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Risk Dashboards with R Shiny: a C-ROSS case study

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Agenda

- Setting the scene:
 - What is C-ROSS?
 - What is a risk dashboard?
 - What is R Shiny?
- Putting it together:
 - Designing the system
 - Designing the dashboard
 - Developing code in RStudio
- The payoff:
 - What's wrong with our current set up?
 - Delivering insights (or, what's the point of all this?)
 - Summary and conclusions
- Q&A



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Setting the scene

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ponsorship
Thought leadership
Progress
Community
Sessional Meetings
Education
Working parties
Volunteering
Research
Shaping the future
Networking
Professional support
Enterprise and risk
Learned society
Opportunity
International profile
Journals
Support

Setting the scene

1. **C-ROSS**
New Chinese regulatory
framework

2. **Risk Dashboards**
Trendy and useful
presentation technique

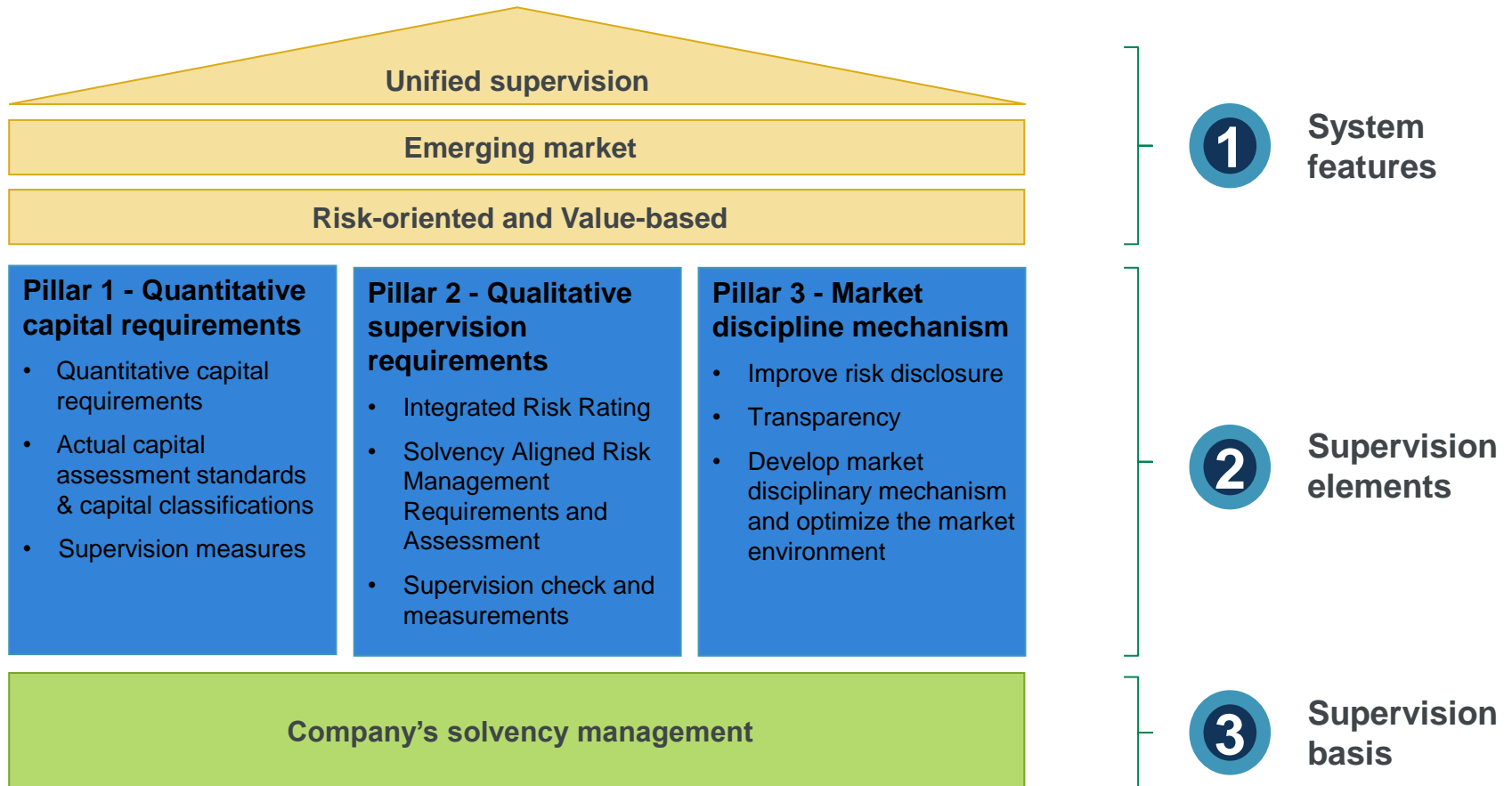


3. **R Shiny**
Trendy web-interface extension to a popular statistical
programming language



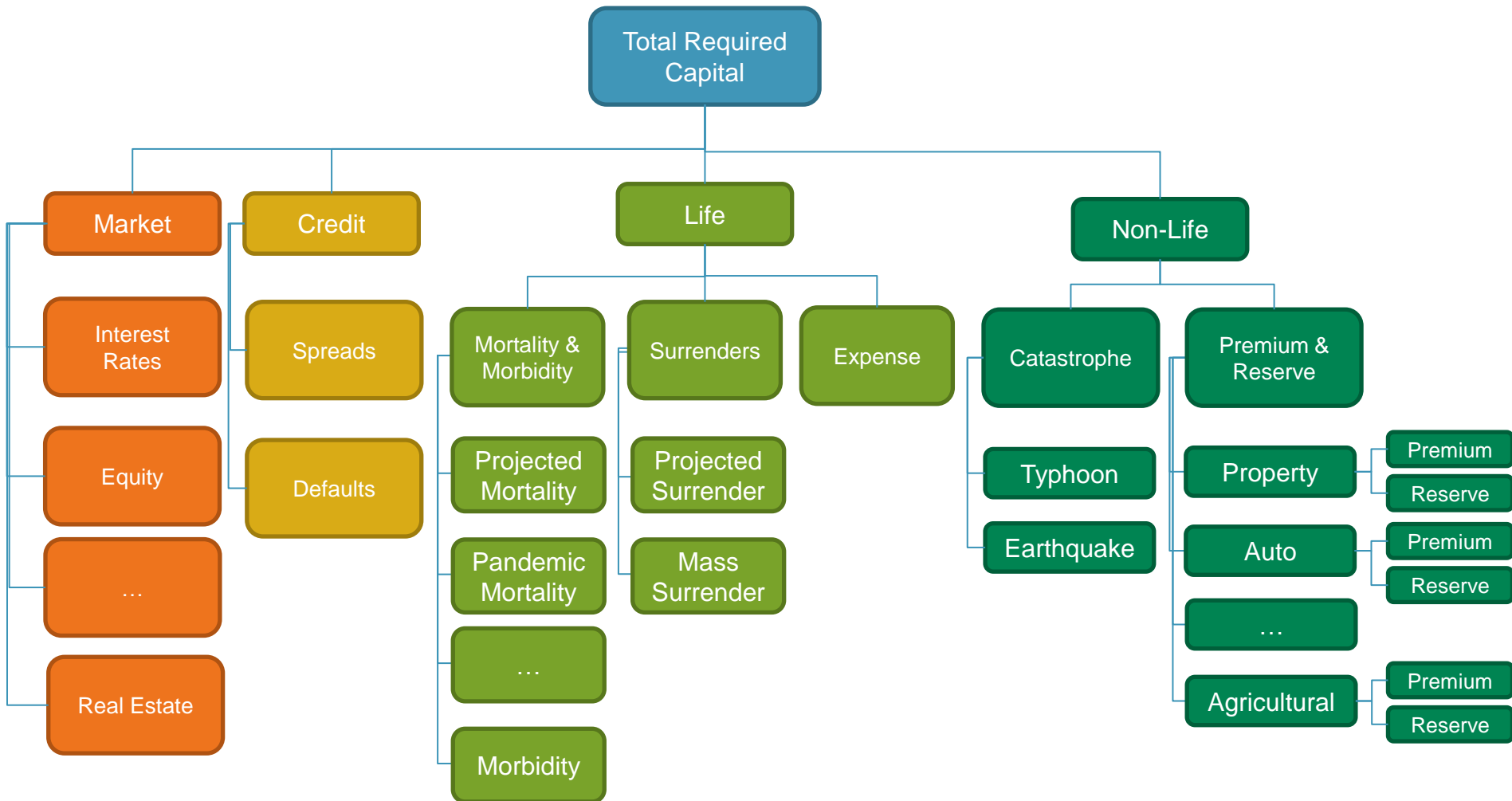
What is C-ROSS?

Overall framework of C-ROSS





C-ROSS: Pillar One





What is a Dashboard?



Communicates information succinctly

Delivers pertinent information

Uses knowledge of human perception

Displays deeper information on demand



make it simple

but not too simple

make it visual

drill-down capability



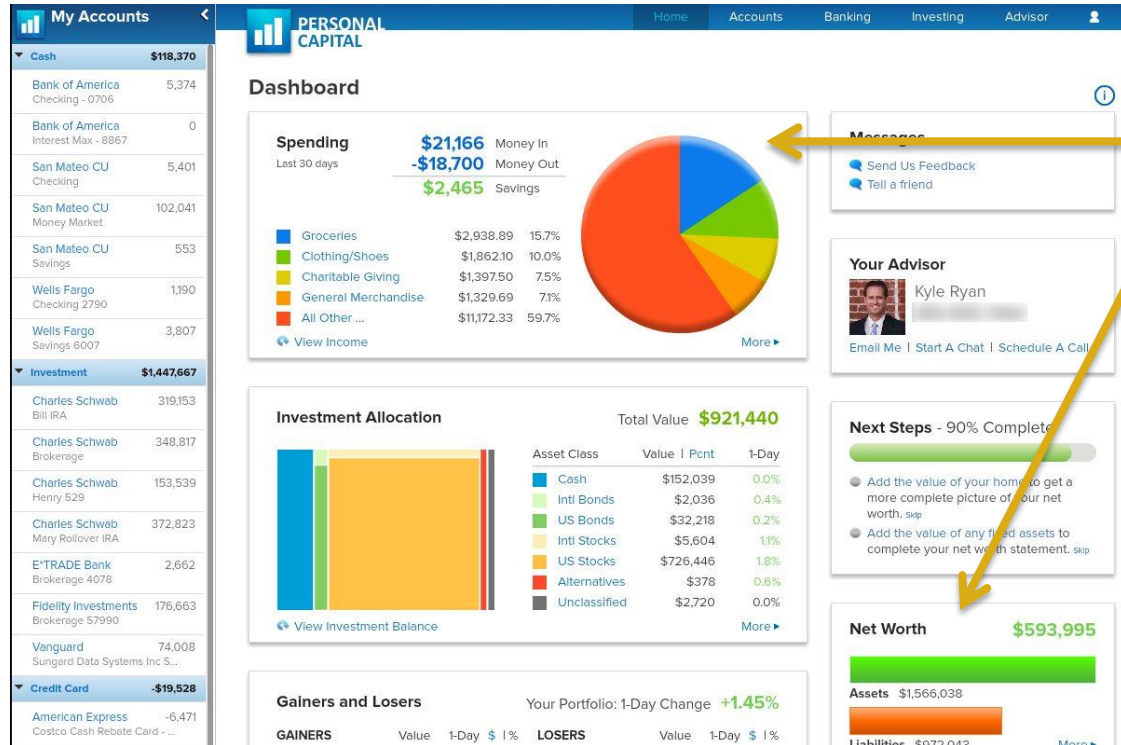
(Risk) Dashboards – examples



All investments / cash in one place



Why this position?



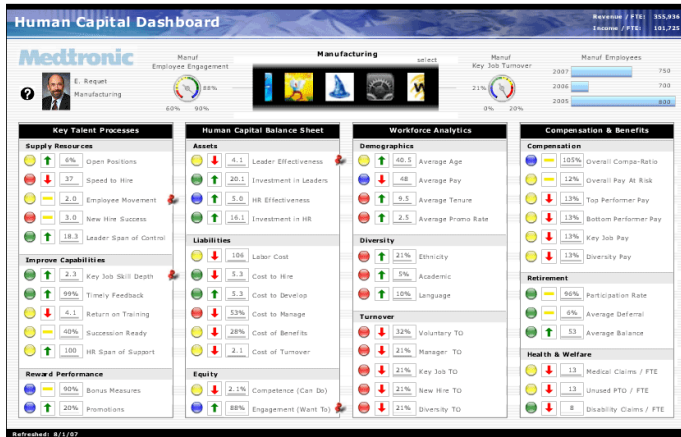
Bright colours, big fonts



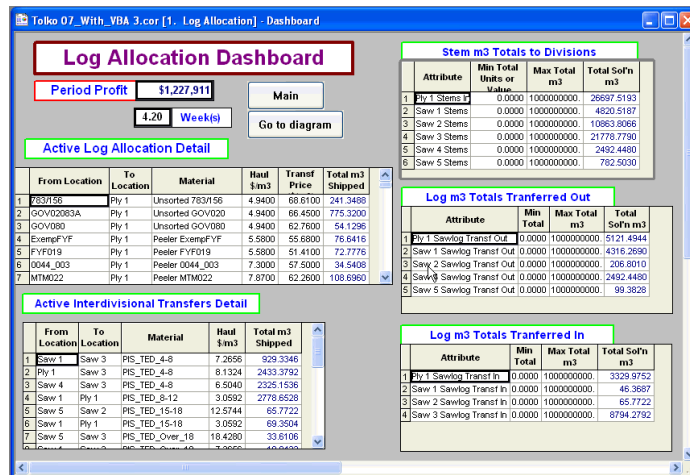
Relative importance? Pie charts?



(Risk) Dashboards – examples



Too much information

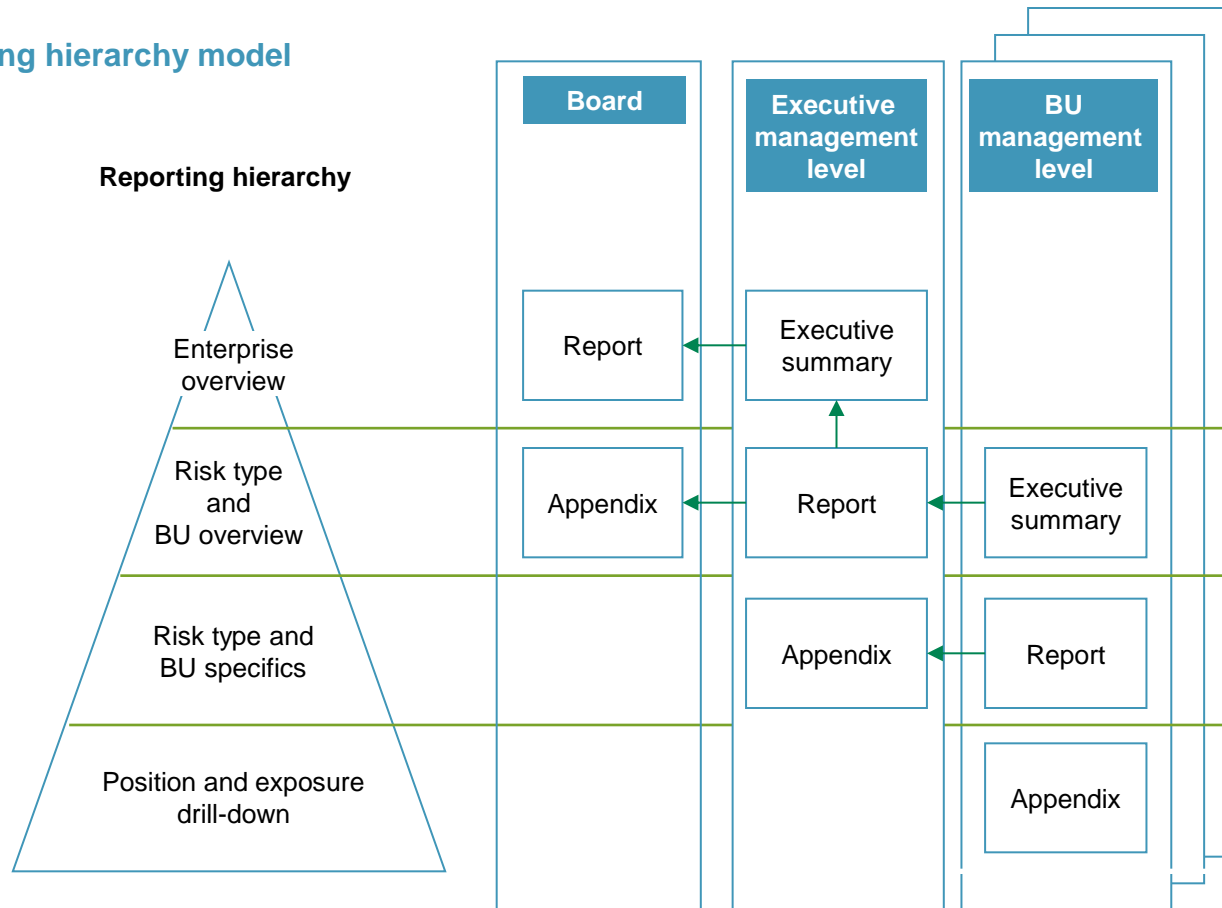


Not visual enough



Managers of differing seniority have different needs

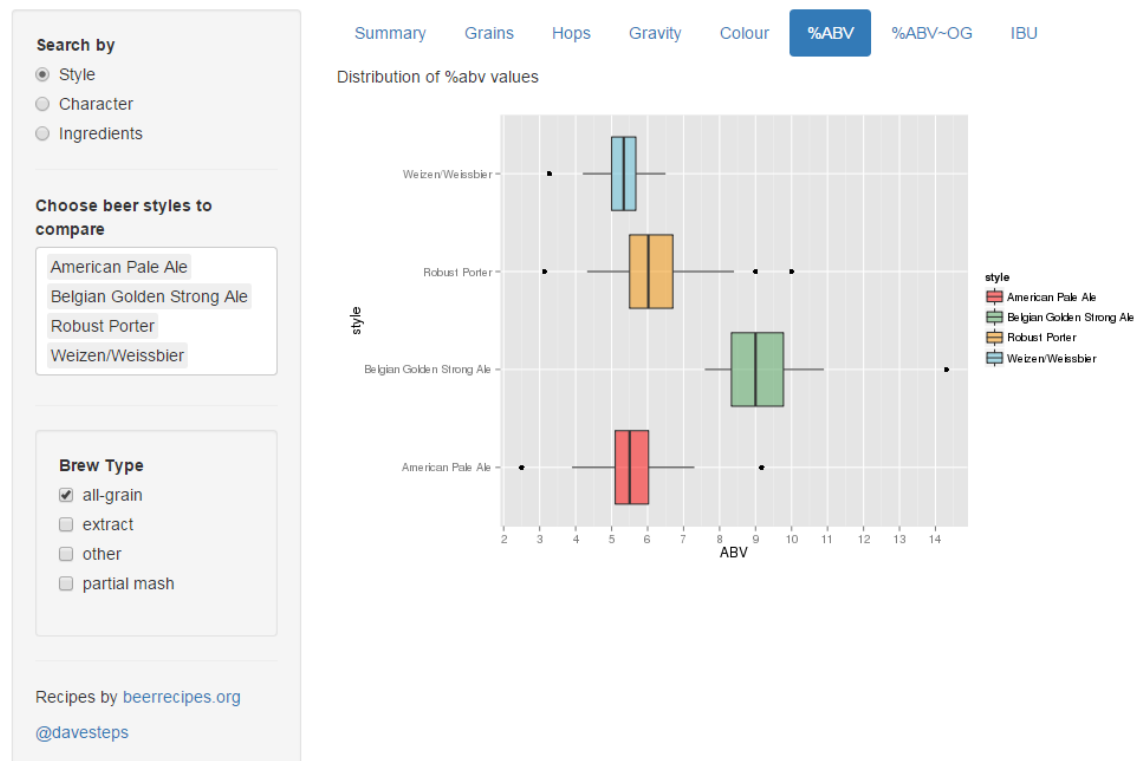
Risk reporting hierarchy model





What is R Shiny?

HomebrewR



- Web interface for R
- Designed to deliver small apps
- Simple rules based layout structures
- Built as part of the RStudio suite
- Uses CSS / Node.js under the hood

<http://www.davesteps.com/homebrewR/>



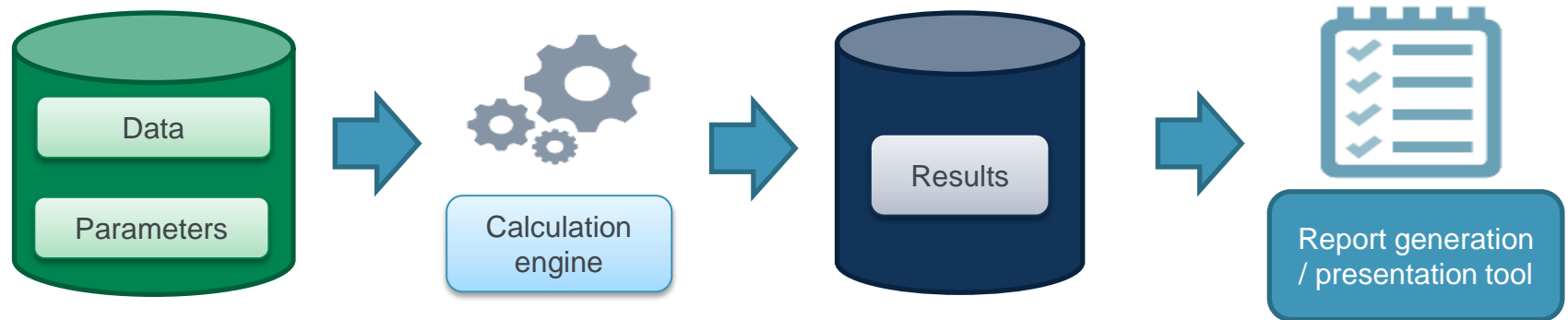
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Putting it together

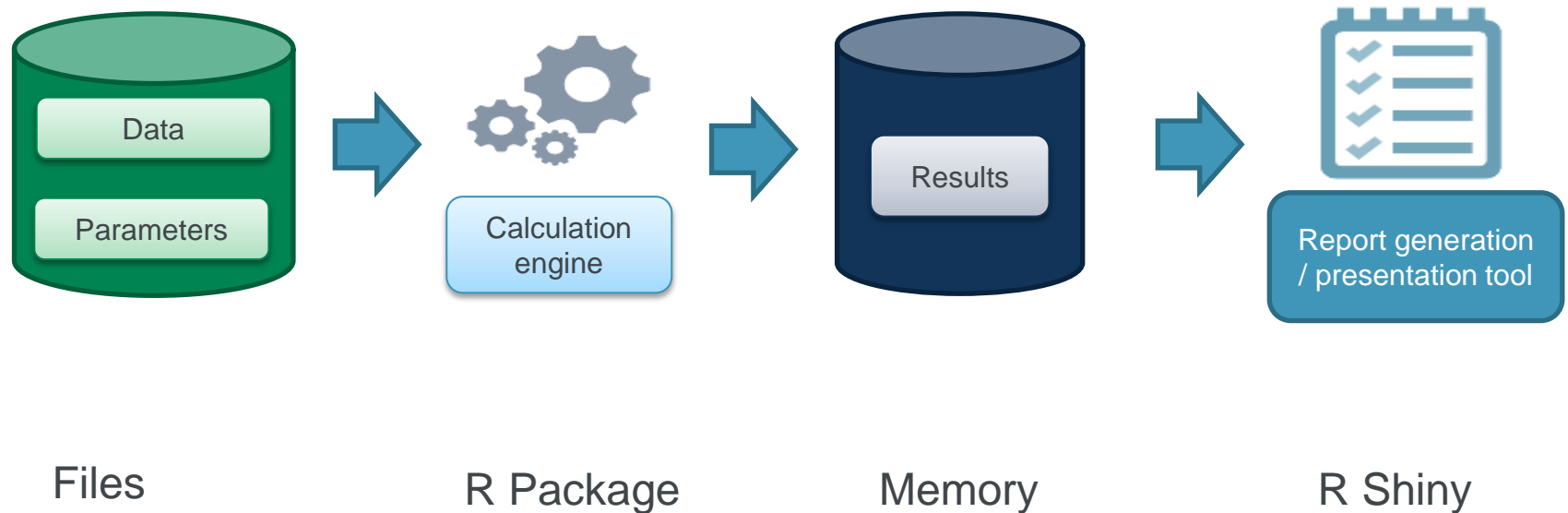
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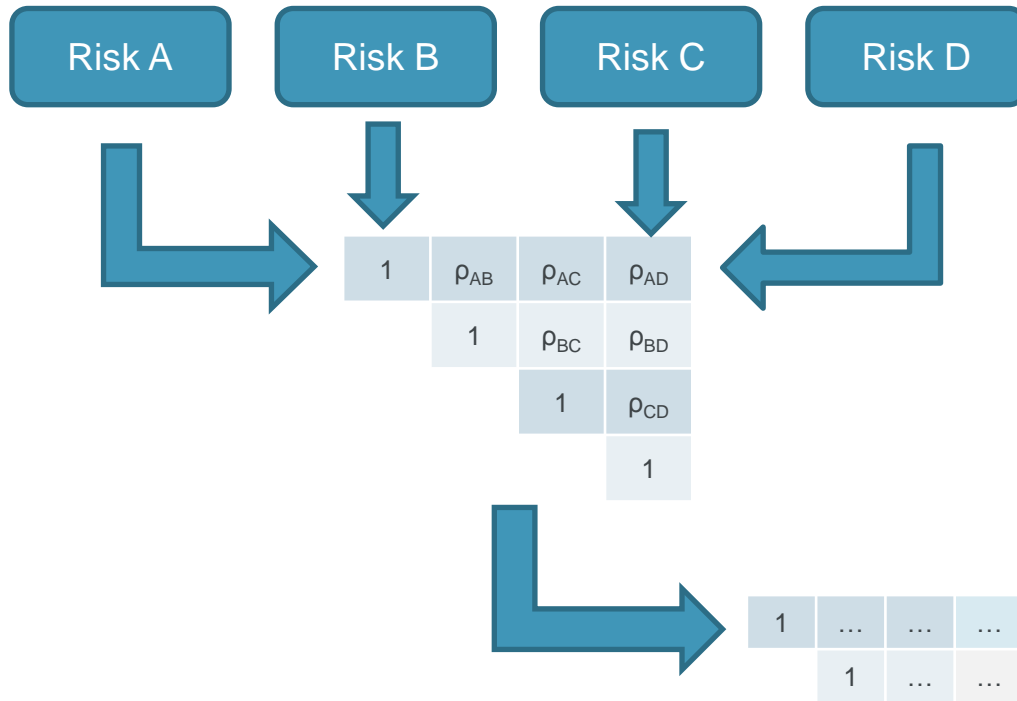
Schematic of a management information system



Schematic of a management information system – demo implementation



Designing your C-ROSS calculations



$$\text{Risk } X = E \times RF$$

$$= E \times RF_0 (1 + k_1 \dots k_n)$$

Table lookups

Aggregation = VCV

Matrix Multiplication

Other required features

- Hierarchy data structure
- Node walking
- I / O

Designing your dashboard:

Brainstorm some ideas

- Solvency margin (current, recent)
 - Integrated Risk Rating
 - Required capital vs Available capital
 - Available capital by tier
 - Required capital by risk
 - Required capital by BU
 - Asset mix
 - Exposures by BU / geography
 - Situation under stress scenarios
 - Market indicators
 - Narrative / action log
-
- 1
- 2
- 3
- 4
- 5
- 6

Developing code in RStudio

Issue with R alone		Solution with RStudio
No IDE	➡	Visual debugger (break, watch, step over, etc)
No version control	➡	Integrated version control with git and github (and SVN)
Difficult to check / test code and difficult to apply the encapsulation principle	➡	Accessible development of packages, including testing

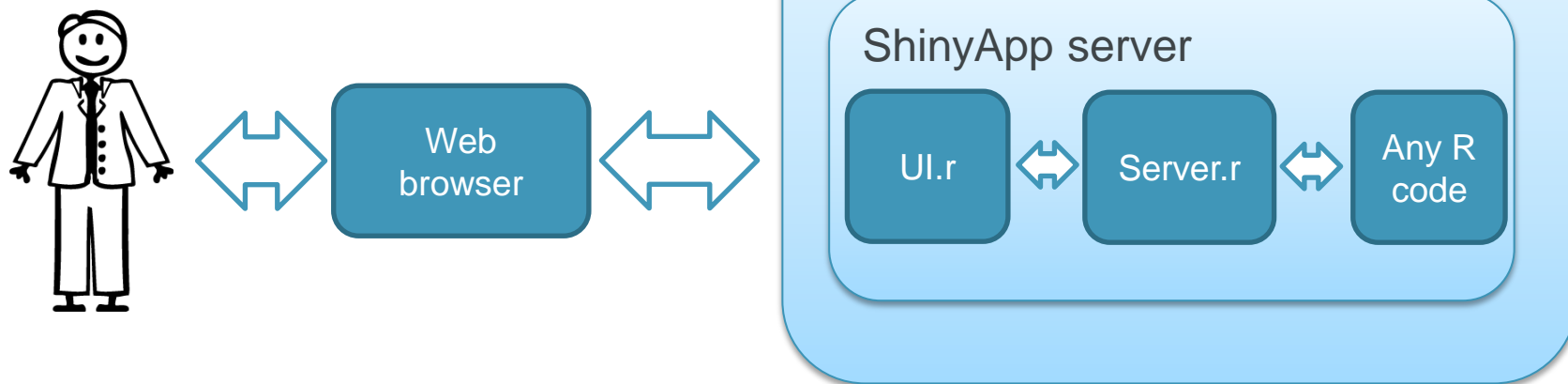


Some issues remain:

- Obscure syntax
- Run times
- Open source

R Shiny – the basics

1



2

Reactivity

Input X

Output Y

$$Y = f(X)$$

When user changes X, Shiny recalculates $f()$ and updates Y

Package shinydashboard

UI.r

```
library(shiny)
```

```
library(shinydashboard)
```

← Load up the new library

```
dashboardPage (
```

```
  dashboardHeader(title = "Old Faithful Geyser Data"),
```

```
  dashboardSidebar(),
```

```
  dashboardBody (
```

```
    fluidRow(
```

```
      box(
```

```
        sliderInput("bins", "Number of bins:", min = 1, max =
```

```
50,
```

```
          value = 30)
```

```
      ),
```

```
      box(
```

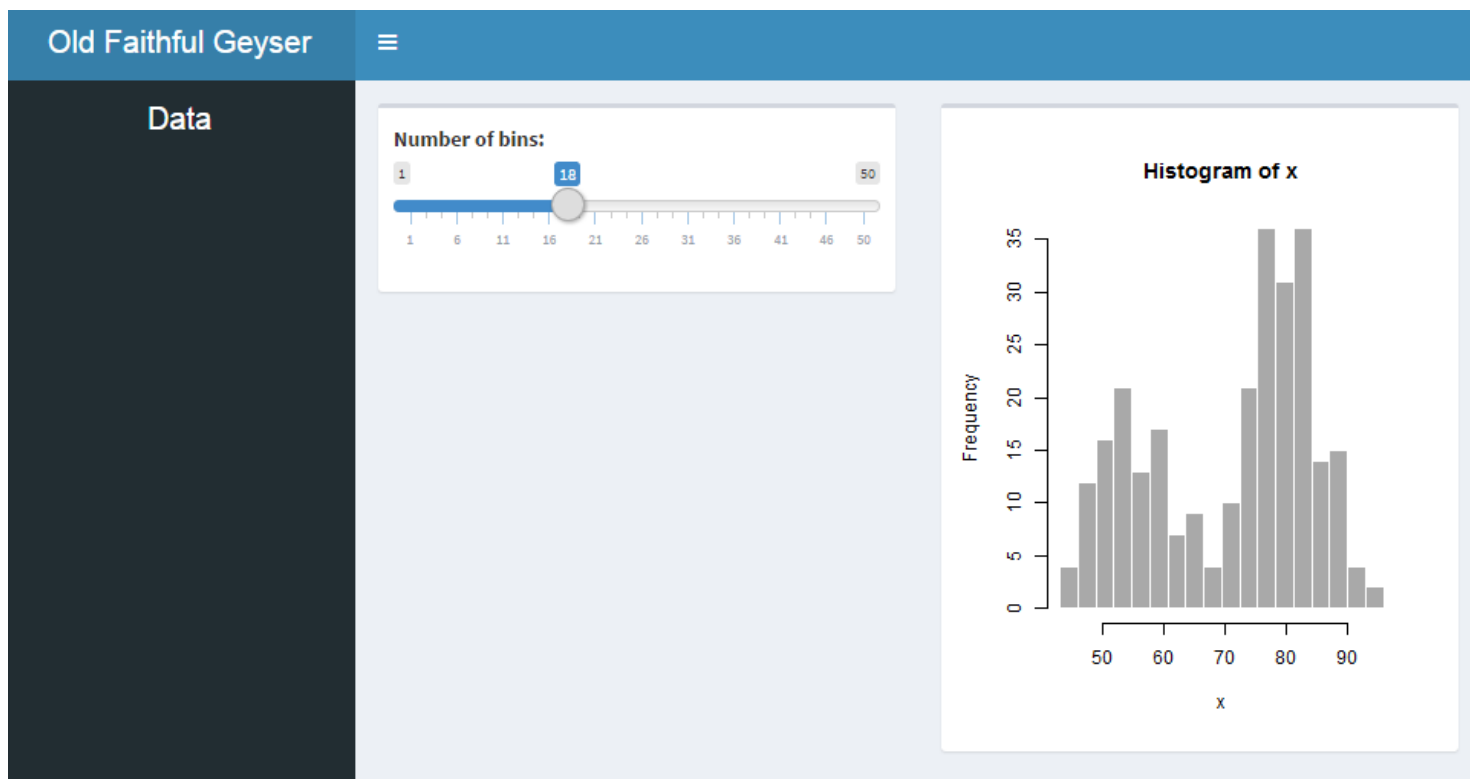
```
        plotOutput("distPlot")
```

```
    )))
```

← Slightly different to the standard Shiny declarations

← Every element needs to be in a box (unless it is already a box!)

Package shinydashboard



Look familiar?



Implementing your C-ROSS dashboard

dashboardPage (

 dashboardHeader (...) ,



Title

A

 dashboardSidebar (...) ,



List tabs

B

 dashboardBody (...)



Lay out each tab's
contents

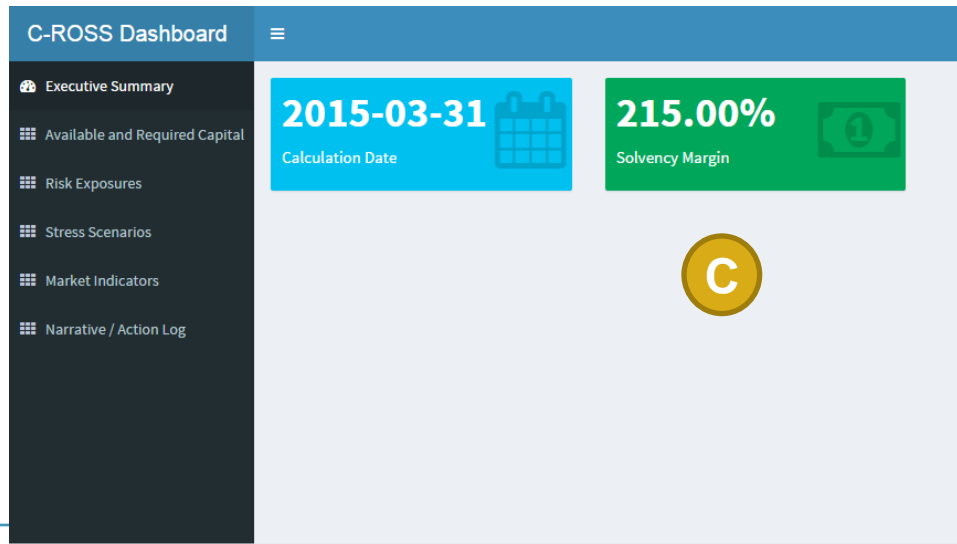
C

)

A

B

C



UI.r

```
tabItems(  
  tabItem( tabName = "Summary",  
    fluidRow(  
      valueBoxOutput( "vbxSummaryCalculationDate" ),  
      valueBoxOutput( "vbxSummarySolvenyMargin" )  
    )  
  )  
)
```

Server.r

```
output$vbxSummarySolvenyMargin <- renderValueBox({  
  
  valueBox( printPercent( LatestSolvenyMargin ), A  
    "Solveny Margin", B  
    icon= icon("money"), C  
    color = ragColour(LatestSolvenyMargin) )  
  
  })
```

A

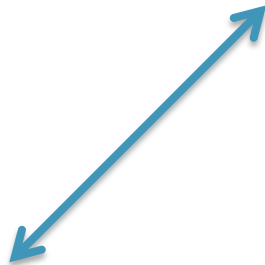
B

215.00%

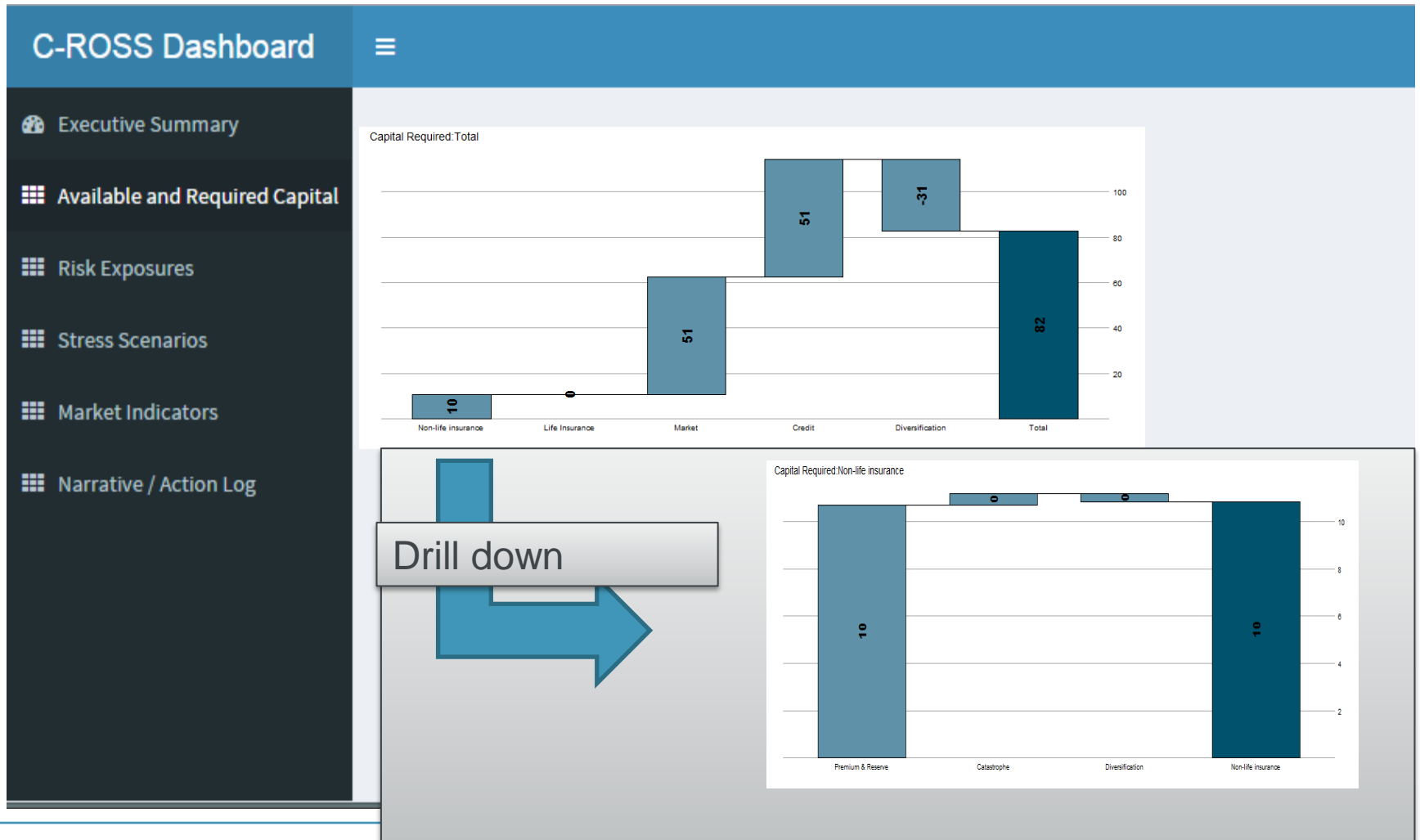
Solveny Margin



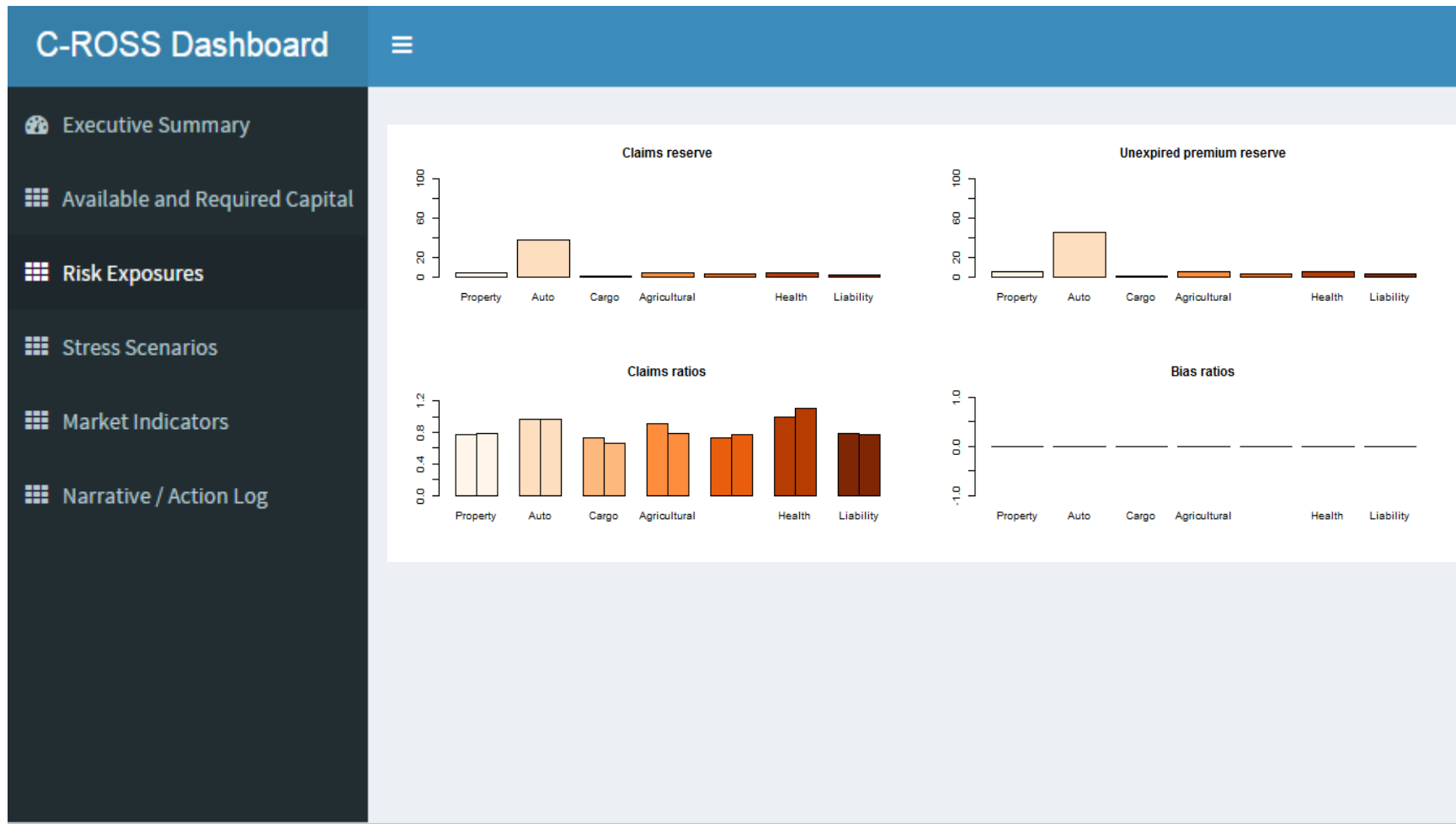
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Available and Required Capital



Exposures by BU





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The payoff

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What's wrong with our current set-up?

1. Out-dated techniques
2. Bad engineering: failing to minimise operational risks and optimise rewarded risks
3. Poor use of resources

Delivering insights (or, what's the point?)

To make good business decisions managers need information which is:

- **presented clearly**
 - **accurate**
 - **timely**
-
- A well designed dashboard will address the presentational issue
 - Accuracy is improved by using code which is tested and version controlled
 - Timeliness is a function of people and process – the people issue is often easier to optimise than process (e.g. data delivery times may be outside of your control)

Summary and conclusions

C-ROSS

A quantum leap for the Chinese insurance industry, which should improve management and customer outcomes, but which presents short-term operational, systems and education challenges

Dashboards

A neat way of presenting pertinent information visually, and an opportunity for actuaries and insurance risk people to take advantage of insights developed in the software industry

R Shiny

A quick, powerful way of creating and delivering management information, and a welcome user interface to R



Questions

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Comments

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Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

The views expressed in this presentation are those of the presenter.



Speaker Bio

Phil Joubert is a principal in the Financial Services practice of Oliver Wyman, based in Hong Kong Office. Phil has fifteen years of experience in the financial services industry, having worked in areas as diverse as actuarial consulting and derivatives trading. He has worked in both Europe and Asia-Pac for a variety of insurers, banks and software houses, and specialises in risk and capital modelling and systems design

Recent experience

- Regulatory capital model design and implementation for several insurers in Europe
- Economic capital implementation for leading pan-Asian insurance group
- Derivatives trading and market risk management
- Capital aggregation systems design for leading ESG provider
- Actuarial automation implementation project for specialist life insurer

Phil holds an MSc in Finance & Mathematics from Imperial College and is a Fellow of the Faculty of Actuaries. He joined Oliver Wyman in 2014, having spent several years as an independent actuarial consultant. Previously he worked at Deutsche Bank and Natixis as a trader and he started his career with Deloitte Actuarial.