A graph is worth a million dollars

The effective use of visualizations in reserving

CAS Spring Meeting 2023
Boston

Jamie Mackay, WTW

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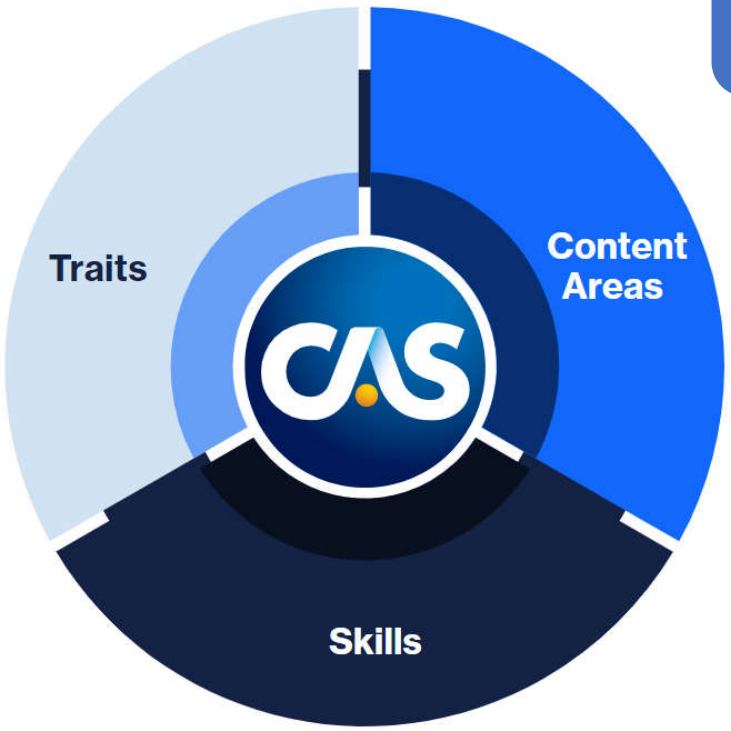
CAS Capability Model



Visual framework that articulates and provides guidance on the traits, skills and knowledge important for most property/casualty actuaries

Use the model to self-assess your levels of professional attributes in 18 different areas

Then identify areas of opportunity to learn and grow and plan your professional development journey

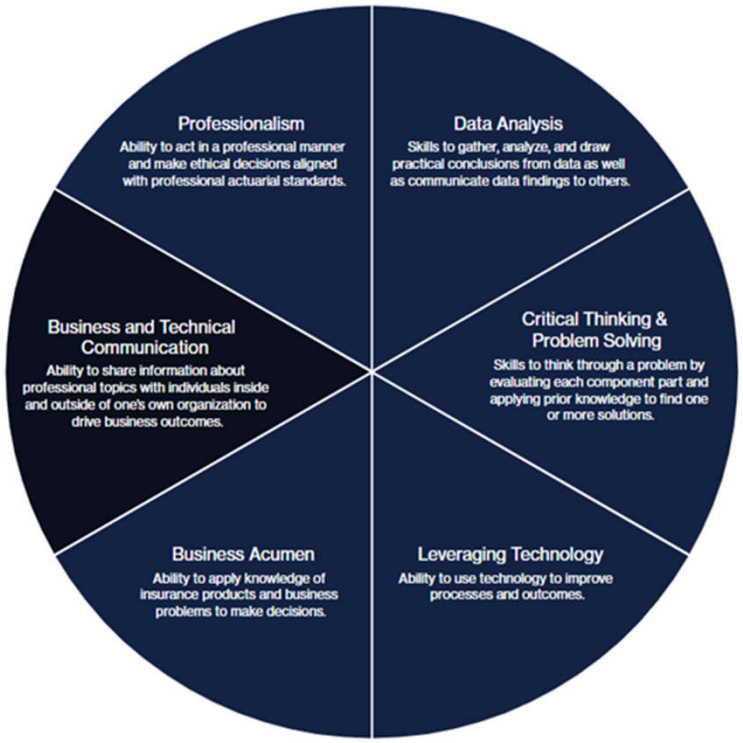
CAS Capability Model

Content Area

Functional Expertise

Knowledge of functional areas in the actuarial space

CAS Capability Model



Skills

Business and Technical Communication

Ability to share information about professional topics within and outside the organization

CAS Capability Model

Level 2

Business and Technical Communication

Adapt one's communication style to the audience, present complex data clearly, etc.

Poll question

Q: Would you describe yourself as a…

a) Numbers person
b) A pictures person
c) I refuse to be categorized in such a simplistic way

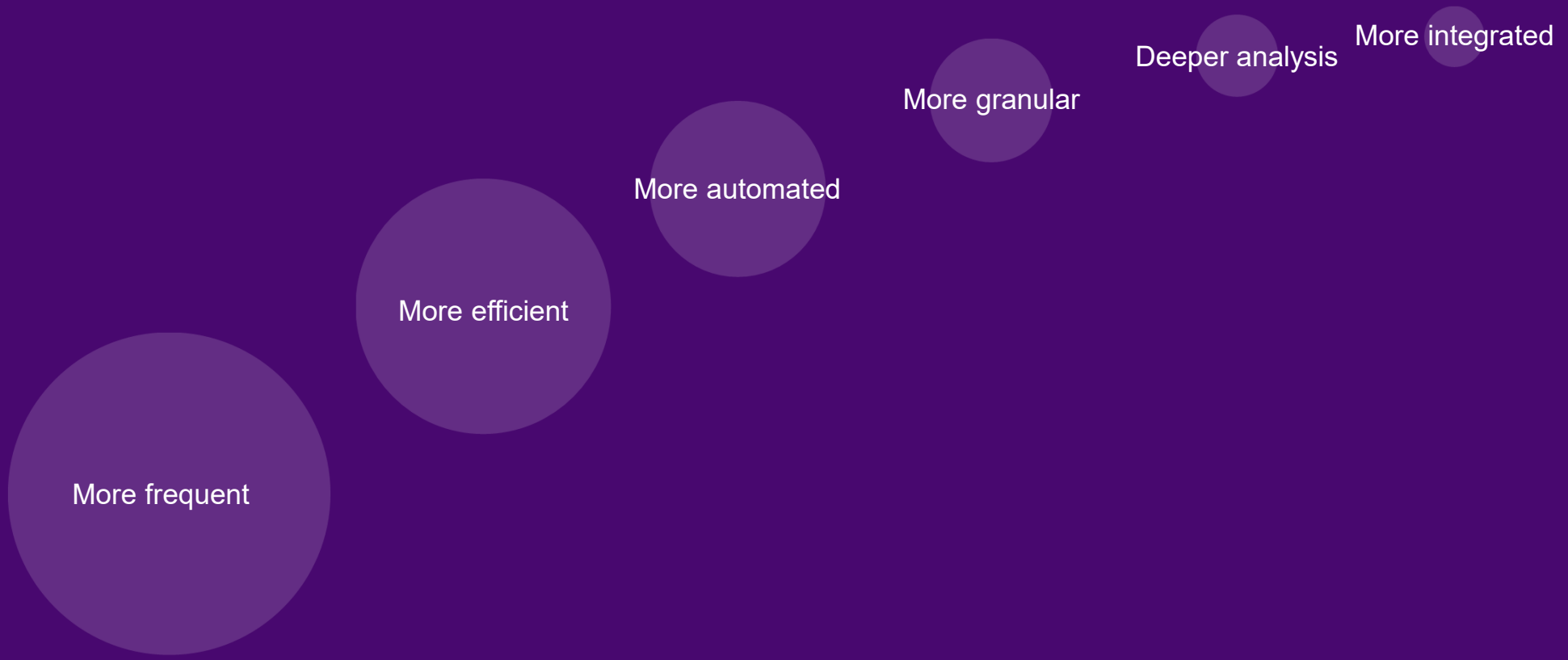
Poll question

Q: How would you describe the stakeholders in your analysis?

a) All numbers people
b) All pictures people
c) A mixture
d) I don't honestly know how they consume information

Context

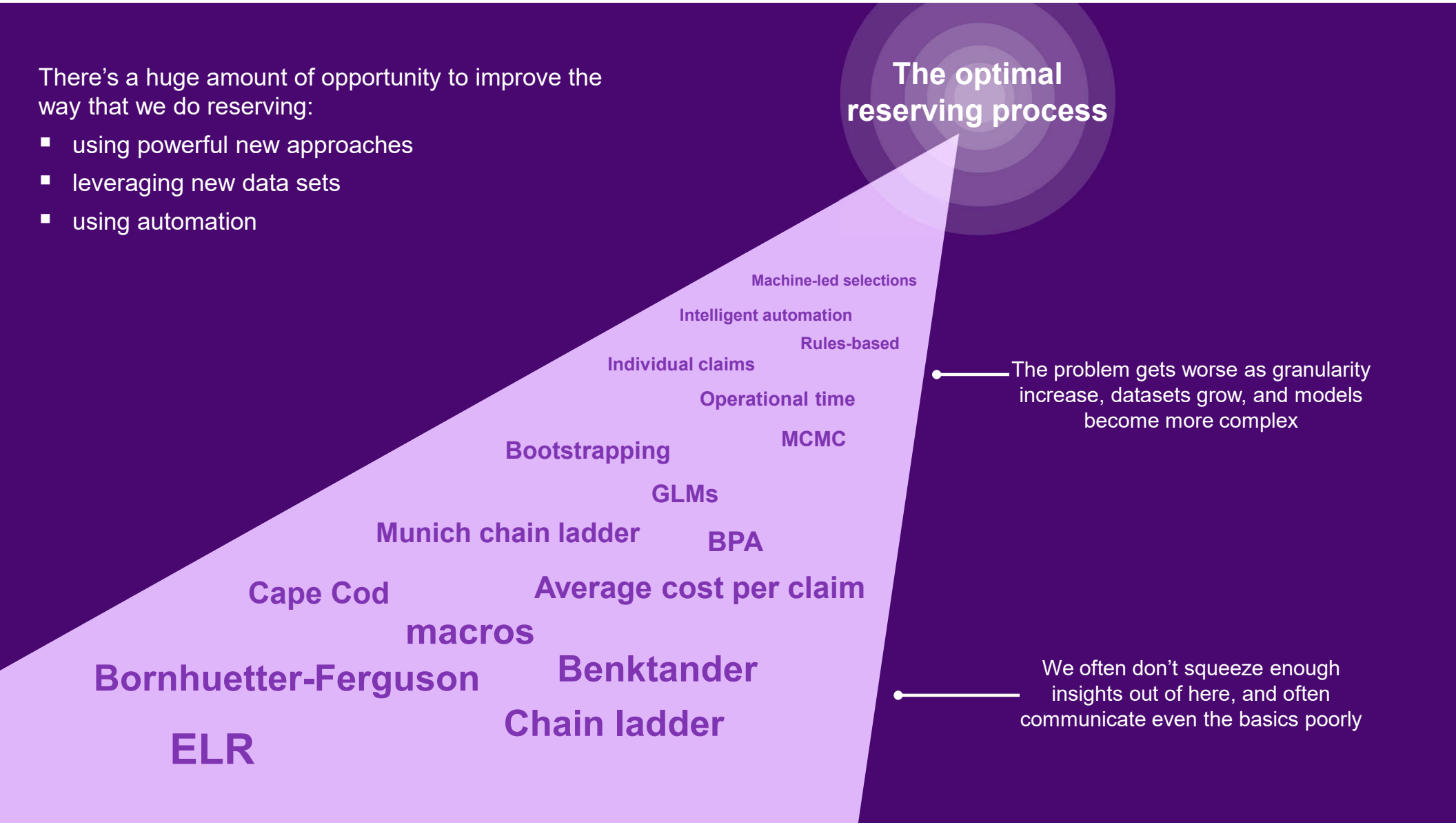
The reserving function of the future



The reserving function of the future

There's a huge amount of opportunity to improve the way that we do reserving:

- using powerful new approaches
- leveraging new data sets
- using automation



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Effective visualizations are a powerful tool:

- Allow you to consume and interrogate vast amounts of data
- Identify trends earlier
- Reduce risk of missing things altogether
- Improve oversight of process
- Improve oversight of assumptions and selections
- Identify key risks
- Identify outliers
- Provide important context
- Deploy resources where needed
- Focus judgmental insight
- Inform drivers of change
- Reduce friction of communication
- **Increase confidence in analysis**

Timing is everything

A claim, trend or data error

Did you see it?

Did you see it? **Is it material?**

Did you see it?

Is it material?

Is it a trend or an anomaly?

Did you see it?

Is it material?

Is it a trend or an anomaly?

Does it affect other lines?

Did you see it?

Is it material?

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Does it affect other lines?

Is it being accounted for?

The importance of context

Did you see it?

Is it material?

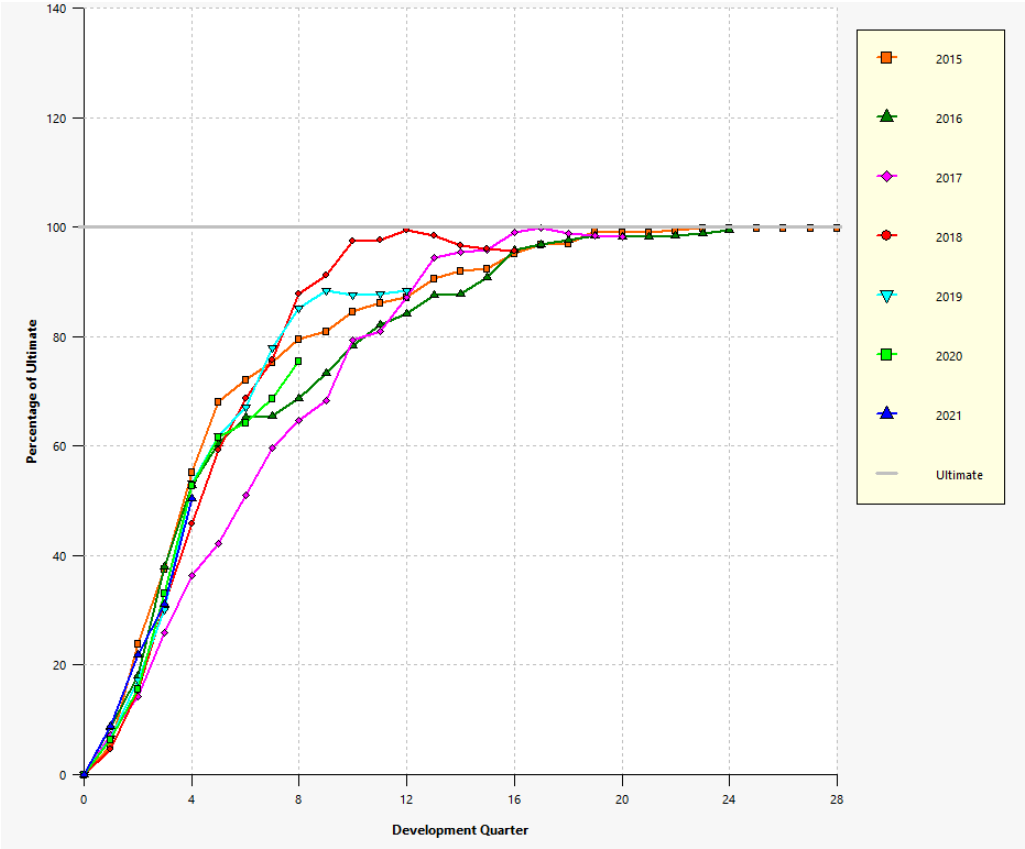
Is it a trend or an anomaly?

Does it affect other lines?

Is it being accounted for?

How?

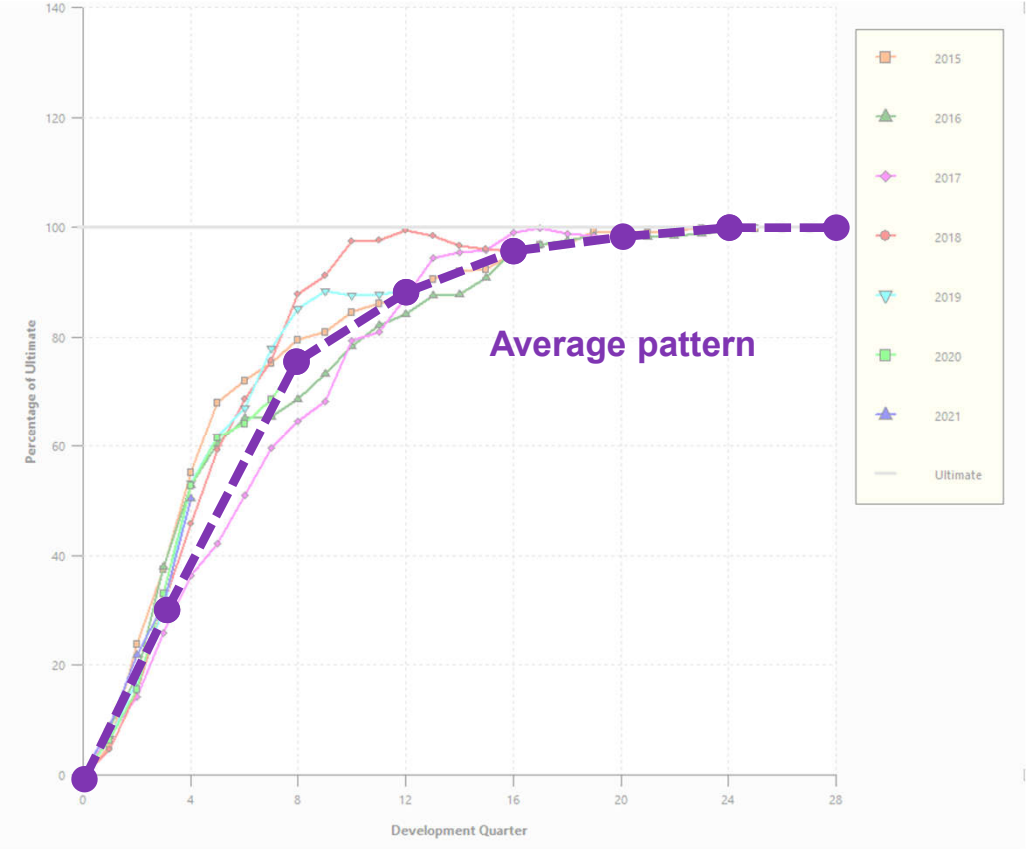
The all singing, all dancing all-origin graph



The all-origin loss development graph is a hugely useful graphical tool

It tells us:

The all singing, all dancing all-origin graph



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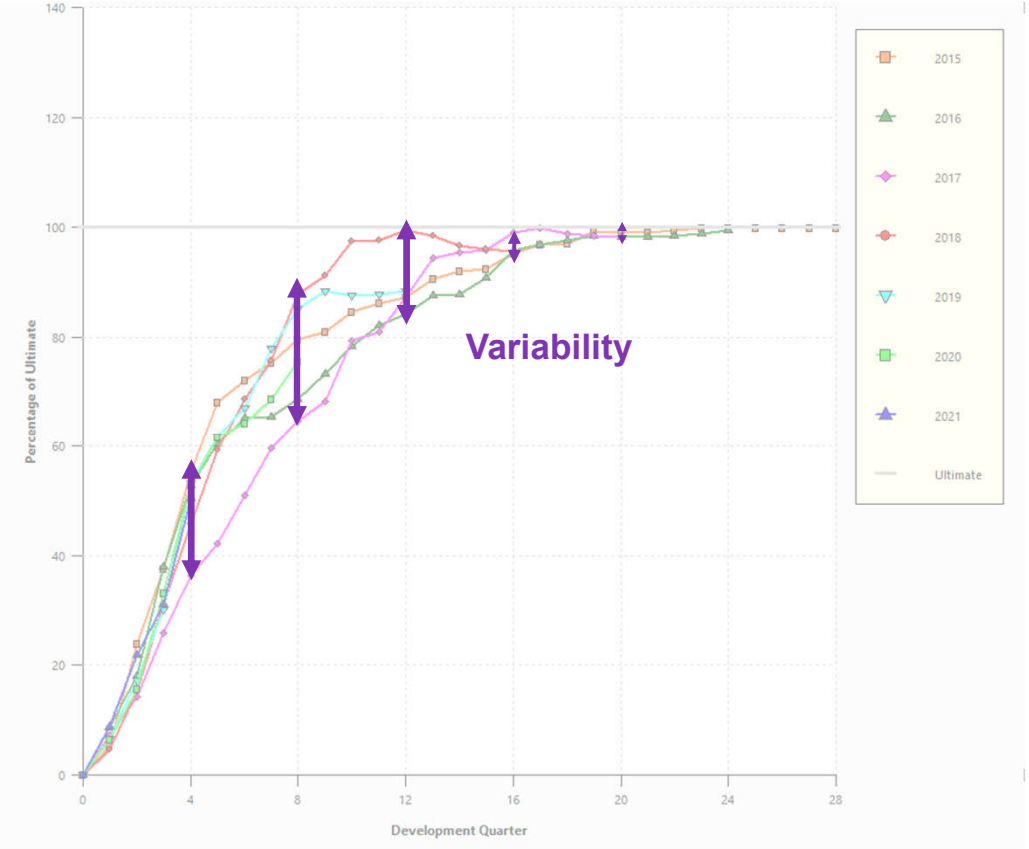
- Our average pattern (used to develop our losses)

The all singing, all dancing all-origin graph



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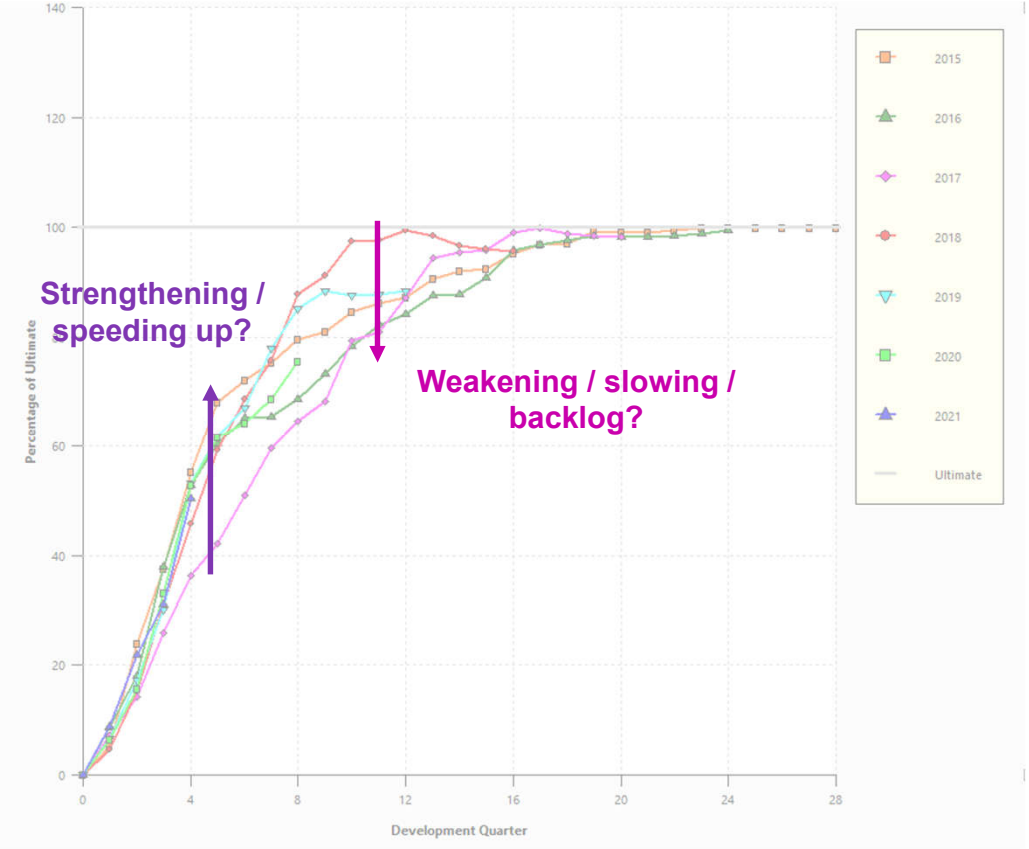

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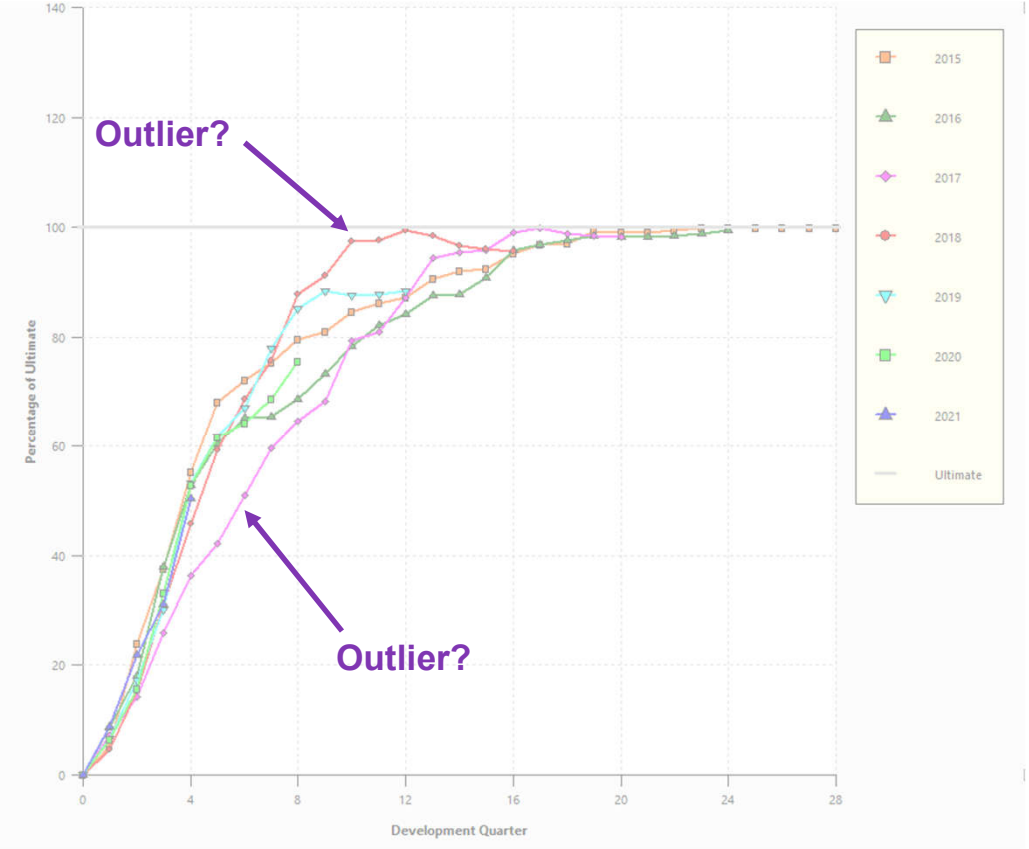
- If there's a time-related pattern associated with that variability (i.e. is the pattern speeding-up or slowing-down?)

The all singing, all dancing all-origin graph



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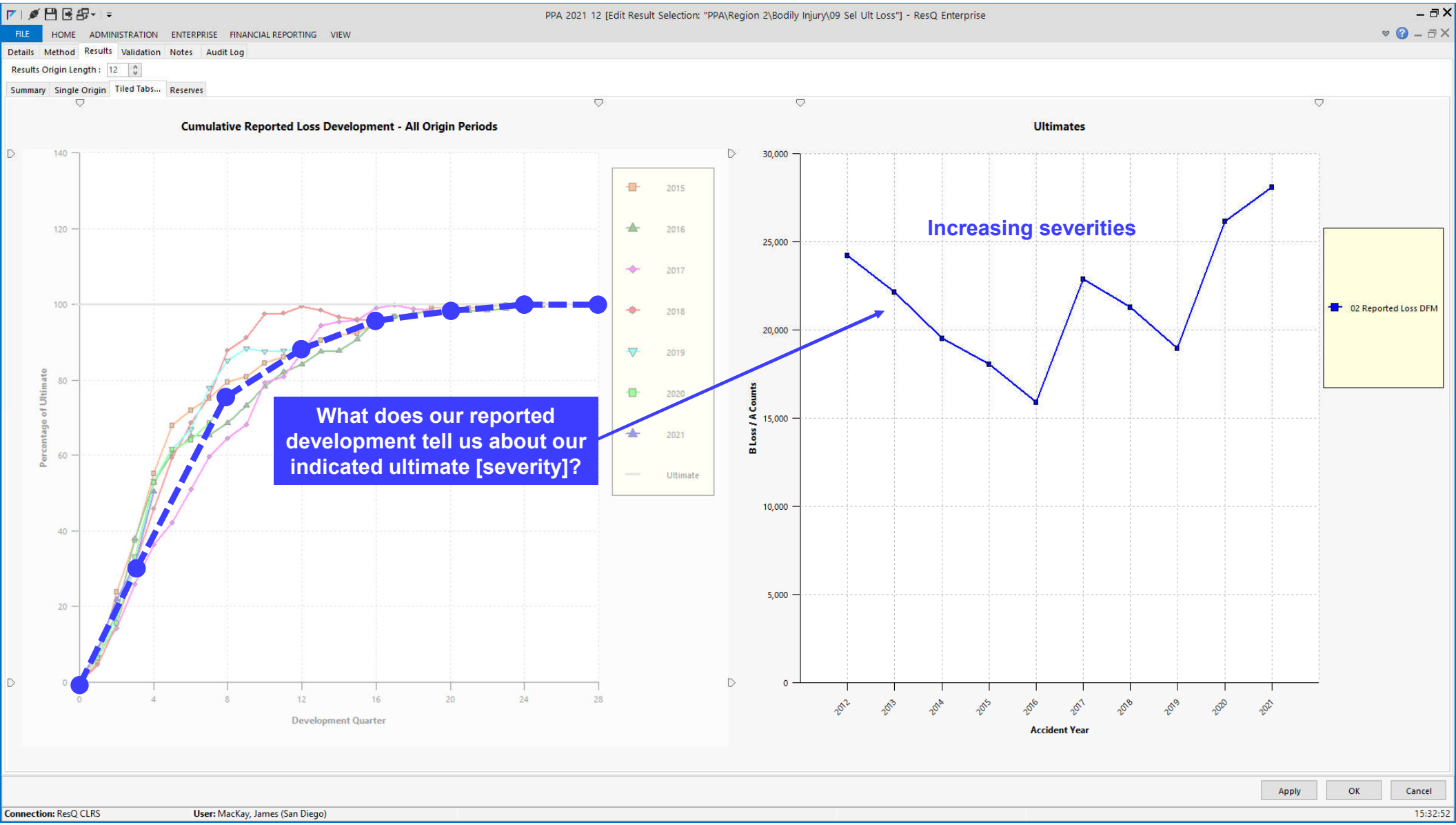
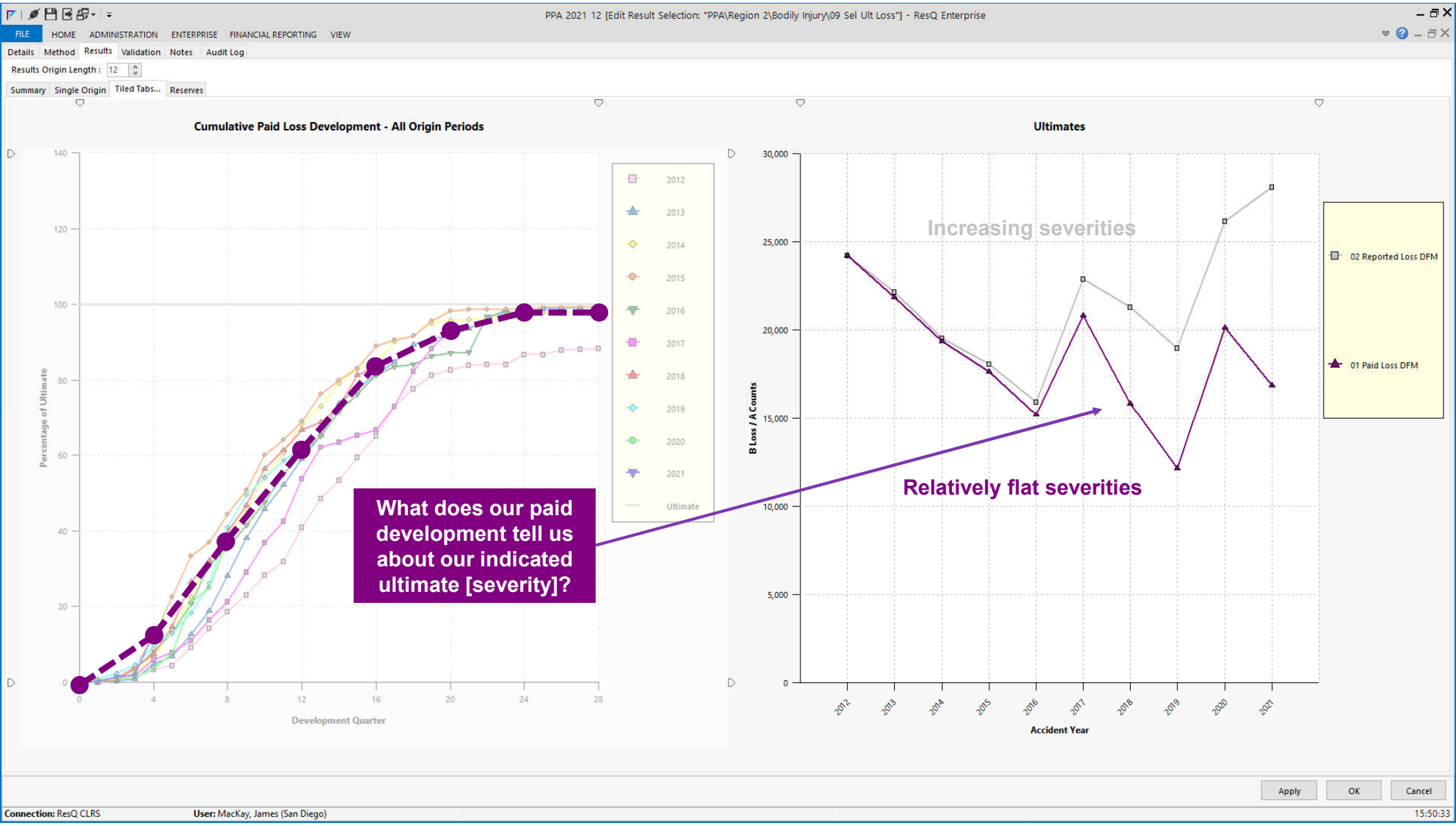
It tells us:

- Our average pattern (used to develop our losses)
- The variability in our historical triangles (which tells us about the variability around our indication)
- If there's a time-related pattern associated with that variability (i.e. is the pattern speeding-up or slowing-down?)
- Are there outliers in our historical development (which may inform how we include or reject those LDFs in the calculation of our patterns)

However, we have to assess the reasonableness of that indication…


PPA 2021 12 [Edit Result Selection: "PPA\Region 2\Bodily Injury\09 Sel Ult Loss"] - ResQ Enterprise
FILE
HOME
ADMINISTRATION
ENTERPRISE
FINANCIAL REPORTING
VIEW
Details
Method
Results
Validation
Notes
Audit Log
Results Origin Length : 12
Summary
Single Origin
Tiled Tabs...
Reserves
Cumulative Reported Loss Development - All Origin Periods
Percentage of Ultimate
Development Quarter
2015
2016
2017
2018
2019
2020
2021
Ultimate
What does our reported development tell us about our indicated ultimate [severity]?
Ultimates
Increasing severities
B Loss / A Counts
Accident Year
02 Reported Loss DFM
Apply
OK
Cancel
Connection: ResQ CLRS
User: MacKay, James (San Diego)
15:32:52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Reserves
Cumulative Paid Loss Development - All Origin Periods
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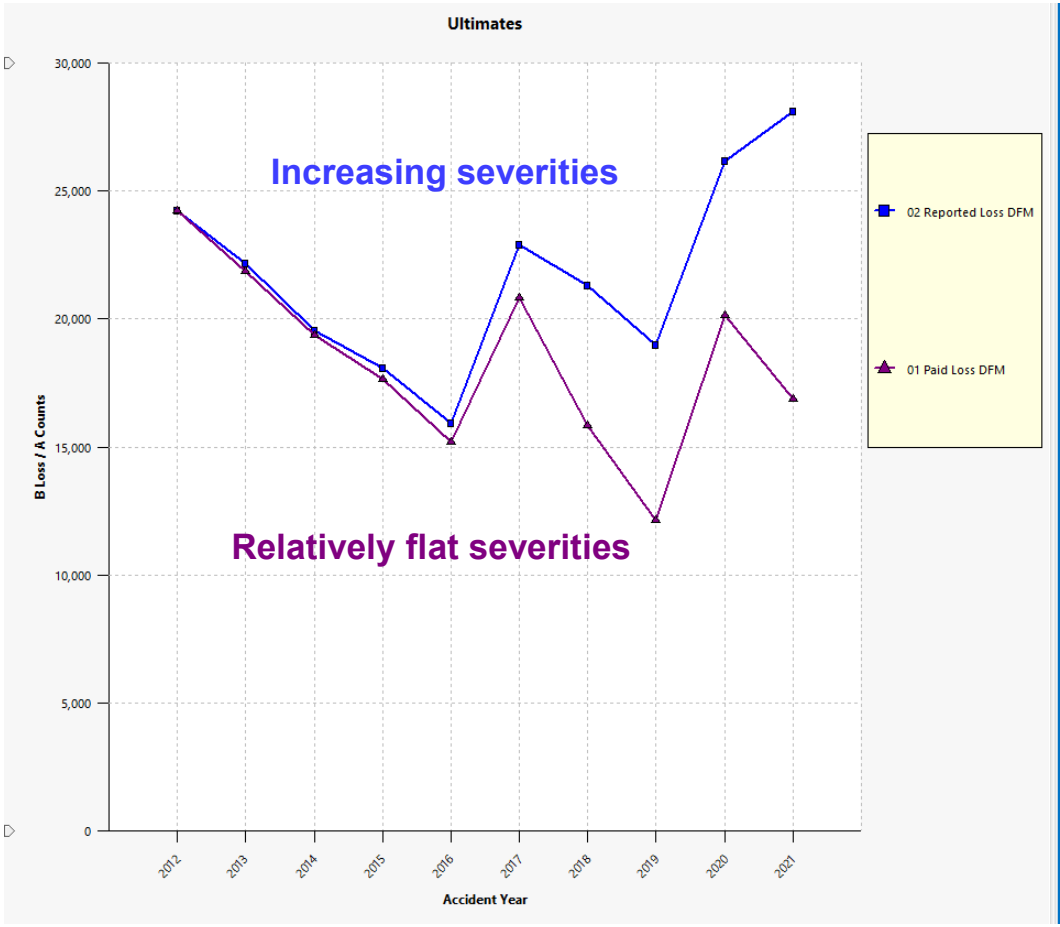
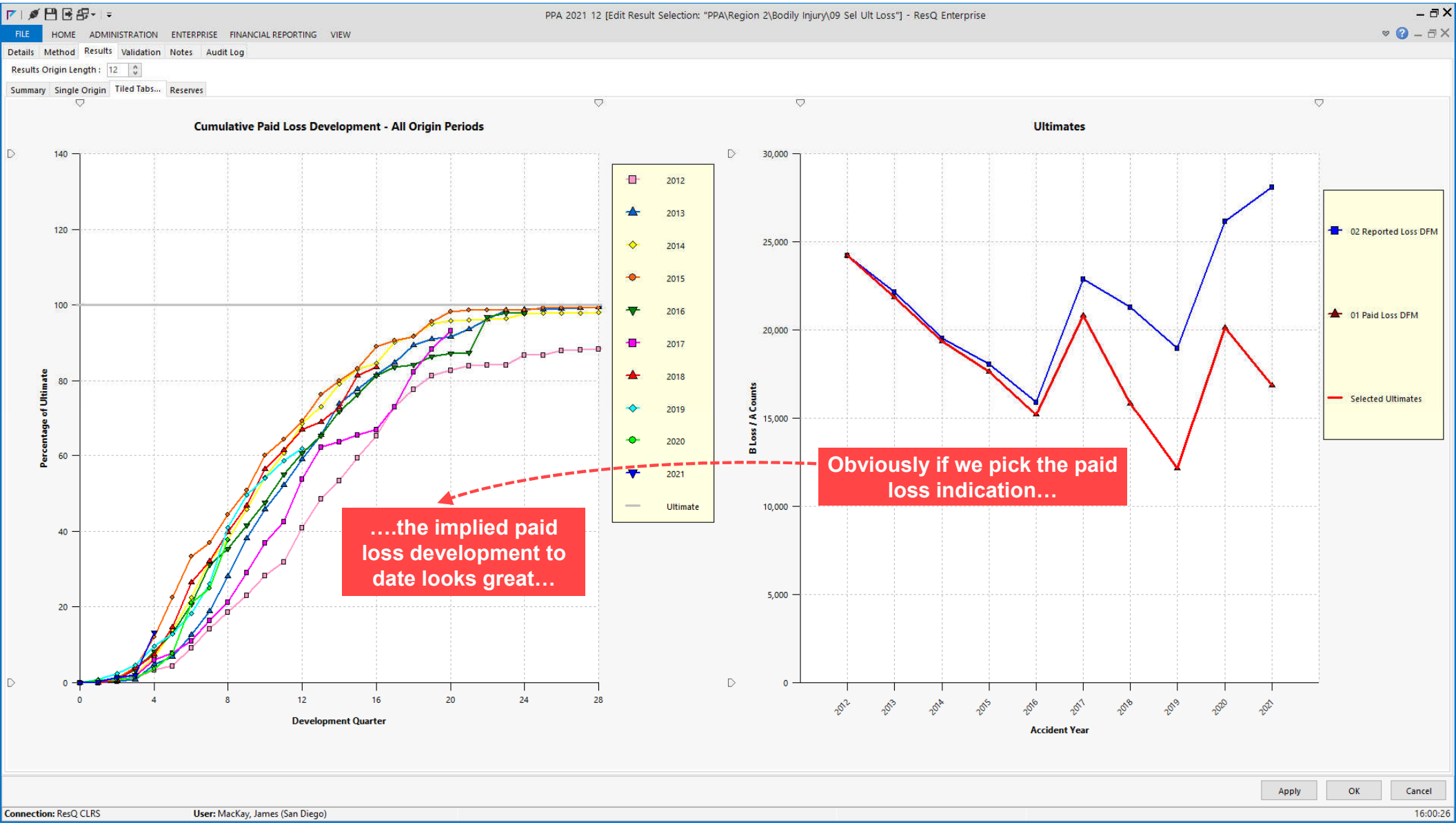
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Ultimate
What does our paid development tell us about our indicated ultimate [severity]?
Ultimates
Increasing severities
Relatively flat severities
B Loss / A Counts
Accident Year
02 Reported Loss DFM
01 Paid Loss DFM
Apply
OK
Cancel
Connection: ResQ CLRS
User: MacKay, James (San Diego)
15:50:33

The importance of context

- We have to make a single selection
- Which is most likely?
- Which is most reasonable?
- Leveraging knowledge of the business is important, but so is understanding the implications of our selection
- Knowing what it's *not*, help build our case for what it is *more likely* to be

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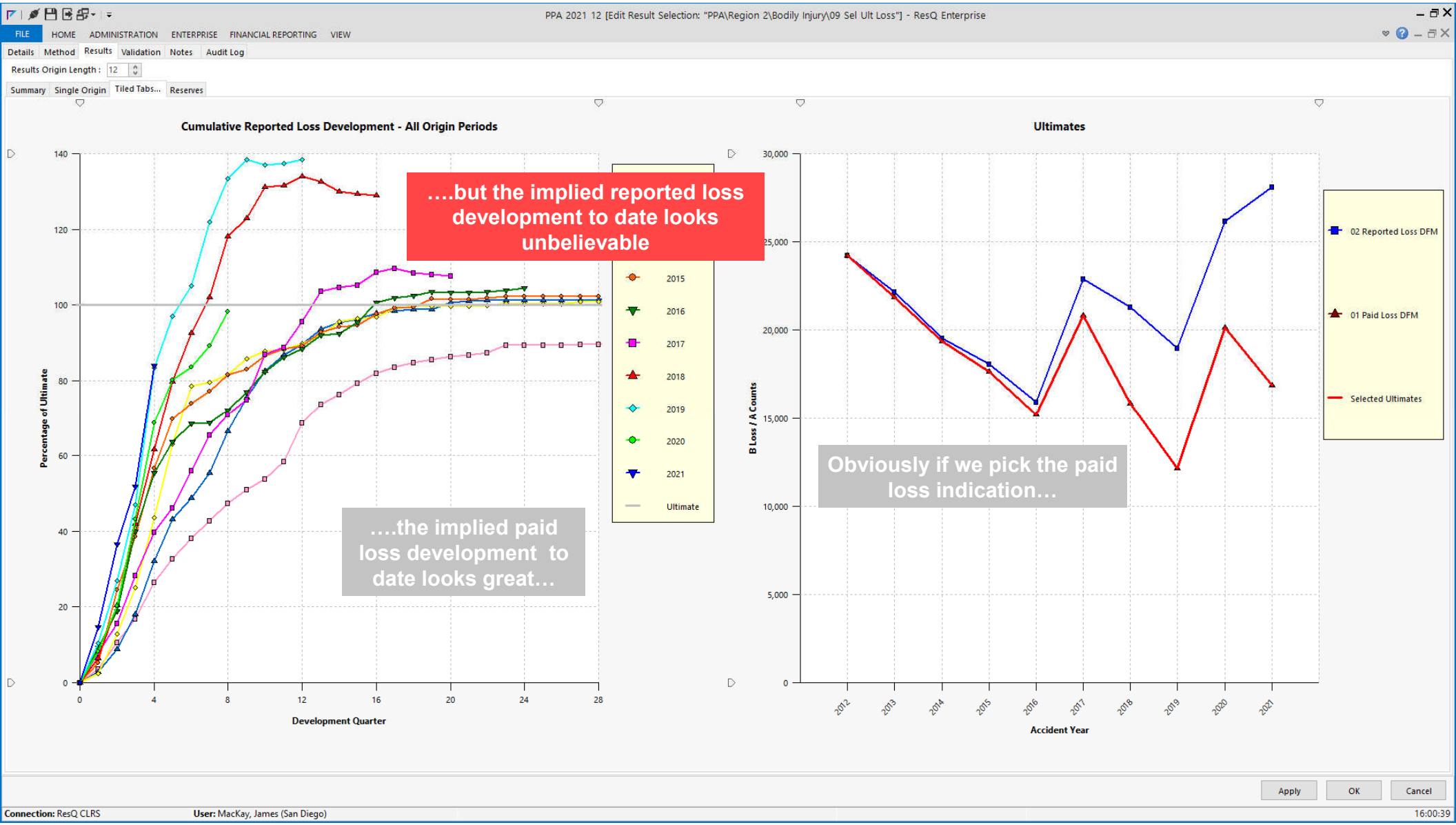
….the implied paid loss development to date looks great…
Ultimates
B Loss / A Counts
Accident Year
02 Reported Loss DFM
01 Paid Loss DFM
Selected Ultimates
Obviously if we pick the paid loss indication…
Apply
OK
Cancel
Connection: ResQ CLRS
User: MacKay, James (San Diego)
16:00:26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….but the implied reported loss development to date looks unbelievable
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Obviously if we pick the paid loss indication…
Apply
OK
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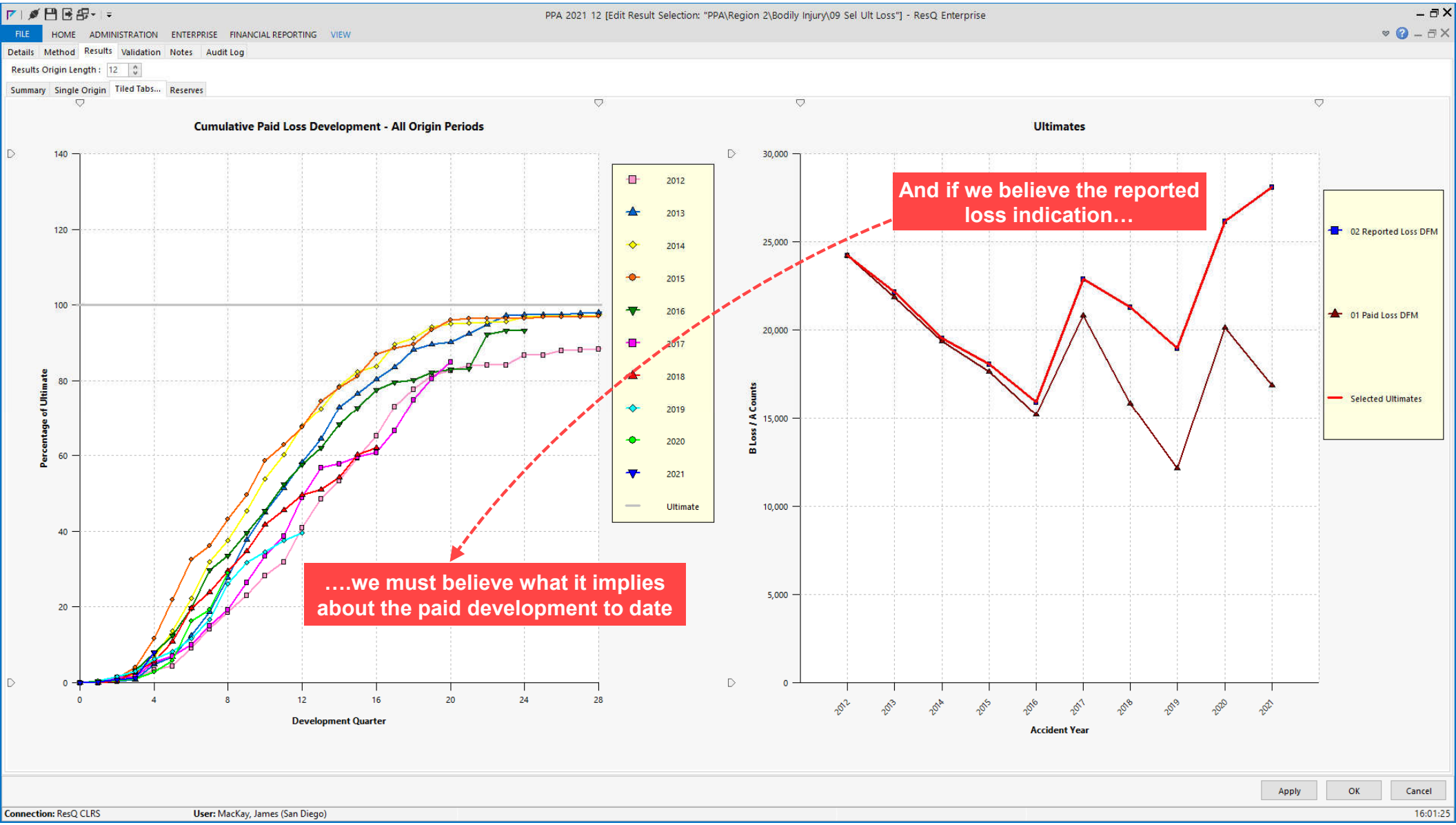
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02 Reported Loss DFM
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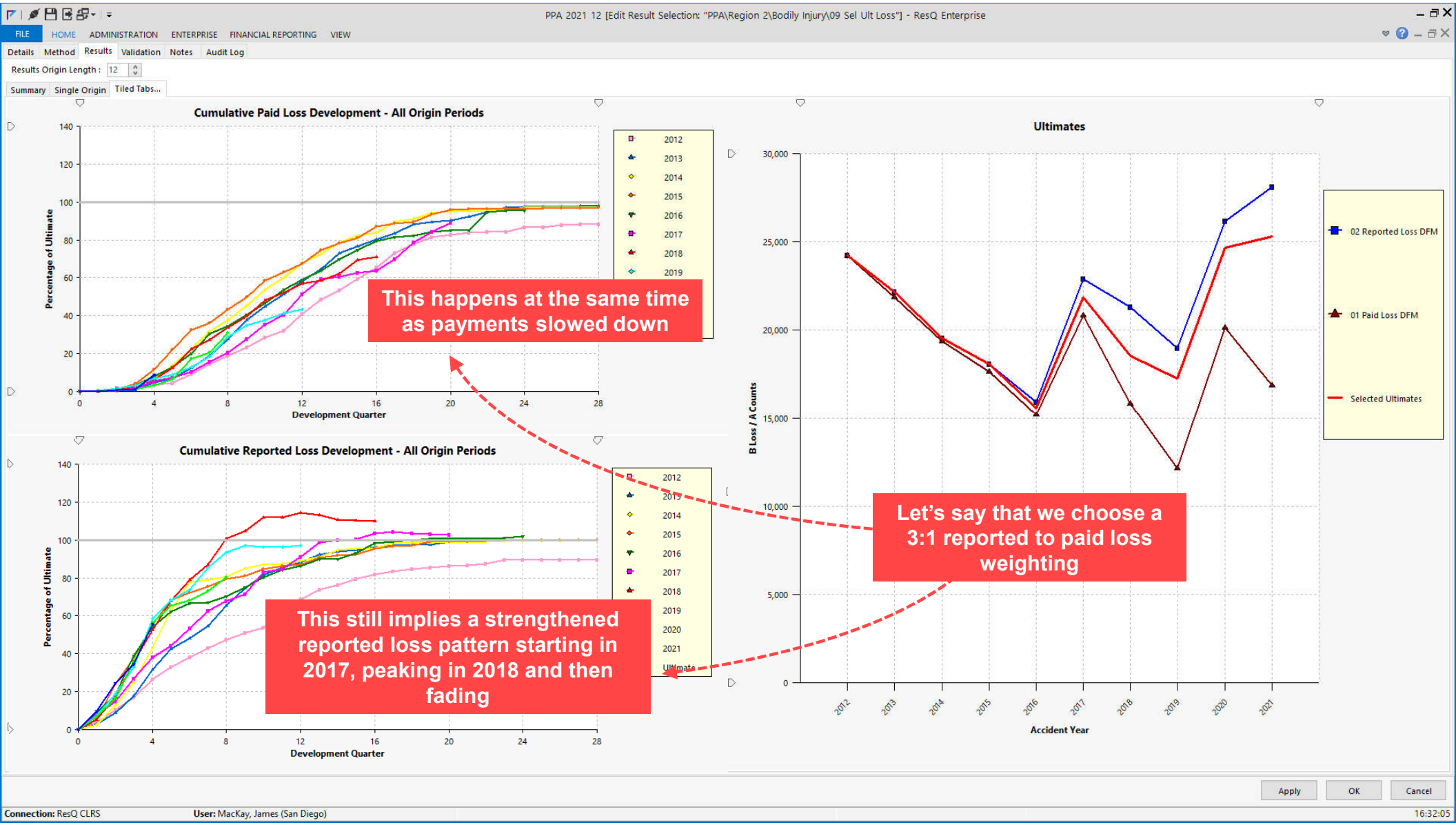
Selected Ultimates
And if we believe the reported loss indication…
….we must believe what it implies about the paid development to date
Apply
OK
Cancel
Connection: ResQ CLRS
User: MacKay, James (San Diego)
16:01:25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This happens at the same time as payments slowed down
This still implies a strengthened reported loss pattern starting in 2017, peaking in 2018 and then fading
Let's say that we choose a 3:1 reported to paid loss weighting
Apply
OK
Cancel
Connection: ResQ CLRS
User: MacKay, James (San Diego)
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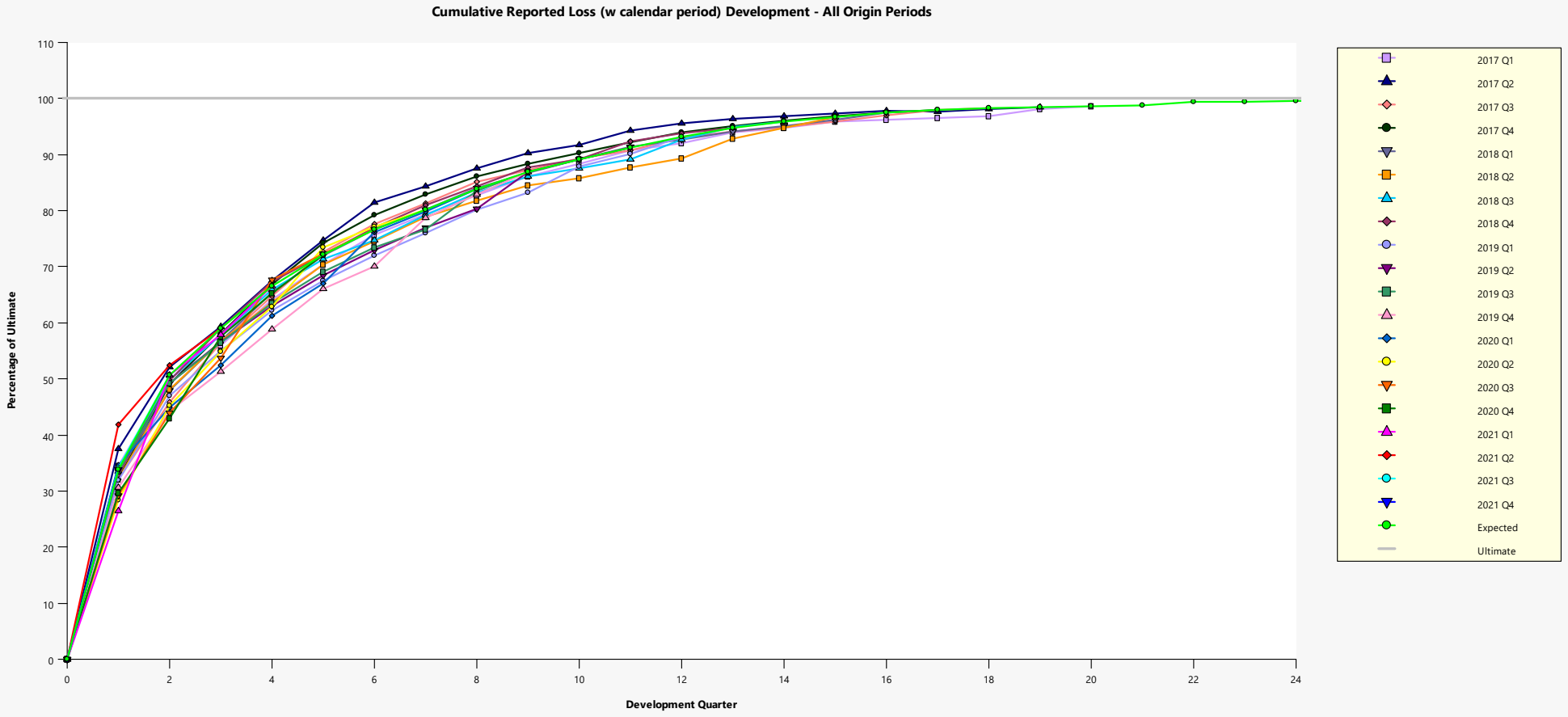
When assessing the reasonableness of a metric or visual, **actively search for a conflicting metric**

A quick eyesight test



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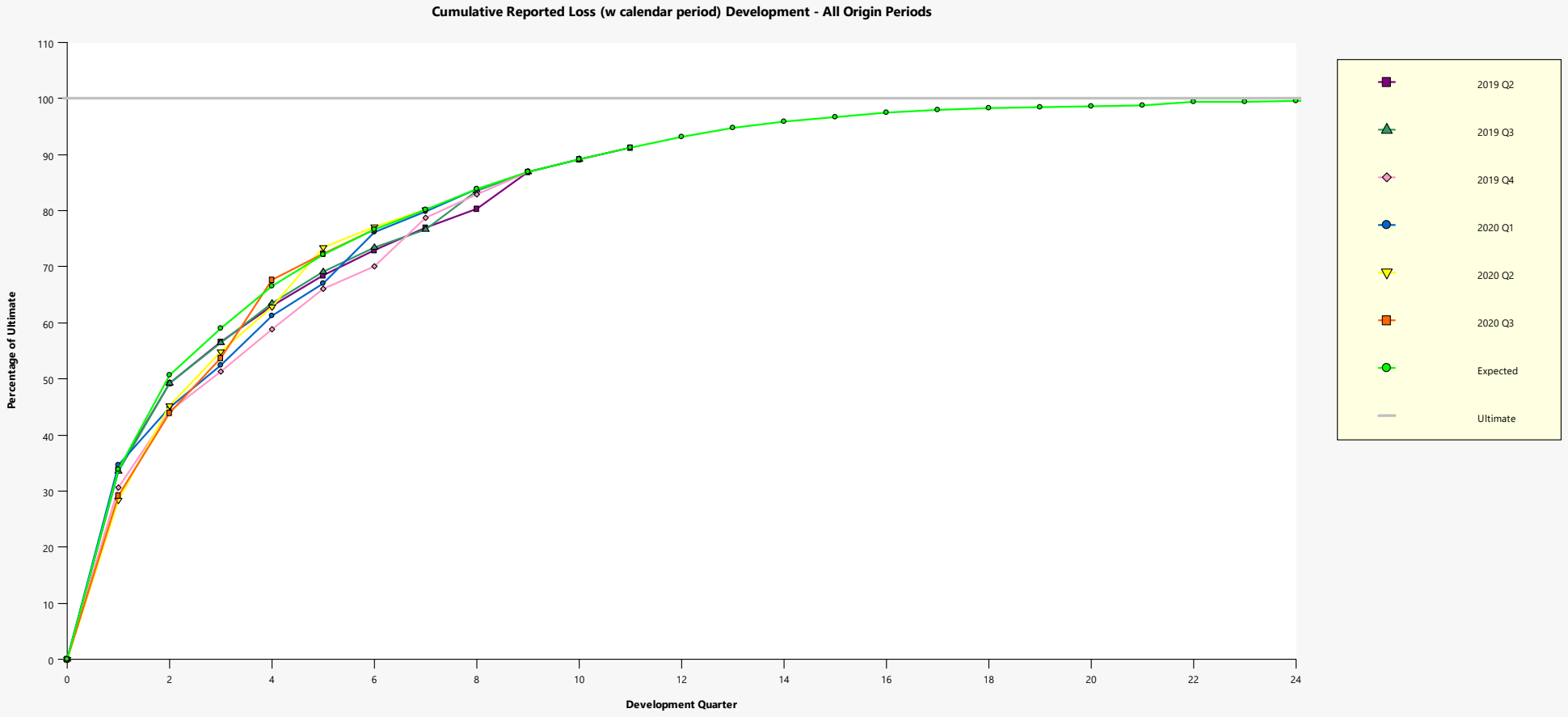
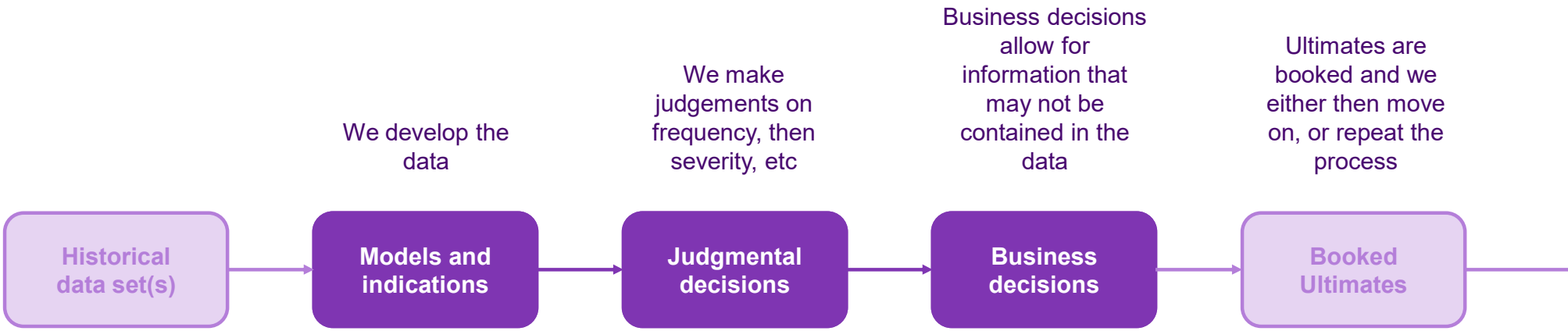


A quick eyesight test

Accident Quarter	(1) 3-6	(2) 6-9	(3) 9-12	(4) 12-15	(5) 15-18	(6) 18-21	(7) 21-24	(8) 24-27	(9) 27-30	(10) 30-33	(11) 33-36	(12) 36-39	(13) 39-42	(14) 42-45	(15) 45-48	(16) 48-51	(17) 51-54	(18) 54-57	(19) 57-60	(20) 60-63	(21) 63-66	(22) 66-69	(23) 69-72	(24) 72-75	(25) 75-78	(26) 78-81	(27
2014 Q1	1.490	1.142	1.104	1.071	1.053	1.042	1.033	1.033	1.035	1.015	1.016	1.014	1.013	1.010	1.008	1.002	1.006	1.004	1.000	1.000	1.001	1.002	1.000	0.999	1.000	1.000	
2014 Q2	1.466	1.171	1.112	1.061	1.053	1.029	1.067	1.039	1.013	1.013	1.004	1.016	1.008	1.005	1.011	1.004	1.000	1.003	1.000	1.001	1.001	1.000	1.000	1.000	1.000	1.000	
2014 Q3	1.550	1.136	1.103	1.080	1.049	1.046	1.047	1.027	1.023	1.023	1.019	1.013	1.012	1.011	1.001	1.002	1.004	1.007	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
2014 Q4	1.583	1.141	1.112	1.068	1.070	1.051	1.028	1.023	1.024	1.019	1.024	1.025	1.017	1.008	1.008	1.000	1.002	1.005	1.005	1.000	1.000	0.999	1.000	1.000	1.001	1.001	
2015 Q1	1.536	1.144	1.111	1.085	1.069	1.033	1.038	1.020	1.022	1.034	1.016	1.024	1.019	1.006	1.013	1.005	1.001	1.001	1.002	1.001	1.000	1.000	1.000	1.000	1.001	1.008	
2015 Q2	1.489	1.152	1.116	1.093	1.064	1.025	1.032	1.038	1.021	1.023	1.034	1.022	1.016	1.014	1.005	1.006	1.002	1.001	1.001	1.000	1.000	1.000	0.999	1.000	1.000	1.001	
2015 Q3	1.470	1.207	1.187	1.062	1.034	1.027	1.040	1.042	1.022	1.031	1.025	1.012	1.010	1.008	1.013	1.007	1.005	1.002	1.011	1.000	1.000	1.000	1.003	1.000	1.000		
2015 Q4	1.547	1.243	1.090	1.041	1.048	1.036	1.049	1.040	1.029	1.031	1.021	1.019	1.016	1.006	1.010	1.006	1.000	1.000	1.000	1.001	1.000	1.001	1.000	1.005			
2016 Q1	1.616	1.113	1.092	1.057	1.046	1.036	1.055	1.054	1.037	1.025	1.031	1.014	1.017	1.012	1.025	1.005	0.999	1.001	1.003	1.002	1.003	1.001	1.001				
2016 Q2	1.327	1.093	1.072	1.066	1.047	1.050	1.046	1.049	1.026	1.032	1.028	1.019	1.010	1.005	1.009	1.006	1.000	1.001	1.001	1.003	1.001	1.004					
2016 Q3	1.394	1.096	1.105	1.085	1.063	1.075	1.064	1.046	1.023	1.023	1.020	1.014	1.018	1.006	1.002	1.001	1.007	1.001	1.005	1.002	1.003						
2016 Q4	1.451	1.141	1.119	1.074	1.077	1.054	1.047	1.049	1.029	1.031	1.010	1.024	1.015	1.008	1.003	1.002	1.004	1.001	1.002	1.000							
2017 Q1	1.457	1.117	1.146	1.098	1.075	1.047	1.043	1.042	1.025	1.028	1.015	1.019	1.009	1.013	1.002	1.003	1.004	1.013	1.006								
2017 Q2	1.386	1.141	1.136	1.106	1.091	1.035	1.038	1.030	1.018	1.026	1.014	1.008	1.006	1.005	1.004	0.999	1.005	1.003									
2017 Q3	1.430	1.233	1.147	1.121	1.068	1.048	1.048	1.024	1.025	1.016	1.025	1.012	1.008	1.011	1.010	1.011	1.003										
2017 Q4	1.522	1.183	1.153	1.111	1.066	1.046	1.040	1.025	1.022	1.020	1.019	1.013	1.010	1.007	1.007	1.005											
2018 Q1	1.431	1.186	1.150	1.102	1.064	1.046	1.048	1.033	1.029	1.025	1.013	1.016	1.010	1.012	1.015												
2018 Q2	1.497	1.180	1.120	1.106	1.061	1.056	1.037	1.033	1.015	1.023	1.018	1.039	1.022	1.021													
2018 Q3	1.489	1.158	1.139	1.085	1.047	1.059	1.051	1.034	1.017	1.017	1.040	1.024	1.010														
2018 Q4	1.516	1.186	1.141	1.072	1.066	1.053	1.042	1.039	1.018	1.034	1.017	1.010															
2019 Q1	1.475	1.171	1.130	1.087	1.066	1.056	1.054	1.038	1.056	1.025	1.034																
2019 Q2	1.456	1.148	1.114	1.087	1.064	1.057	1.043	1.081	1.027	1.023																	
2019 Q3	1.466	1.147	1.123	1.090	1.061	1.044	1.091	1.040	1.025																		
2019 Q4	1.447	1.158	1.150	1.121	1.062	1.123	1.051	1.050																			
2020 Q1	1.296	1.168	1.168	1.094	1.136	1.048	1.051																				
2020 Q2	1.591	1.214	1.143	1.169	1.050	1.041																					
2020 Q3	1.511	1.221	1.259	1.069	1.059																						
2020 Q4	1.451	1.338	1.134	1.105																							
2021 Q1	1.912	1.141	1.149																								
2021 Q2	1.249	1.127																									
2021 Q3	1.482																										
2021 Q4																											
Average Factors																											

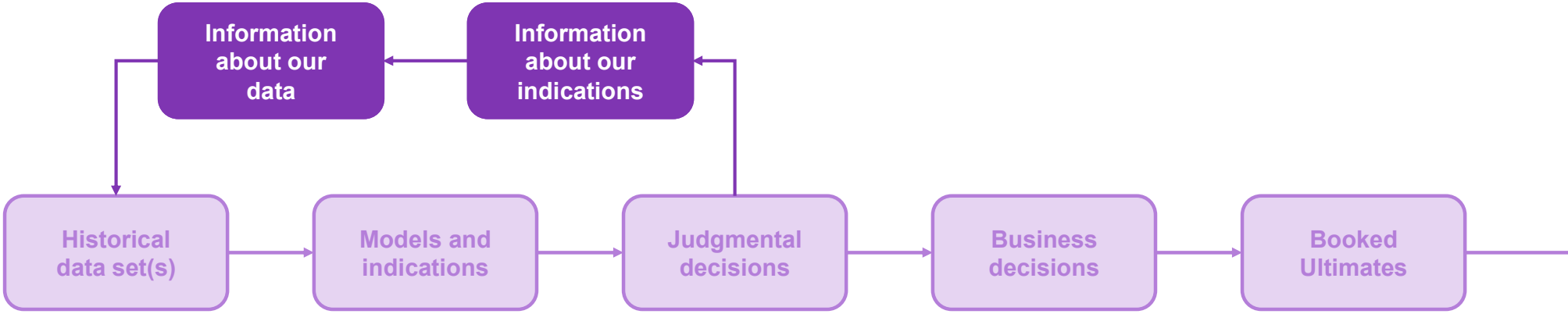
Building a house…

I often compare the development of loss indications as ‘building a house’.



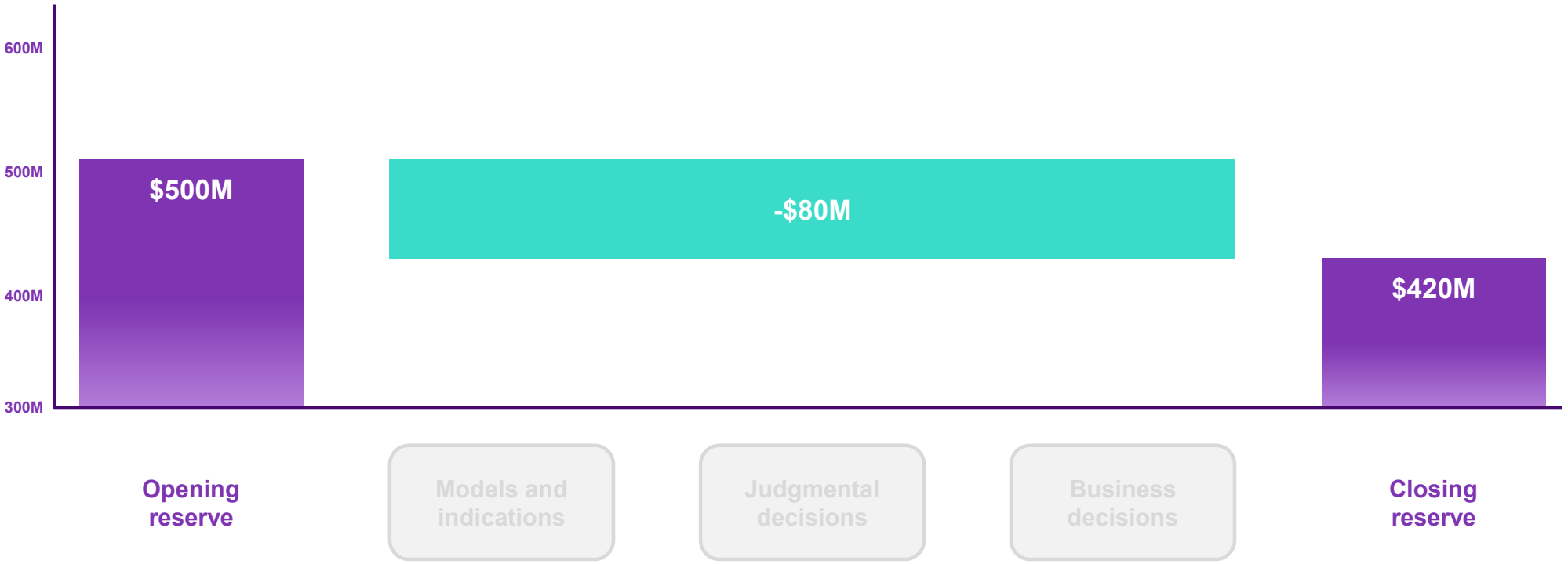
Building a house…and learning about our materials

I often compare the development of loss indications as ‘building a house’.
Using visualizations allows us to feed usable information back to the business and complete the virtuous cycle.
The different perspectives allow us explain the results though a lens understandable to the audience.
In other words, while our data informs our ultimate selections, those same ultimate selections provide context to the data.

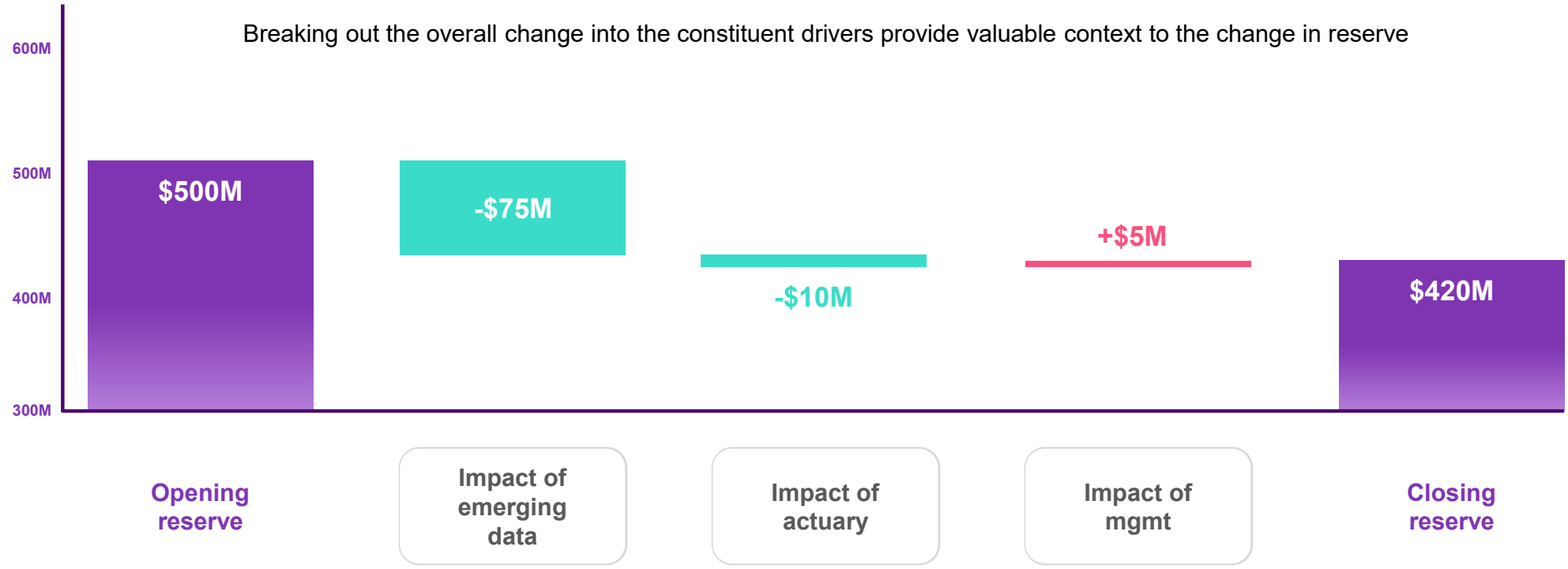


Providing insight into the decision-making process

Providing insight into the decision-making process



Providing insight into the decision-making process



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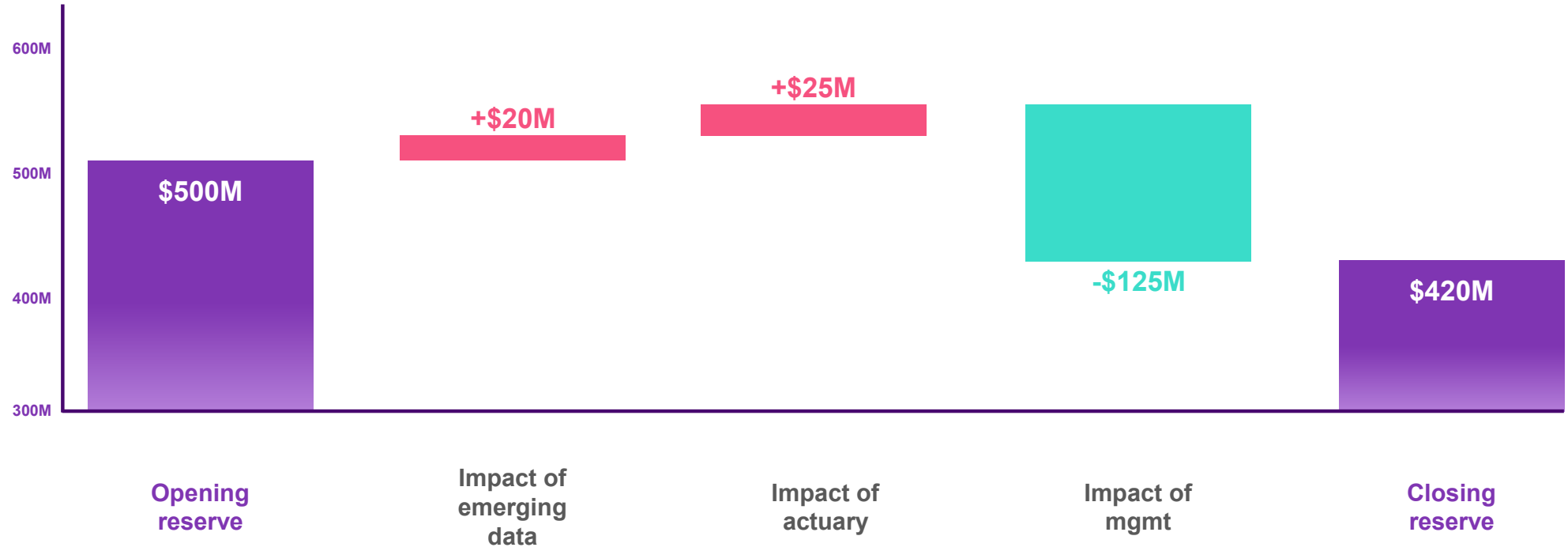
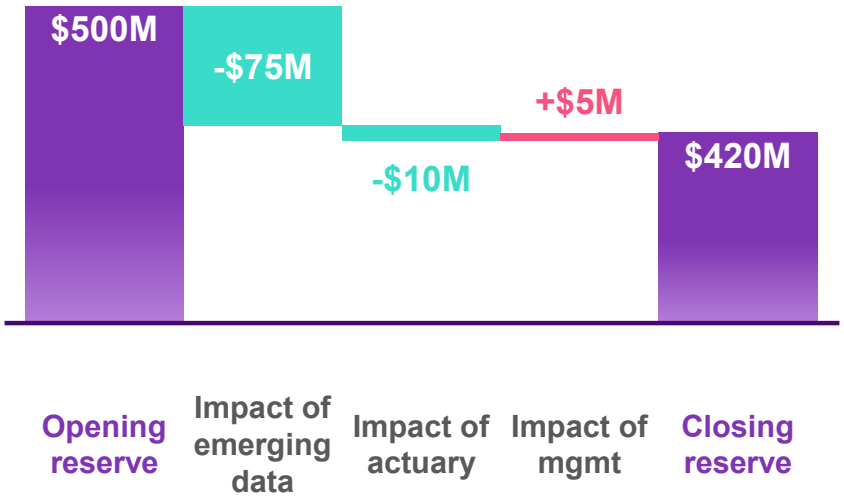
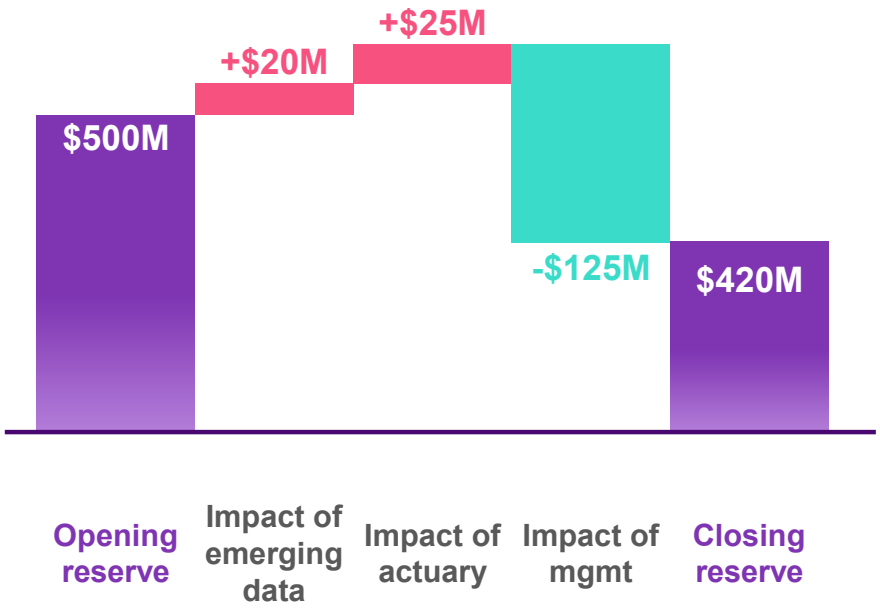


Providing insight into the decision-making process

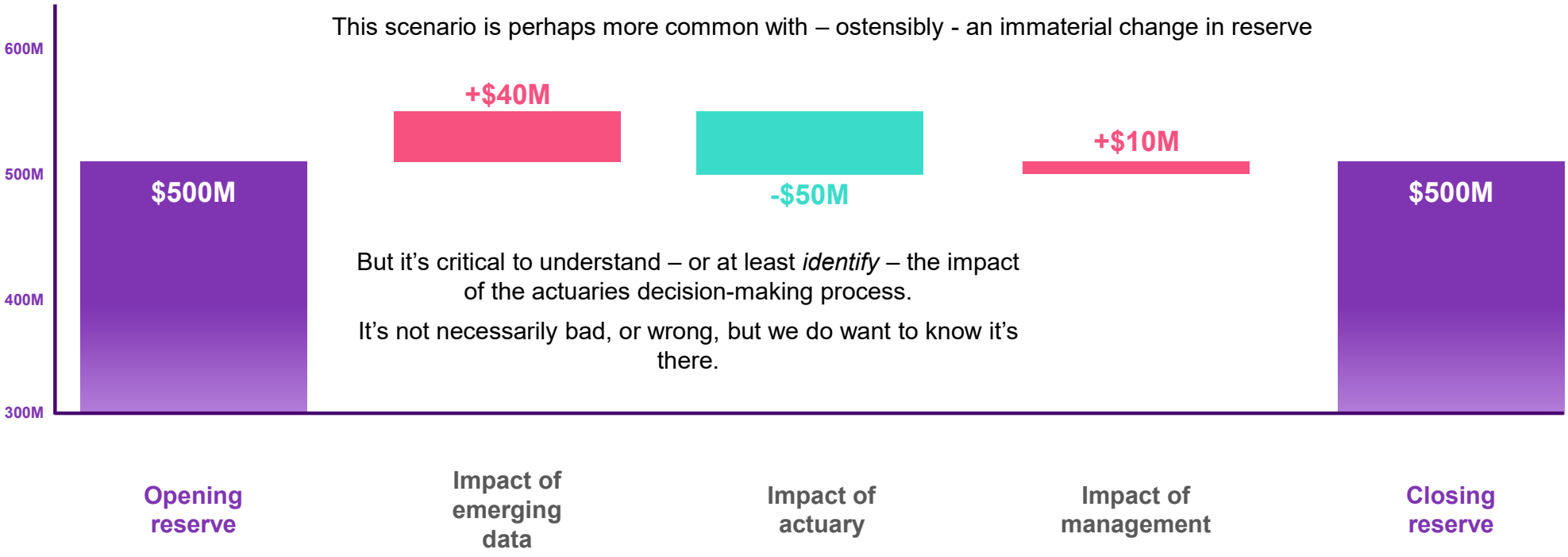
While the overall change in reserve is exactly the same, the picture that emerges is far different





Providing insight into the decision-making process

This scenario is perhaps more common with – ostensibly - an immaterial change in reserve



But it's critical to understand – or at least *identify* – the impact of the actuaries decision-making process.

It's not necessarily bad, or wrong, but we do want to know it's there.

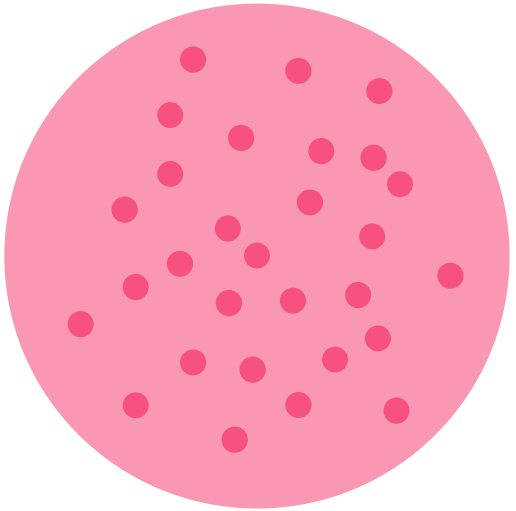
Providing insight into the decision-making process

There's a lot of data, a lot of judgement and a lot of decisions that are made in the course of our day-to-day work

However, not adequately explaining or quantifying the "judgmental" part can potentially lead to

- Distrust
- An inability to reconcile different points of view
- a lack of confidence in our selected result and a perceived lack of transparency

This can result in unfocussed discussions, irreconcilable differences and a increased uncertainty.



Providing insight into the decision-making process

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- An inability to reconcile different points of view
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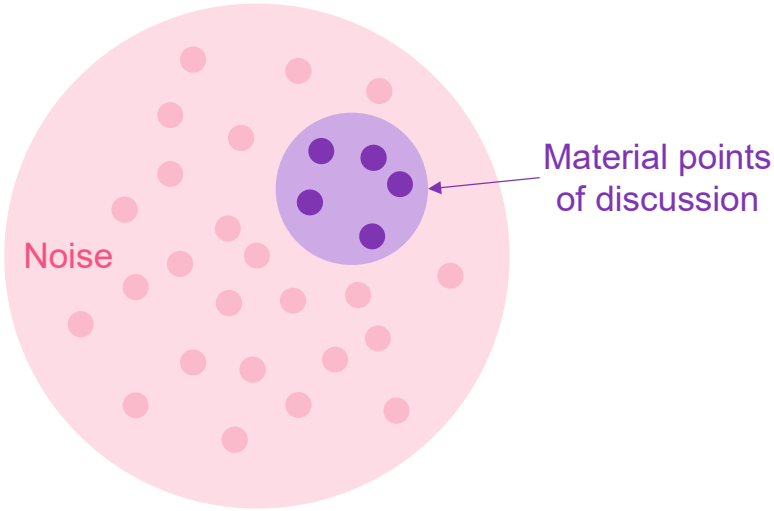
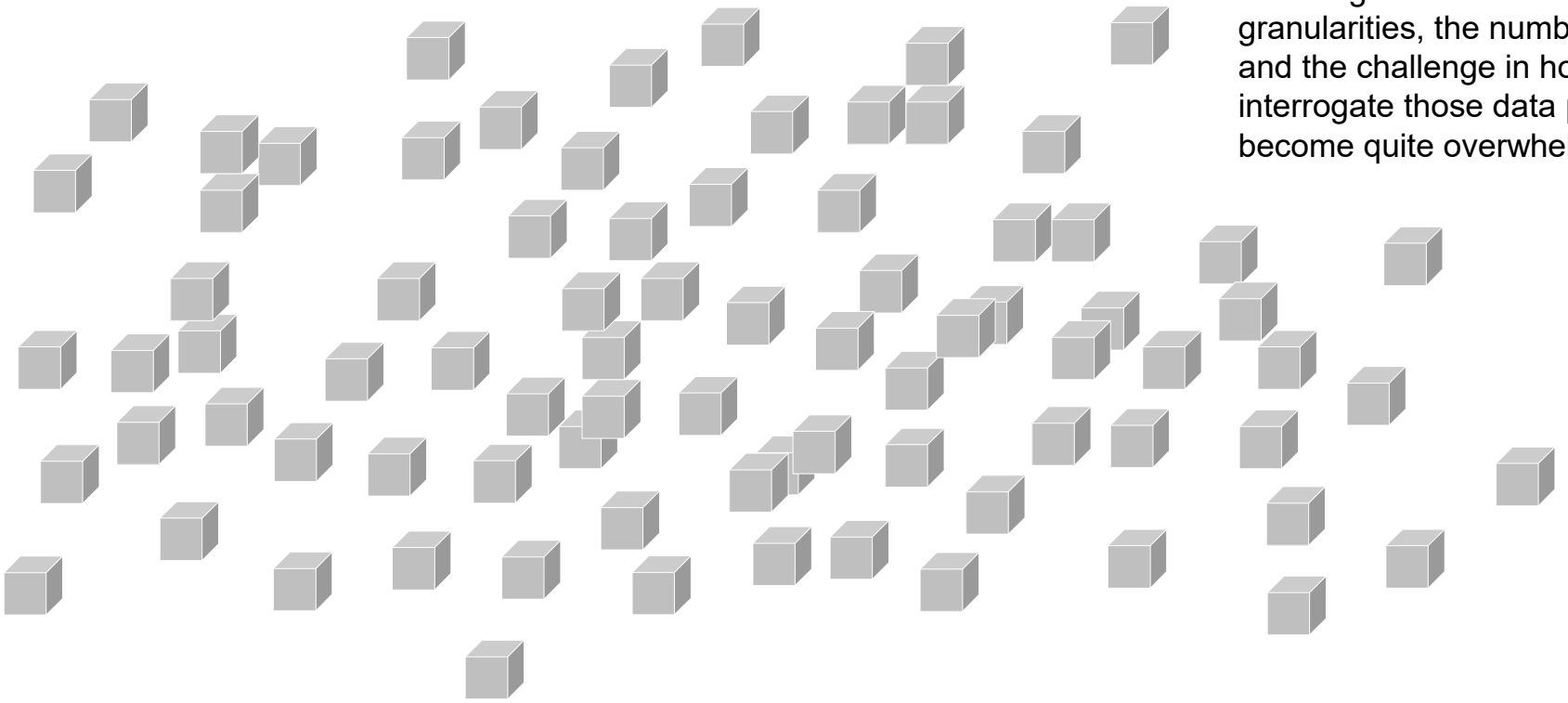
This can result in unfocussed discussions, irreconcilable differences and a increased uncertainty.

Providing suitable context around how our results changed – and by whom and when – allows us to have a more focused discussion on material issues.

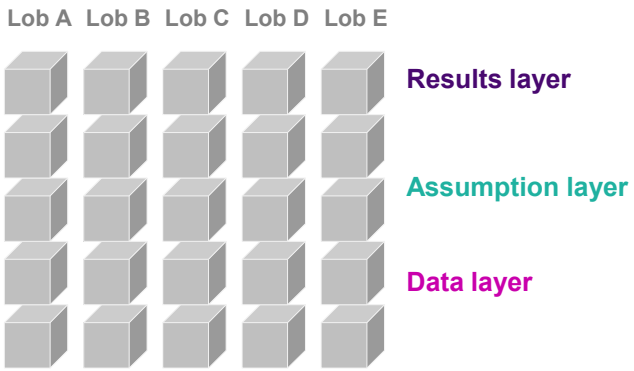


Building a map



With larger data sets and increased granularities, the number of data points – and the challenge in how to effectively interrogate those data points - can become quite overwhelming

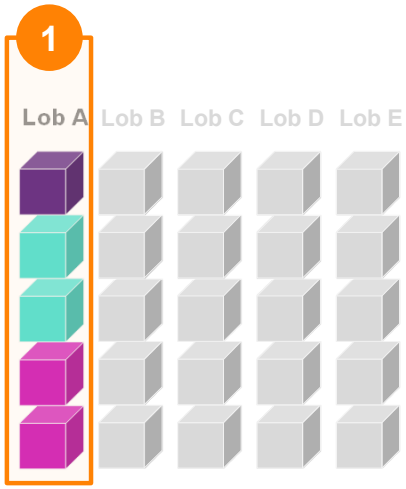
Building a map



Building a map

A **vertical** (ground-up or top-down) allows us to build a story from the data to the results (or vice versa).

This is useful for building a narrative around a specific line of business and allows the user to see a relevant selection of KPIs that explain the results.

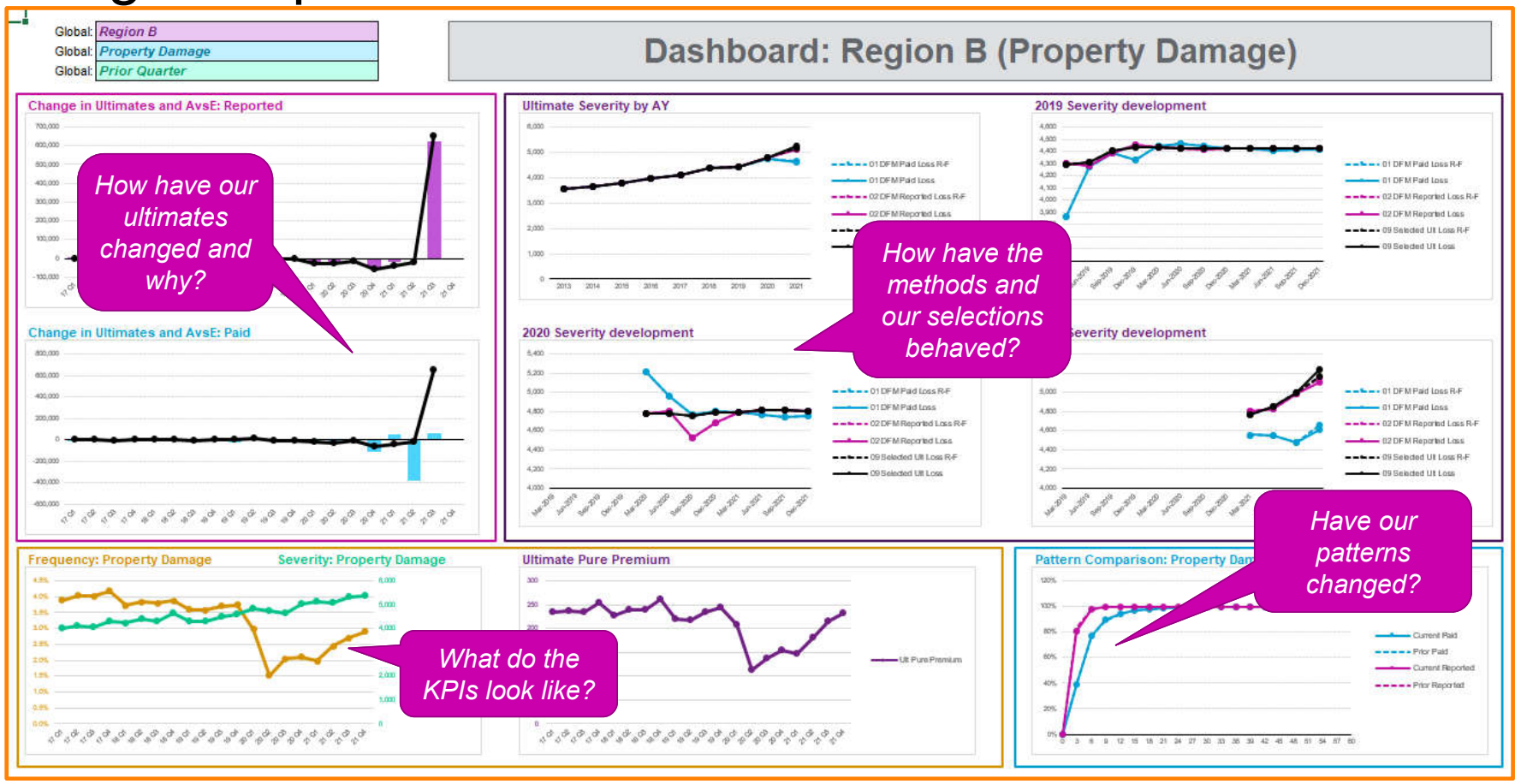


Results layer

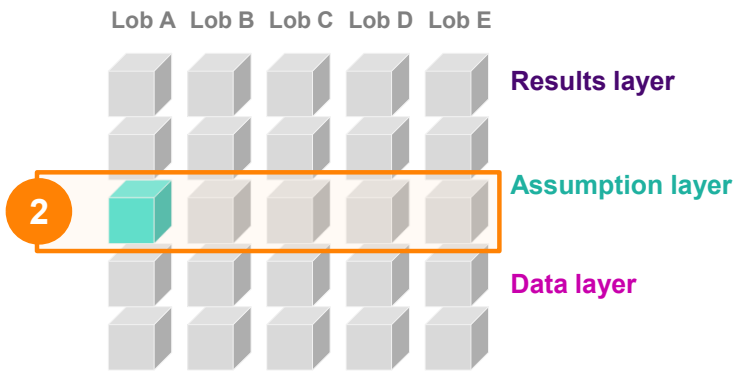
Assumption layer

Data layer

Building a map



Building a map



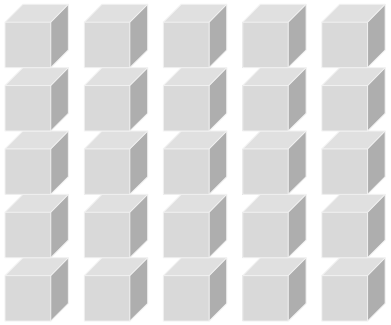
A **horizontal** cut allows us to identify trends or outliers across lines of business.

This is useful when assessing large and / or correlated lines and managing large teams.

Supported by a somewhat consistent approach to data and method conventions across LoBs.

Building a map

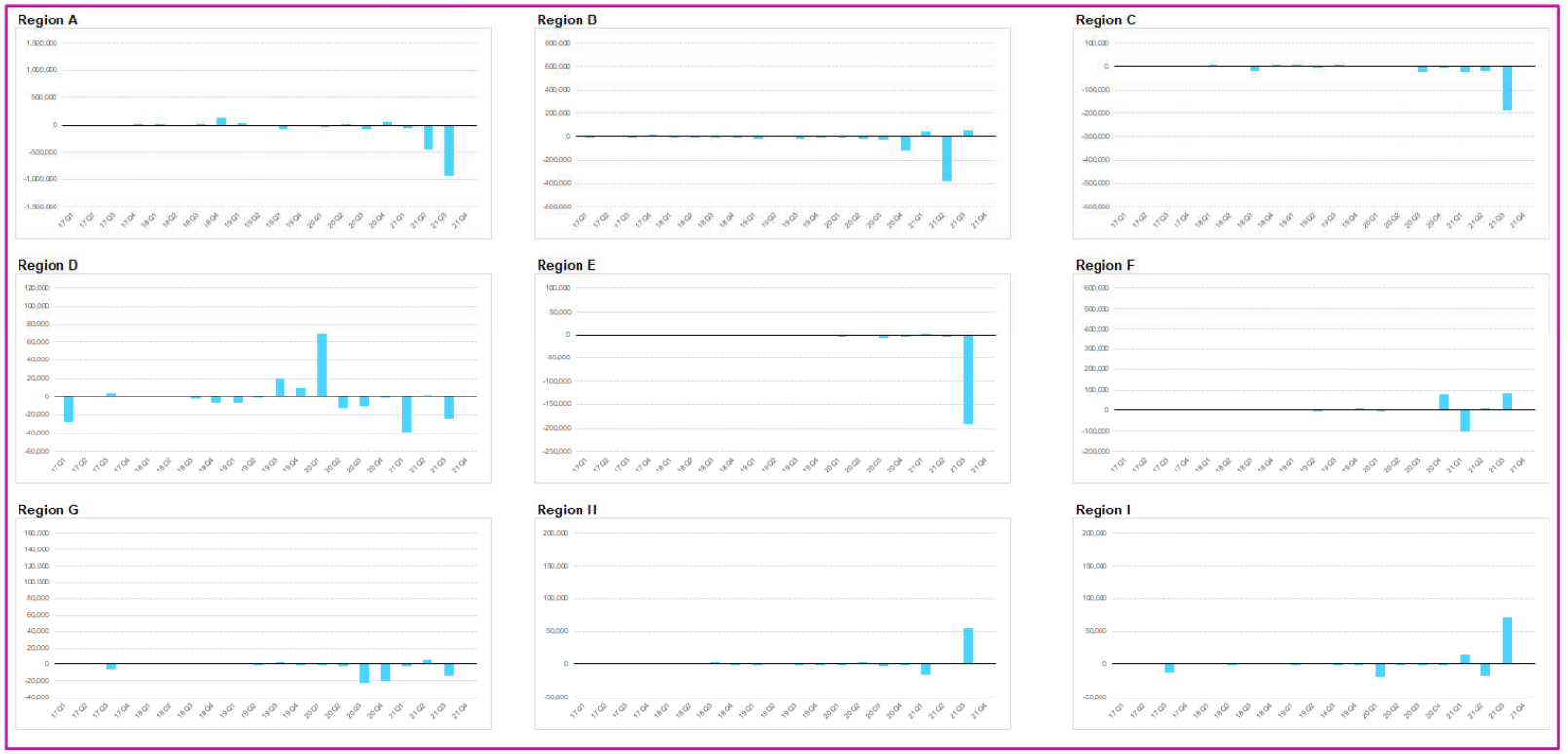
Lob A Lob B Lob C Lob D Lob E



How has the paid developed?

Global: *Property Damage*
Global: *Prior Quarter*

Change in Ultimates and AvsE by Regions and AQ



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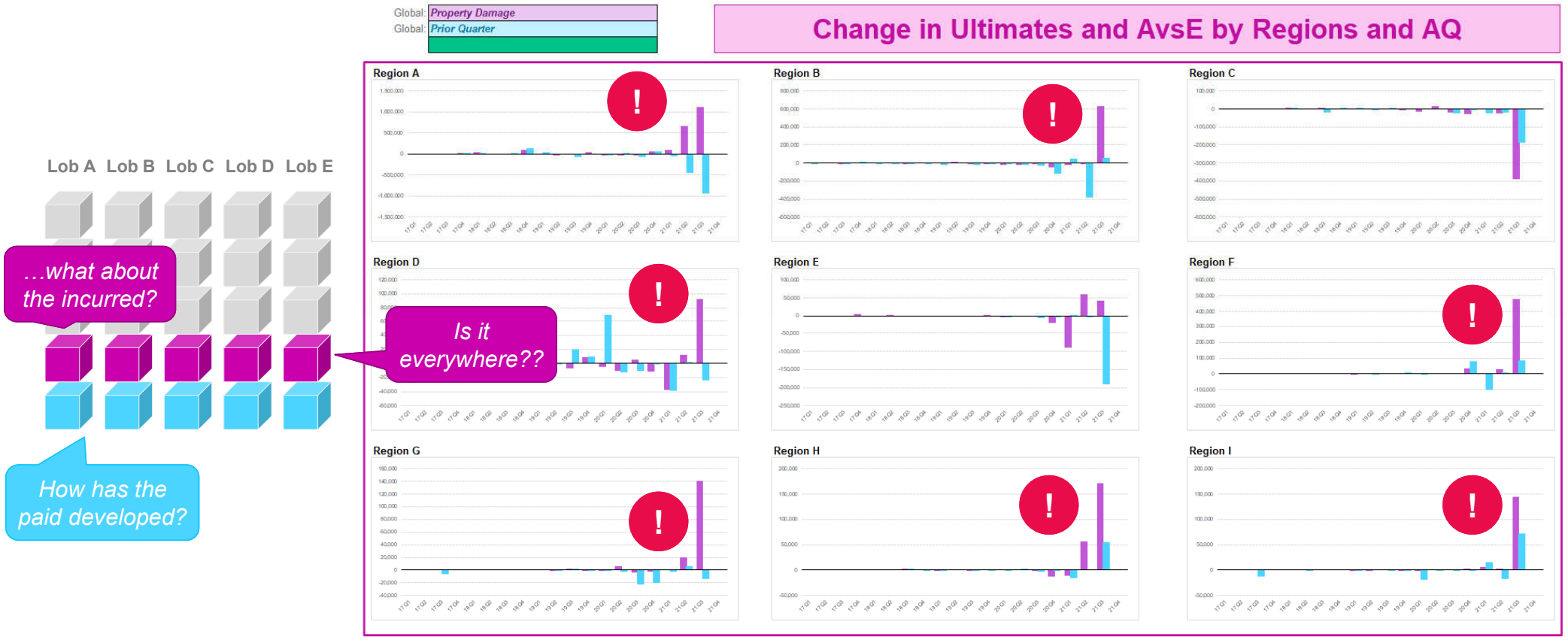

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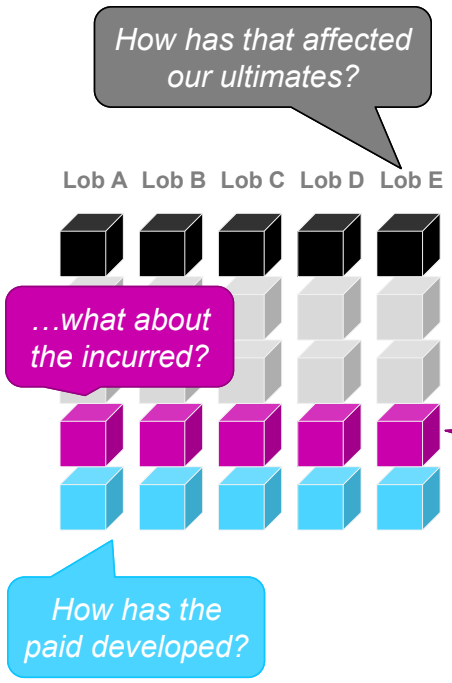

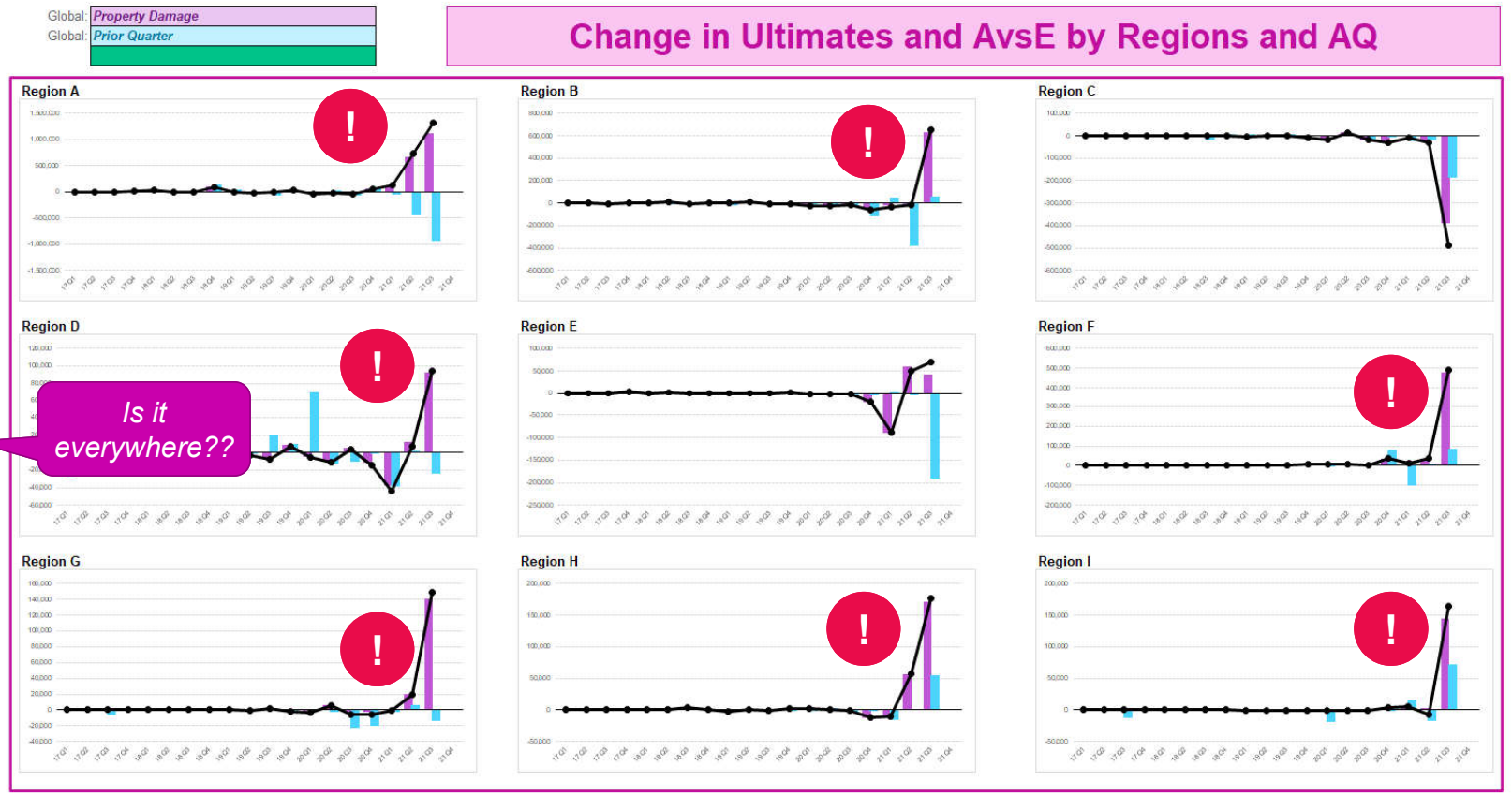

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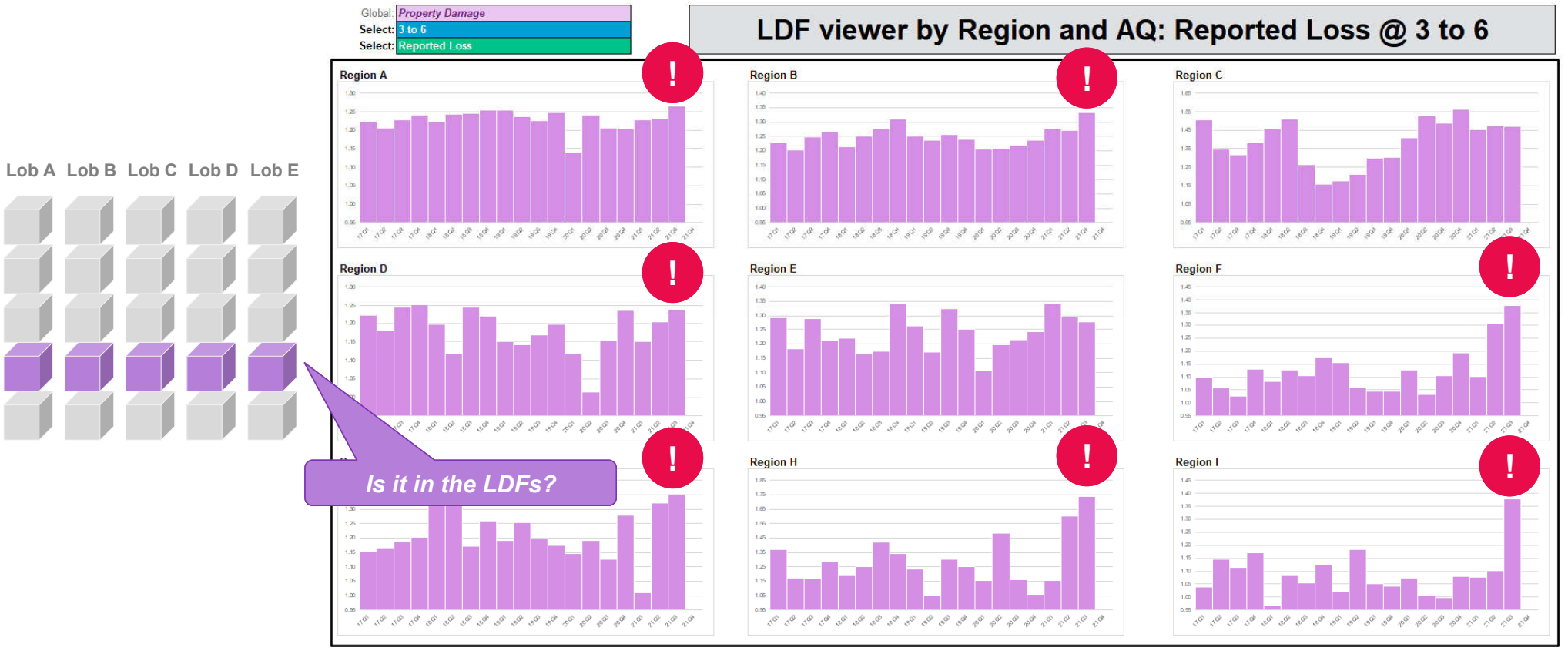

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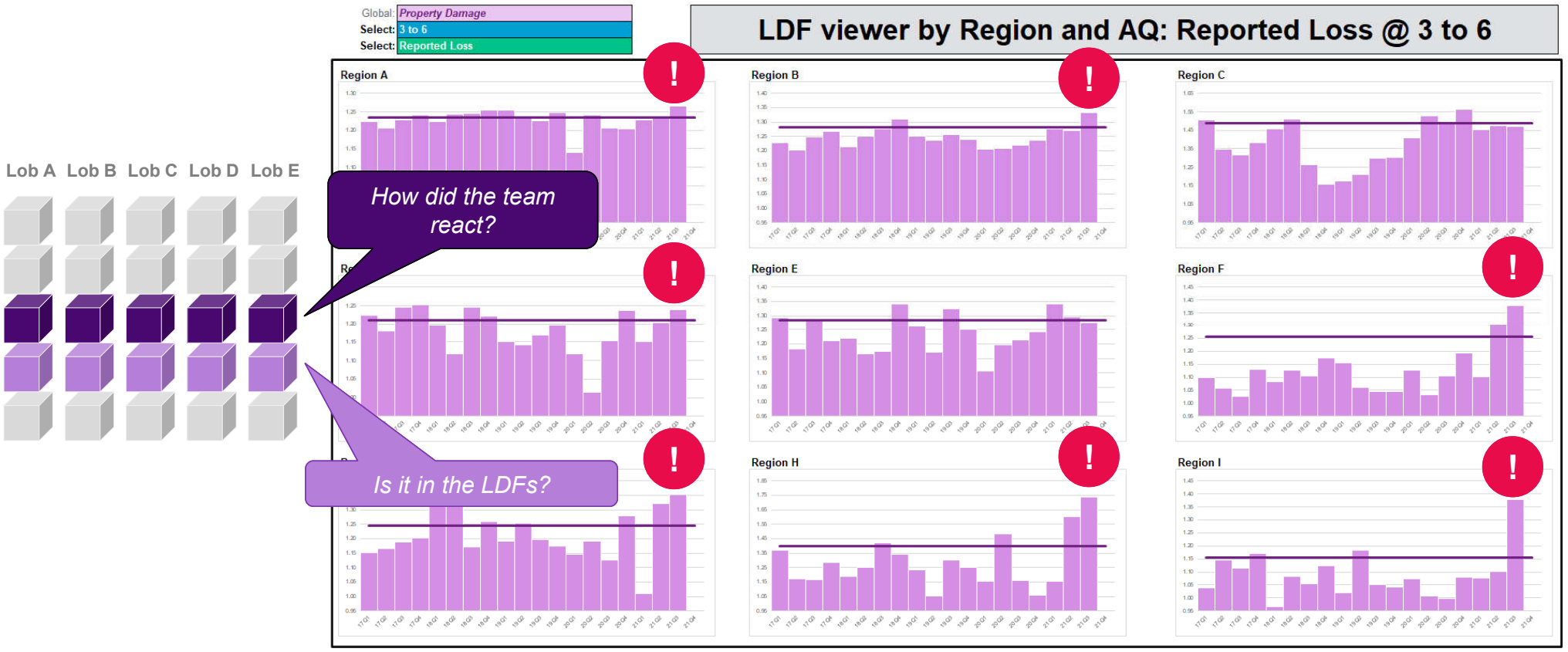

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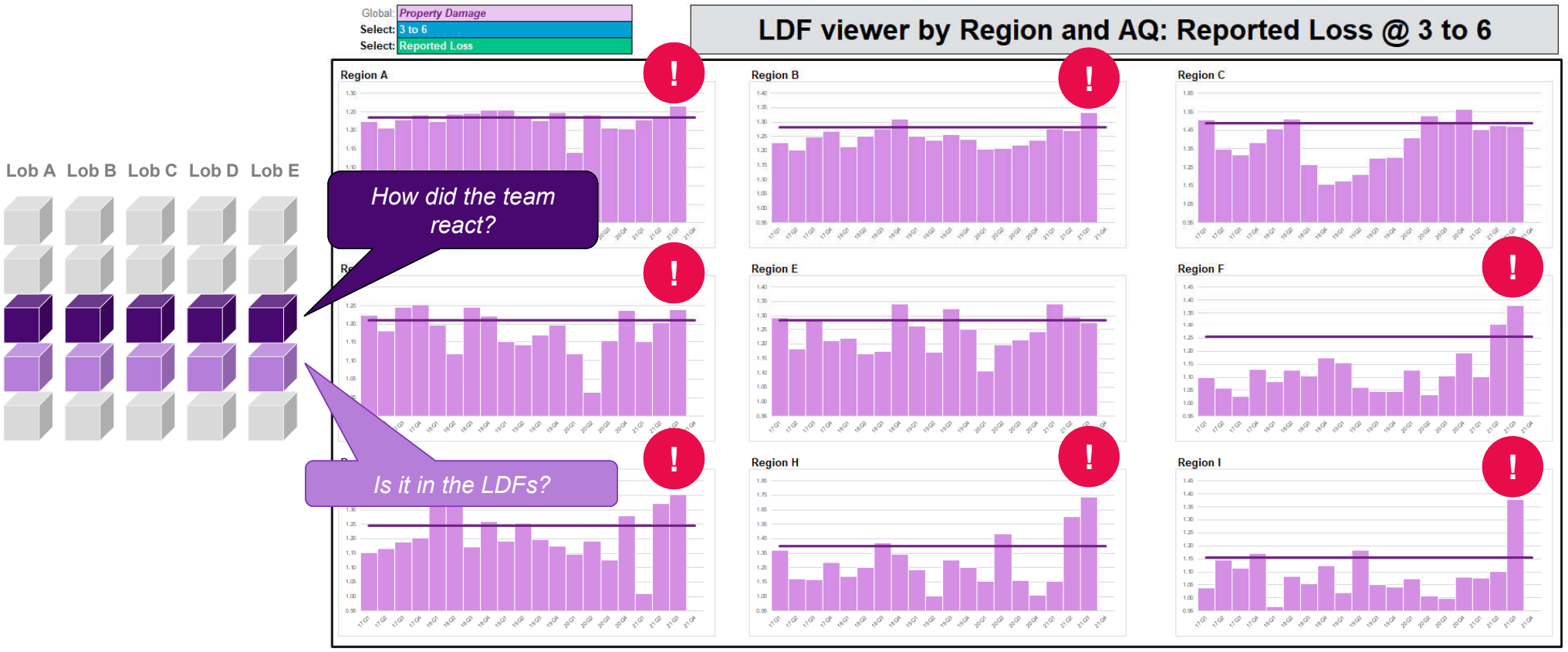

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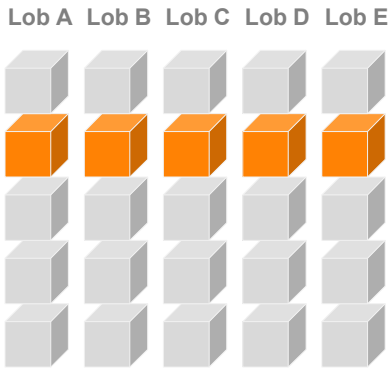
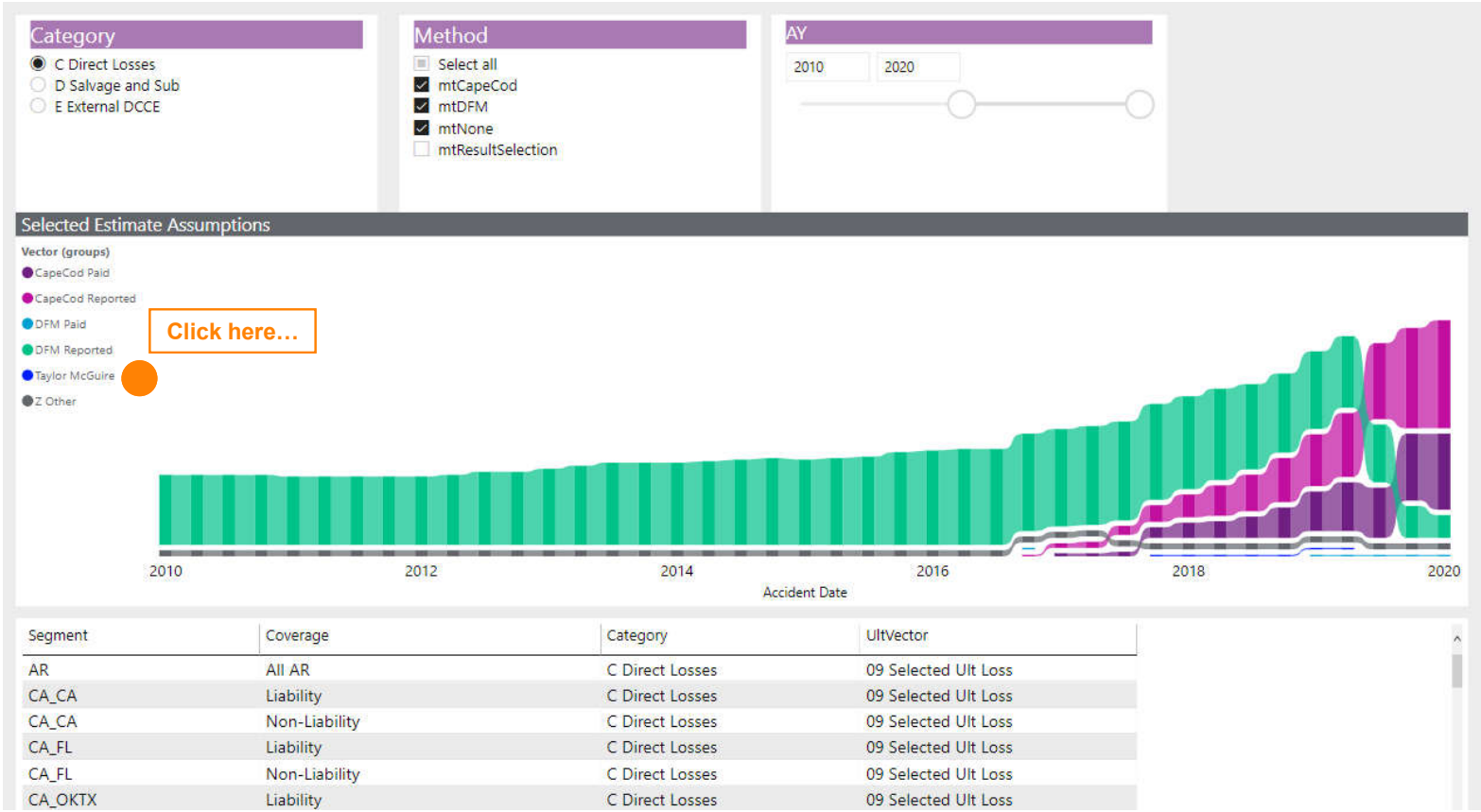
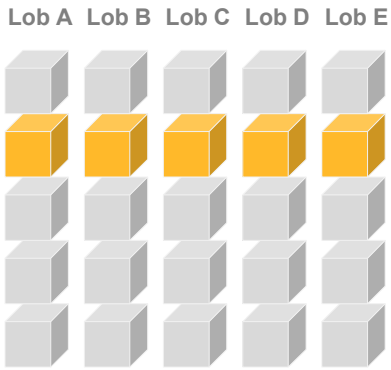
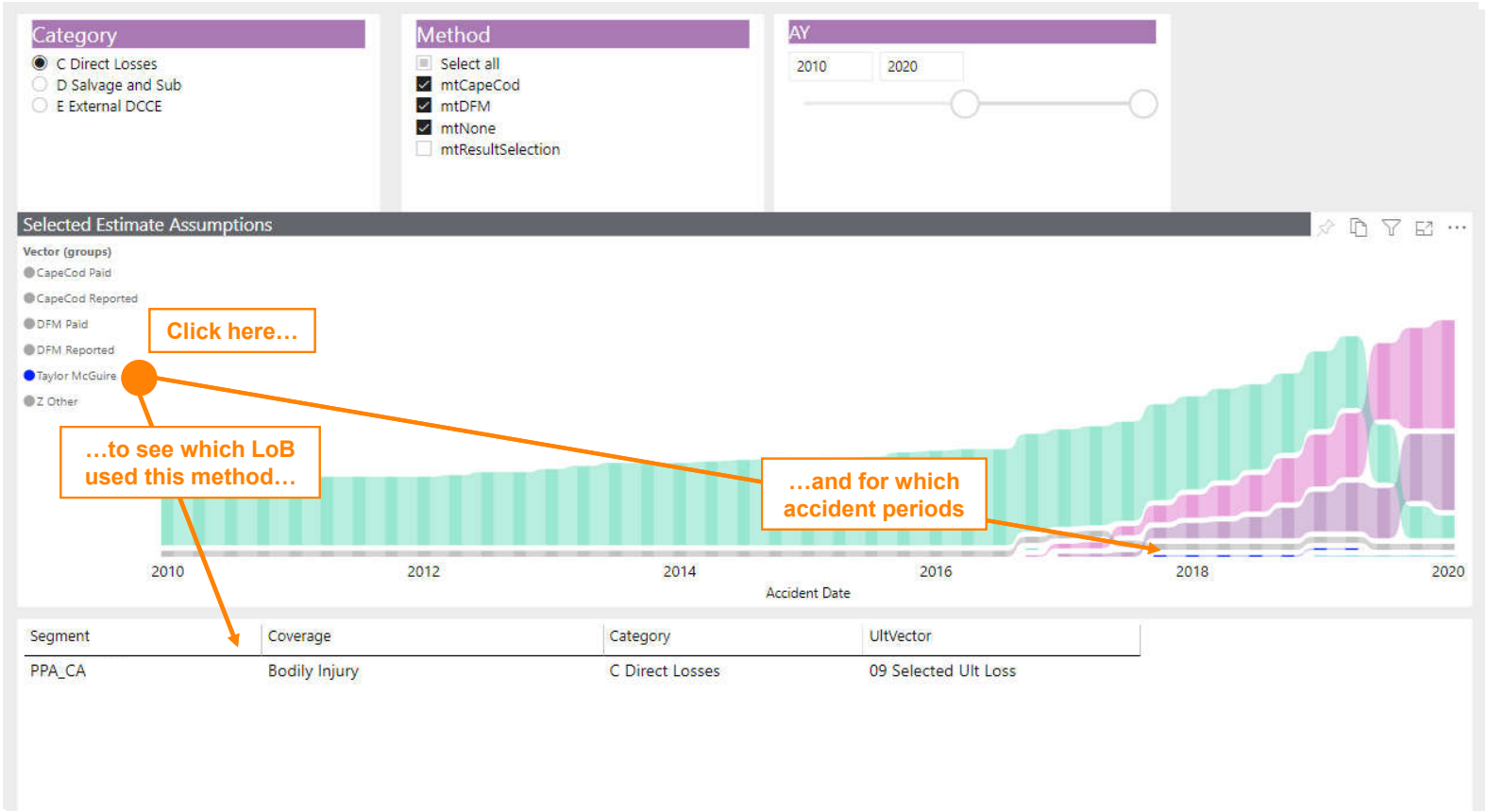




Segment	Coverage	Category	UltVector
AR	All AR	C Direct Losses	09 Selected Ult Loss
CA_CA	Liability	C Direct Losses	09 Selected Ult Loss
CA_CA	Non-Liability	C Direct Losses	09 Selected Ult Loss
CA_FL	Liability	C Direct Losses	09 Selected Ult Loss
CA_FL	Non-Liability	C Direct Losses	09 Selected Ult Loss
CA_OKTX	Liability	C Direct Losses	09 Selected Ult Loss

Building a map





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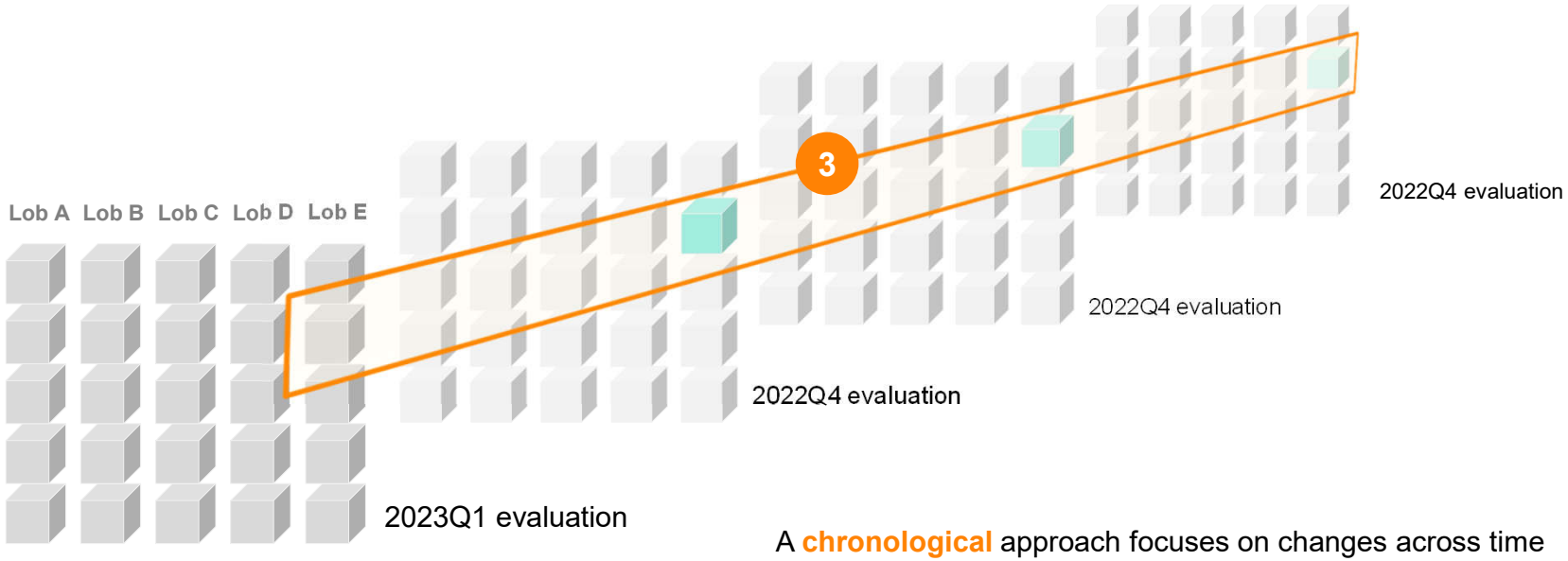
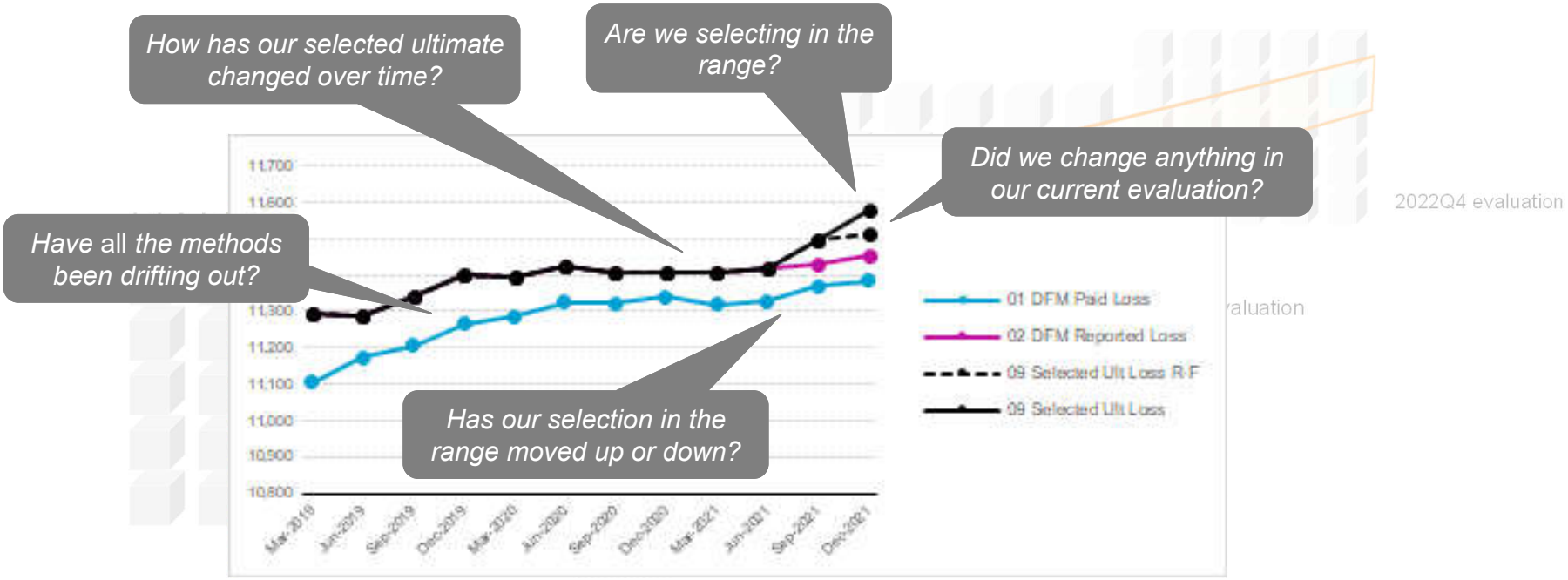


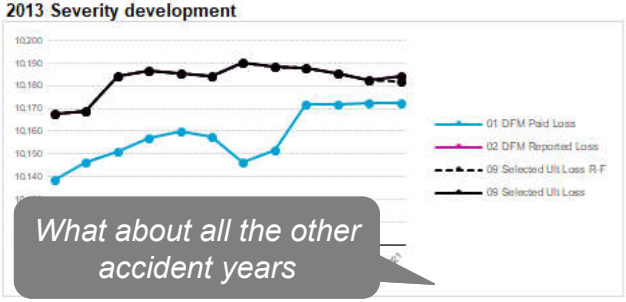
A **chronological** approach focuses on changes across time periods, either in the indicated reserves or in the actions taken by our reserving team.

Being able to see and communicate how data and assumptions change over time allow us to better understand when and why results and outlooks have changed.

Building a map

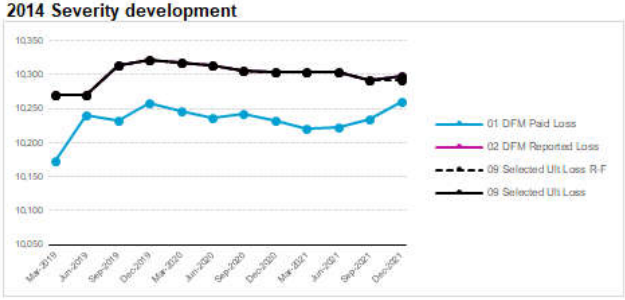


2013 Severity development

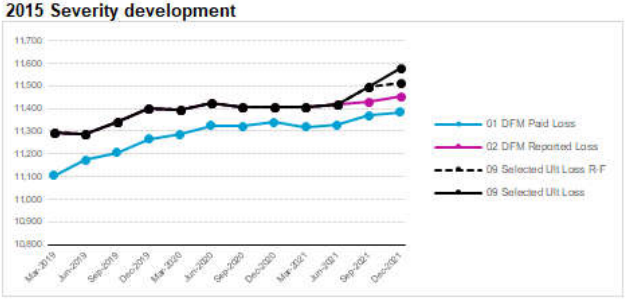


What about all the other accident years

2014 Severity development



2015 Severity development

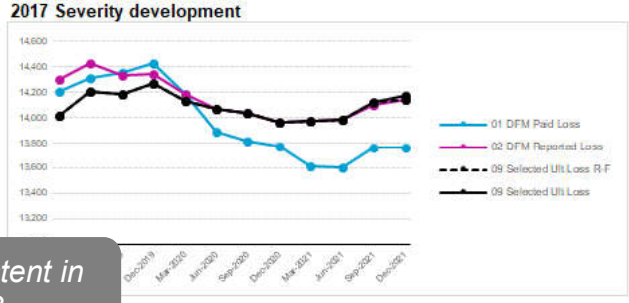


2016 Severity development

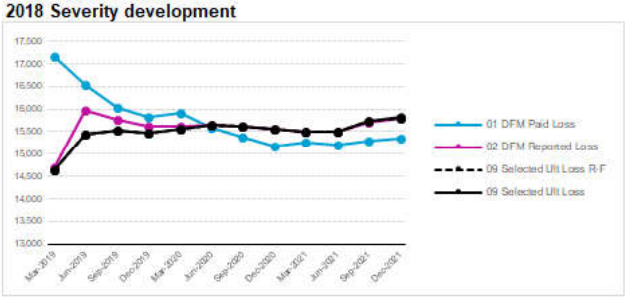
Is there something systemic affecting our methods

Are we being consistent in how we react?

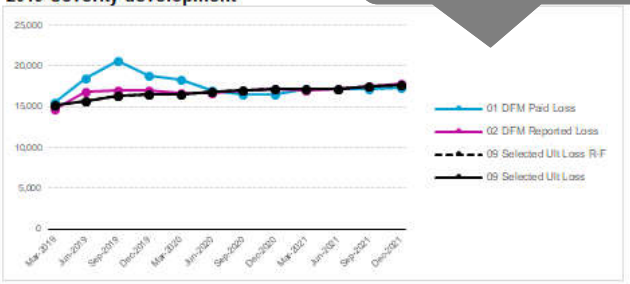
2017 Severity development



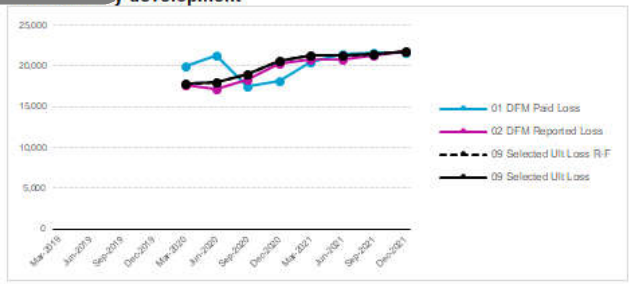
2018 Severity development



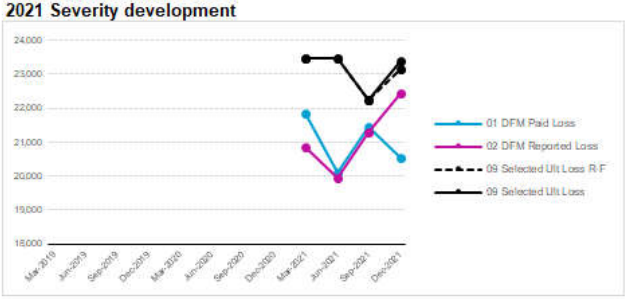
2019 Severity development



y development



2021 Severity development

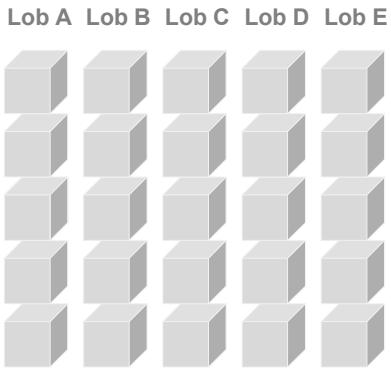


Keeping orientated

Another common challenge is encountered in the results review or socialization phase.

It's important to get the right balance between:

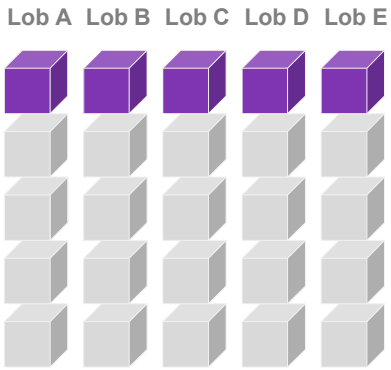
- **numbers, metrics, and visualizations that your audience are familiar with, and…**
- **those that are important to discuss, but might need an explanation**



Keeping orientated

Occasionally high-level discussions can disappear down rabbit holes

After a time, we lose our orientation

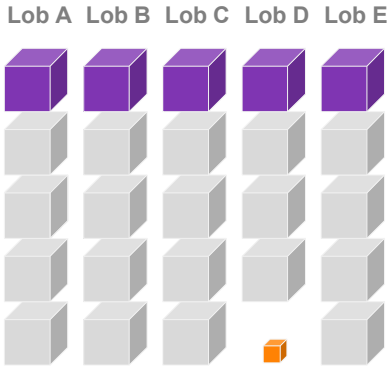


Keeping orientated

Occasionally high-level discussions can disappear down rabbit holes

After a time, we lose our orientation

The risk is that we waste time discussing something that is either not interesting or – more frustratingly – not material



Such disorientation can be countered by:

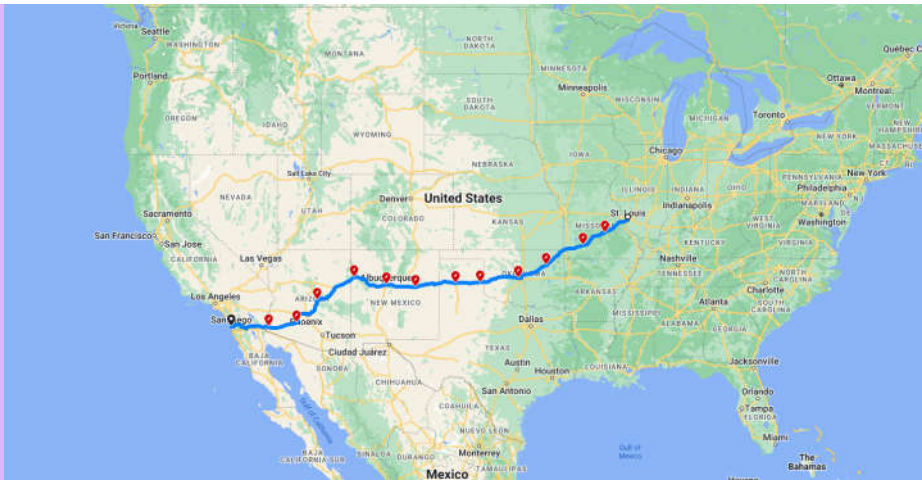
- Ensuring that our visual provides some sort of materiality flag or map or where in the results our presentation is focusing
- Using dynamic visuals that we can interactive and allow us to dive only into areas of the analysis that are both material and provide insight

Poll question

Q. You have to drive from St. Louis to San Diego. Which car do you choose?

Pick one:

- ❑ 2008 Toyota Camry (with 180,000 miles on the clock)
- ❑ 2022 Model 3 (with 5 miles on the clock)



BI tools

Should I be using Power BI or Tableau or Qlikview? Can't I just keep Excel?

BI tools

Should I be using Power BI or Tableau or Qlikview? Can't I just keep Excel?

Excel

Pros

- Easy to find experts (we're all experts!)
- Easy to build, easy to maintain, easy to change
- Understandable data model
- Everyone has it
- Enormously customizable

Cons

- Limits on volumes of data
- Limited stock visualizations
- Not particularly sophisticated data models
- Limited connectivity to external data sources

Power BI

- Dynamic graph interactions
- Can handle large data sets
- Powerful data model
- Access to more sophisticated visualizations
- Much sleeker and more modern looking
- Web / Teams interface

- Potential to 'get lost' in your visuals
- Can be cumbersome to update
- Requires more sophisticated data skills
- Visuals may require explaining
- More challenging to build, maintain and change

BI tools

Different skills?

1 Visualization design

- What to show
- How to show it
- Look-and-feel
- Is it intuitive?
- Interaction
- Navigation

2 Data model

- Tabular calculations, manipulations and queries
- How are the data tables related?
- Does the data model support the interactions?
- Transformations?

3 Data delivery

- Where is the data sourced from?
- How will it be delivered to the visualization?
- How often will it be updated?
- *How* will be updated?

4 Delivery

- Where will the visualizations be…visualized?
- Is the information secure?
- Who can see it?
- Will the interactions work?

BI tools

Considerations

Do I need it quickly?

Looking for something or communicating something?

Do I want to pull my audience into my analysis or push information to them?

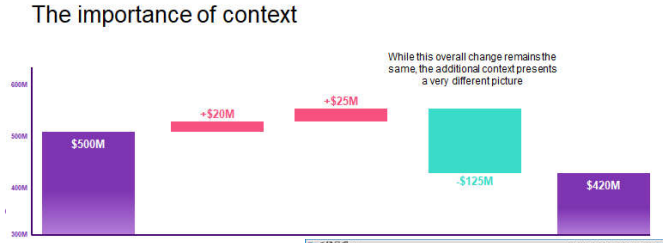
One off visual or will this dashboard be used again and again?

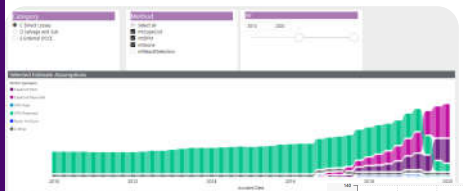
Am I communicating a discrete trend or am I telling a narrative?

Do I want to control who can view the data and when?

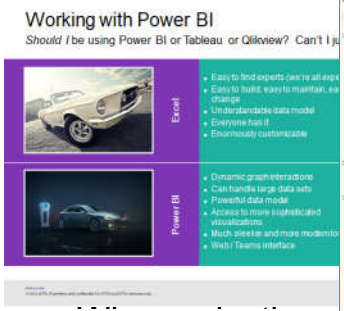
Summary

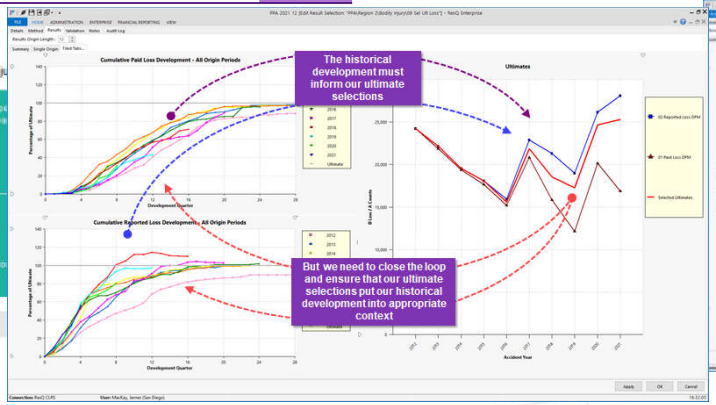
- A line on graph doesn't really tell us much: **provide context**
- When assessing the reasonableness of a metric (e.g. ultimates severity) **actively search for a conflicting metric**
- **Close the loop**: build a narrative around how the data and indications influence our selection, but consider also how our selections inform our understanding of the data
- **Understand and communicate change** at a granular level: what did the data do? What did the actuary do? Are we booking at the 45th percentile or the 60th?
- When using diagnostics to assess reasonableness, **think about what provides the most useful context**. Is it the data and variety of indications? Is it other lines of business or other states? Is it the history of the indication?
- When selecting your visualization medium and format, **make it fit-for-purpose**: who is the audience and what metric will they understand? Who is the builder? Where will the visualization be consumed? How will it get updated? How often will be updated? How often will be viewed?
- **Orientate your audience**: remember where you are in the warren
- **Don't get carried away**:
  - is this visualization appealing vs is it helpful?
  - Is it the best-in-class now vs. will be audience be familiar with it?
  - Don't keep reinventing a slightly better wheel

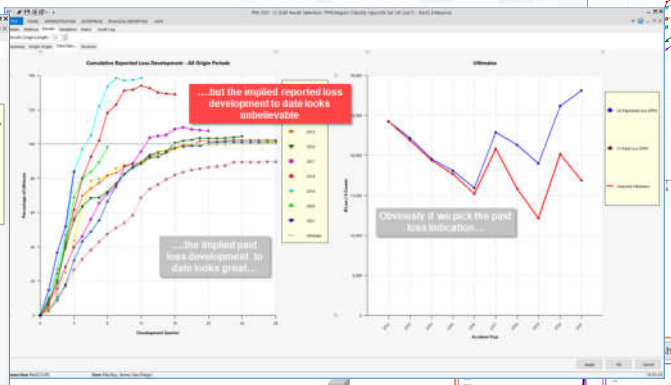


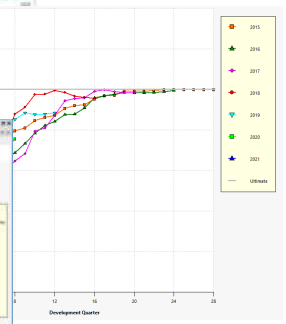


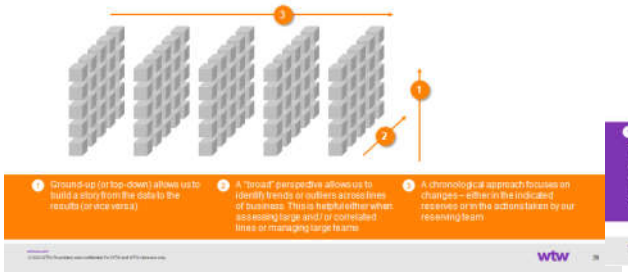
: provide context

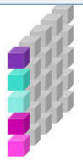


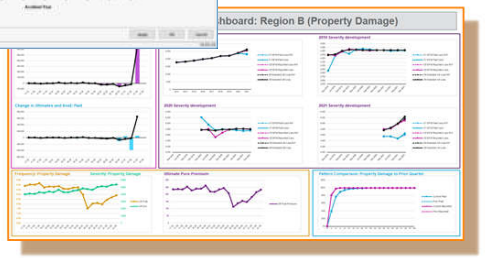


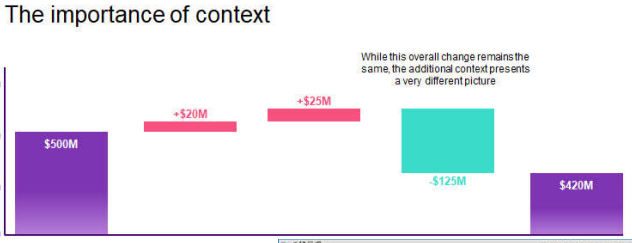


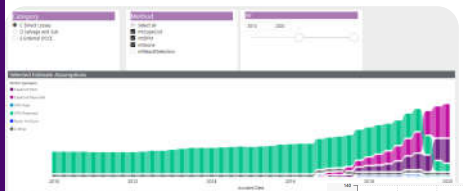




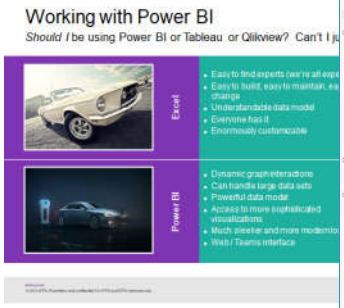


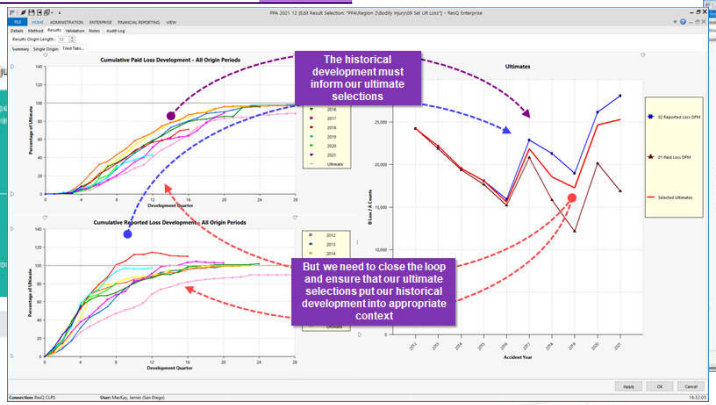


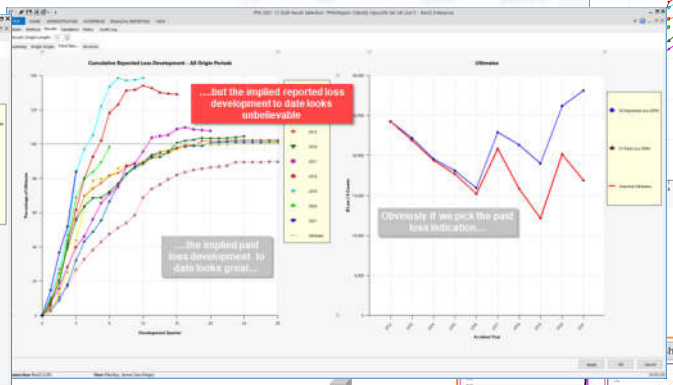


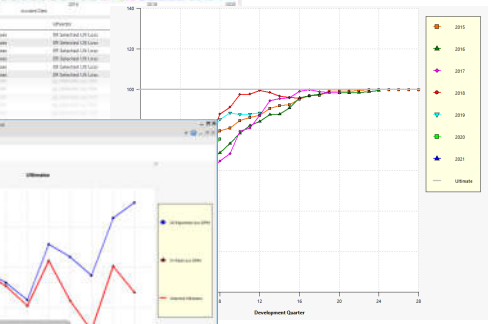


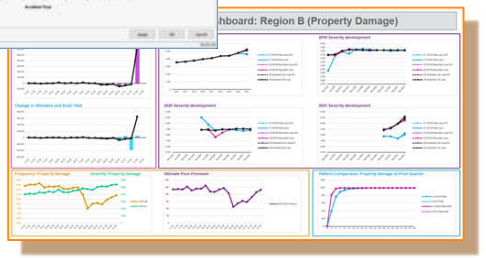
provide context

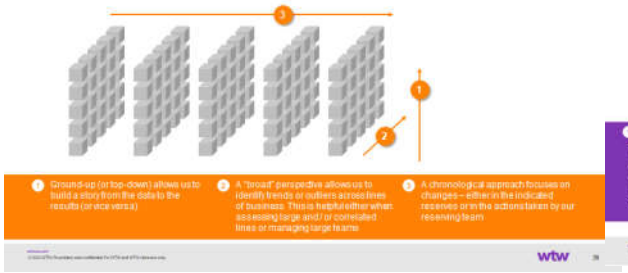


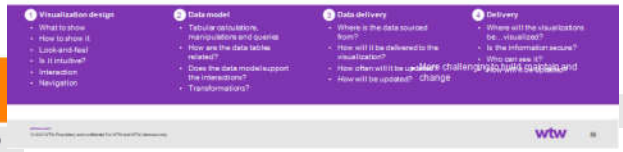












provide context

Thank you