/files/files/Modeling\\_Efficiency\\_Techniques\\_Final\\_4-11-13.pdf](https://www.actuary.org/sites/default/files/files/Modeling_Efficiency_Techniques_Final_4-11-13.pdf)

# MODELING EFFICIENCY IN A PBR WORLD

A majority of participants<sup>1</sup> are utilizing techniques or technology to reduce run time and some are struggling with lengthy run times



<sup>1</sup> Results presented on this slide taken from Oliver Wyman's 2020 PBR Survey, which received responses from more than 50 participants covering 95% of the individual life insurance market

# MODEL REFINEMENTS

All participants<sup>1</sup> anticipate significant refinements to their PBR implementation, with most focusing on analytics, automation and controls

Model refinements | All participants

Modeling and software



# 100%

of participants anticipate making significant refinements to their PBR implementation in at least one of the following categories

## Analytics and analysis tools



82%

## Valuation process - automation



67%

## Valuation process - controls



59%

## Assumptions



53%

## Run time reduction techniques



33%

## Policyholder deposits modeling



16%

<sup>1</sup> Results presented on this slide taken from Oliver Wyman's 2020 PBR Survey, which received responses from more than 50 participants covering 95% of the individual life insurance market

# 2

## **MODELING SIMPLIFICATIONS UNDER PBR**

# VALUATION MANUAL REQUIREMENTS



*A company may use simplifications, approximations and modeling efficiency techniques to calculate the NPR, the deterministic reserve and/or the stochastic reserve required by this section if the company can demonstrate that the use of such techniques does not understate the reserve by a material amount, and the expected value of the reserve calculated using simplifications, approximations and modeling efficiency techniques is not less than the expected value of the reserve calculated that does not use them.*

VM-20 Section 2.G



# METHODS TO COMPLY WITH THE VALUATION MANUAL

## Methods of demonstration

## Takeaway/Result

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**01** Brute force calculation of the minimum reserve with and without the simplification

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**02** Argument establishing general bounds on a potential deviation in the reserve estimate

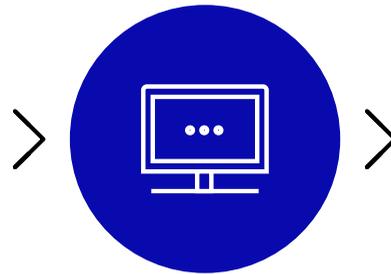
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**03** Using representative cells to establish a materiality range

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**04** Focused demonstration on dominant reserve under PBR

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**05** Demonstration commiserate with the level of the complexity of the simplification or modeling efficiency technique used.

**3**

**KEY TAKEAWAYS**

# KEY TAKEAWAYS

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**01** Model efficiency can be achieved throughout a variety of modeling techniques and attempts to strike a balance between accuracy and runtime

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**02** The complexity of principles-based reserve calculations have led to an increased focus on model efficiency for life writers

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**03** VM-20 explicitly allows for model simplifications as long as sufficient support is provided

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# MODELING TECHNIQUES - PRINCIPLES-BASED RESERVING (“PBR”) AND BEYOND

**BILL CEMBER**

**AUGUST 31, 2020**



# Scalability



# Scalability

## Discussion Items

1. Background
2. New Products
3. New Functionality

# Scalability

## Background

### Majors changes in the industry

- Regulatory change (this presentation!)
- Low interest rates & covid
- Changing consumer behavior & needs

### Models need to do more

- Principle-based reserves valuation and projections
- Additional what-if analysis
- More frequent re-pricing and new product designs

# Scalability

## Background

Model scalability – Increasing the functionality and size of models without detracting to model runtime or maintainability

### Size

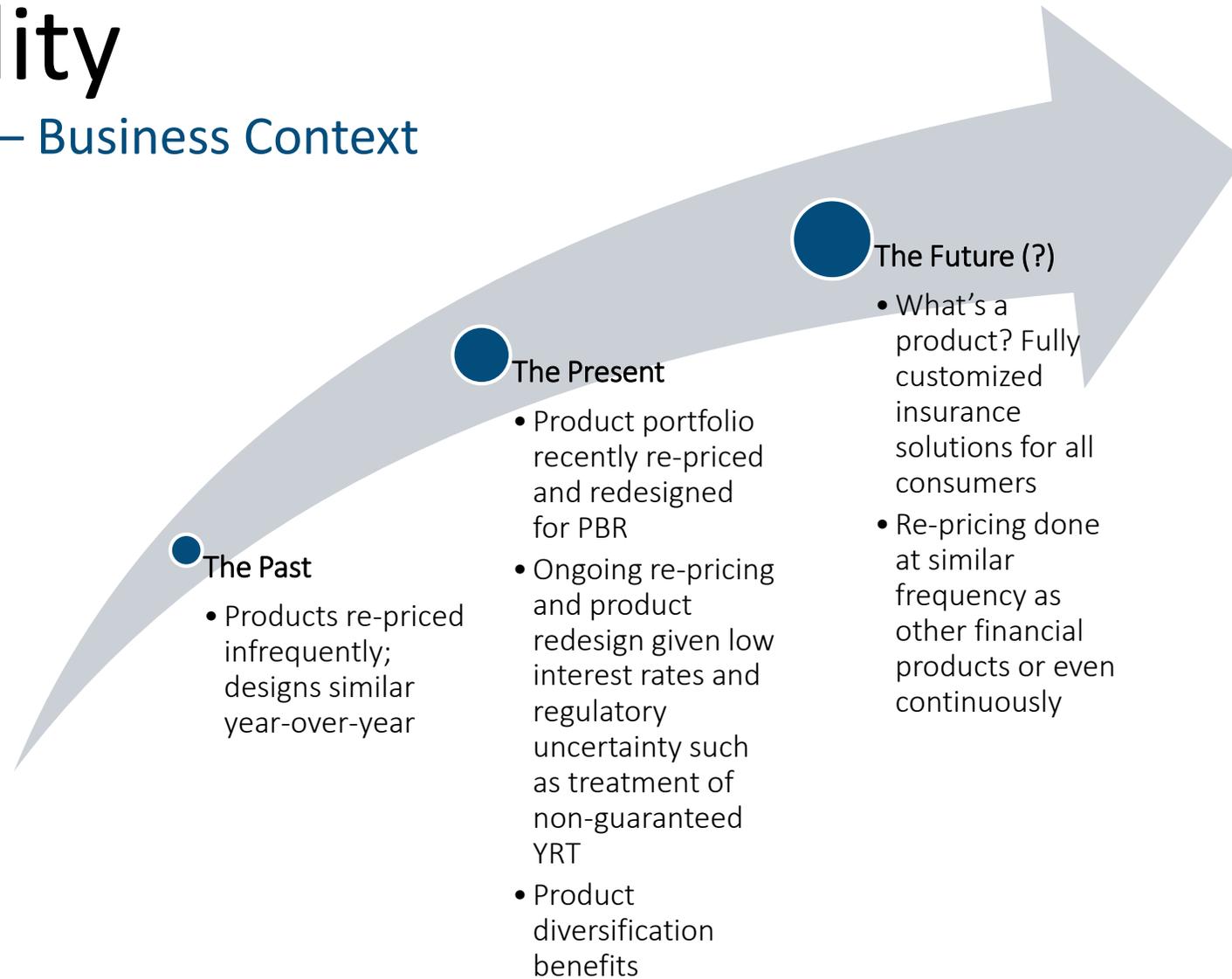
- Number of products
- Number of inforce records

### Functionality

- Valuation (you should already have this)
- Projections
- Sensitivities and what-if analysis
- Combined new business & inforce calculations

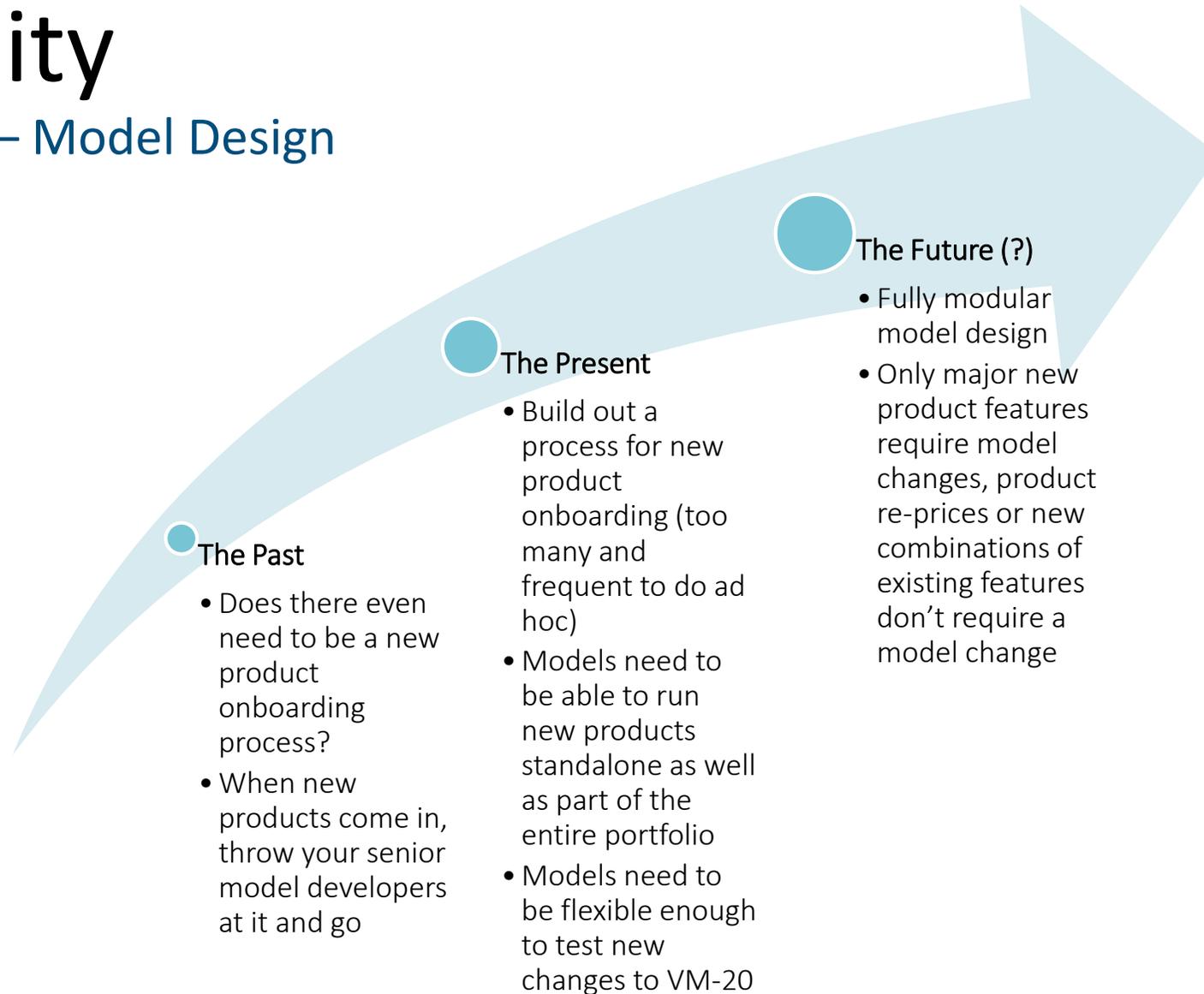
# Scalability

## New Products – Business Context



# Scalability

## New Products – Model Design



# Scalability

## New Products – Example Onboarding Process



# Scalability

## New Products – Modularity

Accounts

No-lapse guarantee

Charges

Death benefit  
options & DOLI

Assumptions

Reserve calculations

A new product as viewed as a series of building blocks

# Scalability

## New Functionality – Key Questions

### Reserve recalculation

- How often will reserves be recalculated?
- How will reserves be interpolated between recalculation points

### Assumptions

- Use time zero assumptions or vary assumptions at future projection points?

### New business

- Inforce only or inforce + new business?
- How will future products be modeled?

# Scalability

New Functionality – Answers

It Depends!

# Scalability

## New Functionality – Guiding Principles

- **Do everything (pretty well)** - The model needs to do everything—if your valuation results are calculated from multiples models, likely projection results will not match valuation results exactly (and that's okay)
- **Short-term vs long-term** - Short-term vs long-term projections require different solutions. E.g. unlocking mortality improvement makes a much larger difference for a 100-year pricing projection as opposed to a 5-year forecast
- **Focus on the material** – Always ways to make the model more accurate. Aim for getting the material things right, not actuarial perfection
- **Technology has its limits** – Throwing more compute power can help, but won't solve all problems

# Scalability

## New Functionality – Modularity

Valuation  
methodology

Outer loop liability  
projections

Outer loop asset  
projections

Dynamic assumption  
unlocking

Post-reserve  
calculations (e.g.  
capital, taxes,  
profitability)

New business

New model functionality viewed as a series of building blocks. Depending on the specific functionality required, some of these will be more important than others

# Sensitivities & Disclosures



# Sensitivities & Disclosures



# Sensitivities & Disclosures

Assumption	VM-31 Section	Unique Requirements	Modeling Considerations
Lapses	3.D.4.h	<i>For policies that give policyholders flexibility in timing and amount of premium payments, the results of sensitivity tests related to the following premium payment patterns: minimum premium payment, no further premium payment, pre-payment of premium assuming a single premium and prepayment of premiums assuming level premiums.</i>	<ul style="list-style-type: none"> <li>-Flexibility to handle different premium patterns</li> <li>-Ability to dynamically calculate minimum or level premiums</li> <li>-Methodology discretion around interpretation of level and minimum premiums (e.g. premiums for life of the policy of end of no-lapse guarantee)</li> </ul>
Reinvestment Strategy	3.D.6.r	<i>[D]ocumentation supporting the appropriateness of the modeled company investment strategy compared to the actual investment policy of the company.</i>	<ul style="list-style-type: none"> <li>-Flexibility to handle company reinvestment strategy in addition to A/AA floor (if demonstrating using model)</li> </ul>

# Sensitivities & Disclosures

Assumption	VM-31 Section	Unique Requirements	Modeling Considerations
Margin Analysis	3.D.4.d	<i>Rationale for the particular margins used and a description of testing performed to determine the size and direction of the margins by duration, including how the results of sensitivity tests were used in connection with setting the margins.</i>	-Ability to handle margins by duration
Post-Level Term Profitability	3.D.4.k	<i>Summary results of the seriatim comparison of the present value of postlevel term cash inflows and outflows for the DR as required by VM-20 Section 9.D.6.</i>	-Ability to vary policyholder behavior assumptions dynamically at a seriatim level -Ability for model to output required cashflows to demonstrate appropriateness of dynamic assumptions



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