

Getting the best out of forecasting software

Robert Fildes

Professor, Department of Management Science
Centre for Marketing Analytics and Forecasting

Nikolaos Kourentzes

Professor, Department of Management Science
Centre for Marketing Analytics and Forecasting

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Marketing Analytics & Forecasting



Lancaster University
Management School

Europe's leading research centre in applied forecasting

Services

- Short courses (open & bespoke)
- Consultancy
- **MSc summer projects**
- Software development
- Knowledge-transfer partnerships
- PhD research projects

Expertise

- Marketing analytics
- Supply chain forecasting
- Forecasting & planning processes
- Machine learning

Applied in a wide variety of sectors (eg FMCG, govt, pharma)



Prof John
Boylan



Dr Sven
Crone



Dr Florian
Dost



Prof Robert
Fildes



Dr Nikolaos
Kourentzes



Dr Nicos
Pavlidis



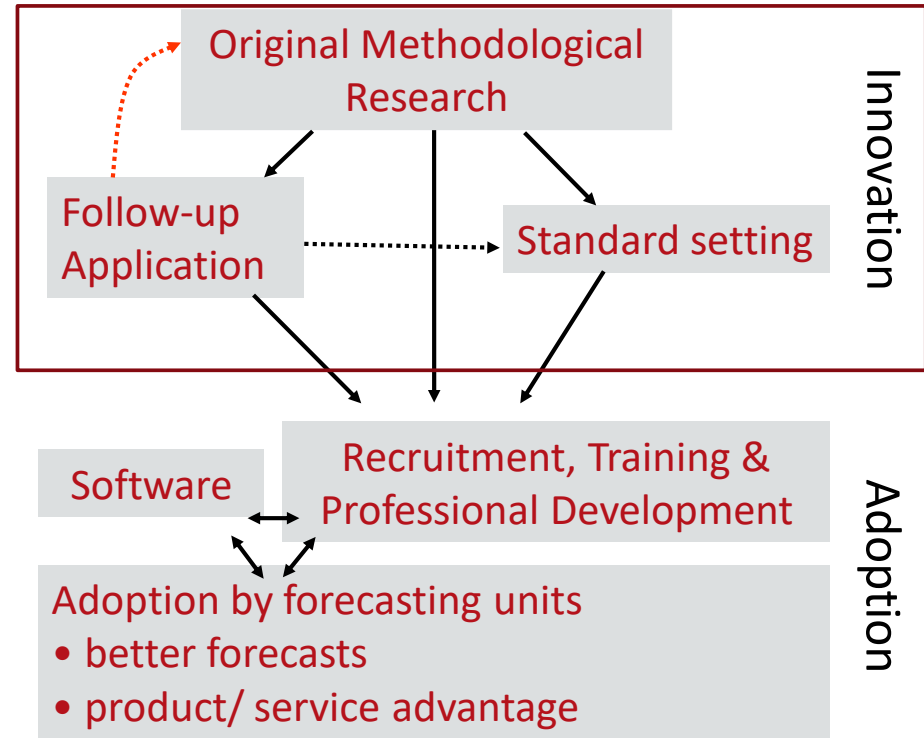
Dr Ivan
Svetunkov

Who's forecasting? Why is software important?

- Analysts
- Demand planners
- Software suppliers
- Researchers

Application areas

The Diffusion of Forecasting Research into Practice



The dotted arrows  show weak links

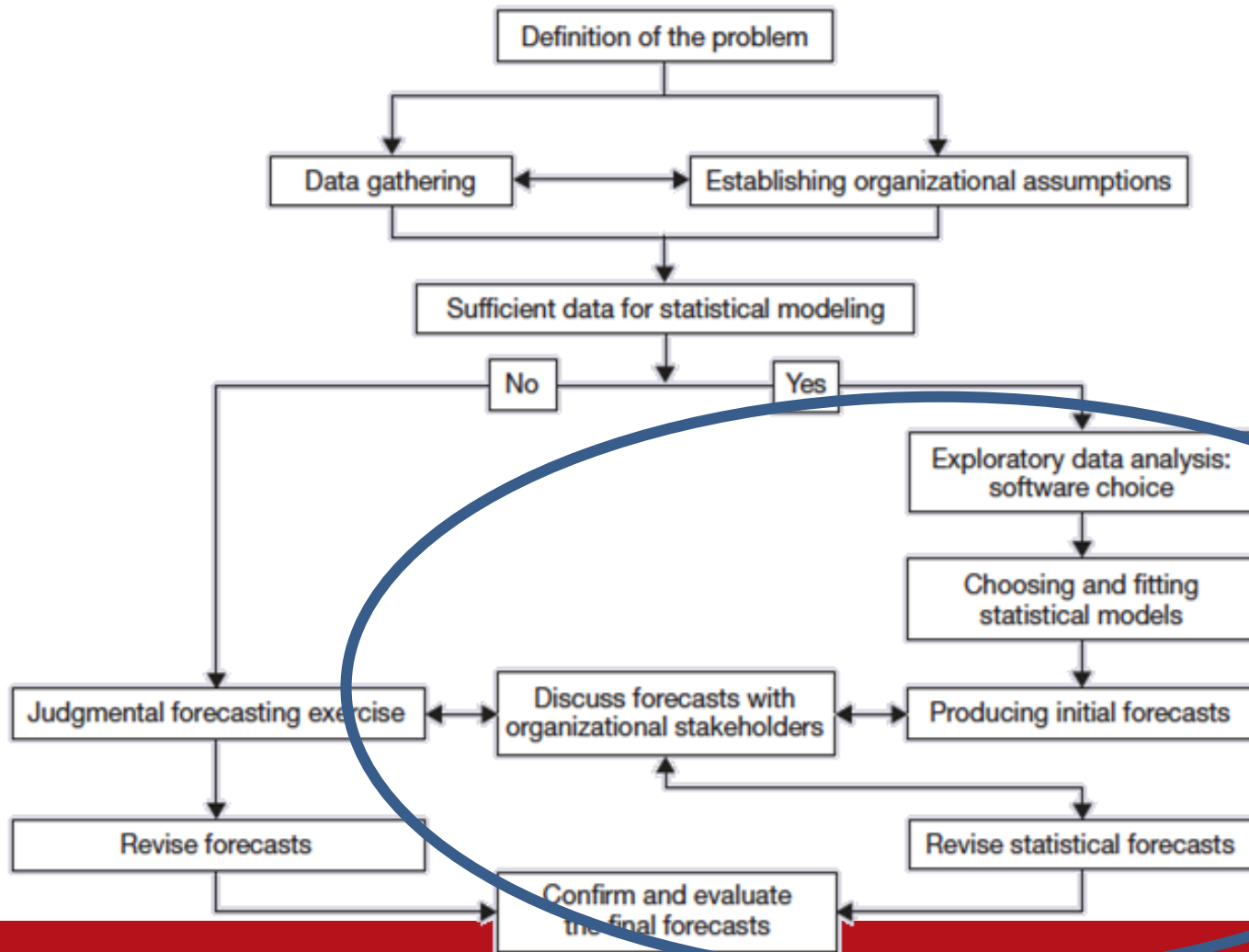
Fildes, R. (2017). Research into forecasting practice. *Foresight: The International Journal of Applied Forecasting*, 39-46.

Forecasting software: the issues

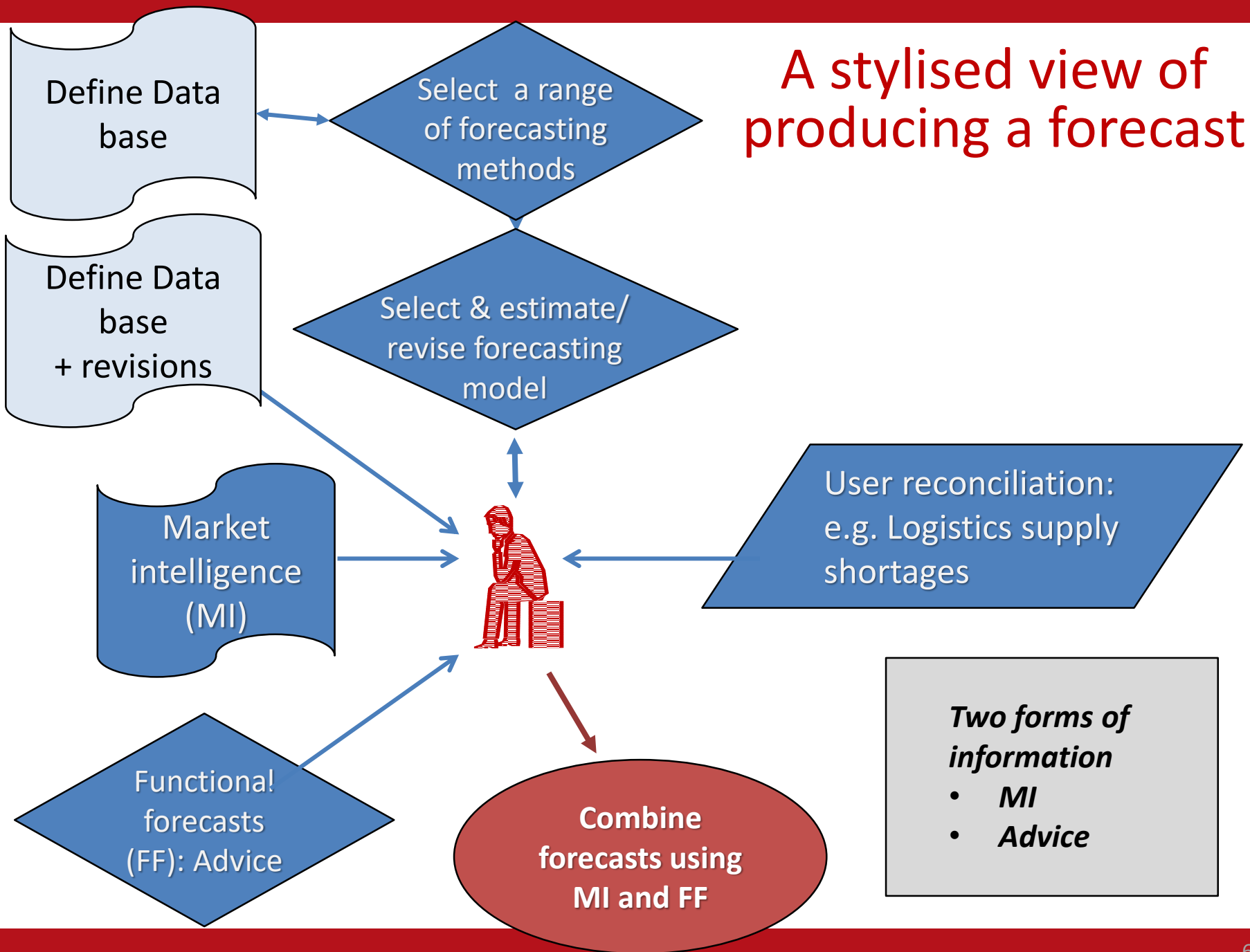
- Identifying a list of requirements
 - Matching the software to the job
- Choosing the right software
 - Must have
 - Like to have
 - The software source/ supplier
- Getting the best from the chosen software

The process of organisational forecasting

The Forecasting Process: A Task-Analytic Perspective



A stylised view of producing a forecast



Two forms of information

- **MI**
- **Advice**

Key elements

- Selection
 - Short-listing
 - What job is to be done
 - Open source (R, Python) vs proprietary (SAS, IBM)
- Tuning for organizational forecasting
 - So you've spent £1M; it's producing forecasts for operations: **now what?**
- Incorporating judgment (MI)

Types of software: The OR/MS survey

- 100+ forecasting software products identified
- 20 respondents: now on-line updating
- Survey biennial for 20 years

- General Purpose Statistical
- Specialist forecasting
- Econometric
- Forecasting support systems
 - Demand planning/ call centre
- Mathematical/ statistical languages
 - R, Python, MATLAB



+ Excel

<https://www.informs.org/ORMS-Today/Public-Articles/June-Volume-45-Number-3/Software-Survey-Forecasting-2018>

Choosing the type of software

- So what's wrong with Excel?
- Need to match organizational processes
 - The users' expertise?
 - The data
 - One-off vs operational forecasting
- Open source vs proprietary

Discussion question: What are the current issues?

Benchmarking organisation's forecasts

- Sample of time series
 - Actuals
 - Statistical forecasts + judgmental adjustments
- Competitive methods
 - In an ideal world
 - In the real world as is
 - Forecast Value added (from judgmental adjustments)?
- Agreed accuracy measures
 - Out-of-sample rolling origin
 - Avoid sensitivity to 'outliers' e.g. data near zero
 - (Davydenko and Fildes, in Gilligand et al., Business Forecasting, Wiley & SAS)
 - Match with decision problem (aggregation, forecast horizon)
 - Segmentation and monitoring

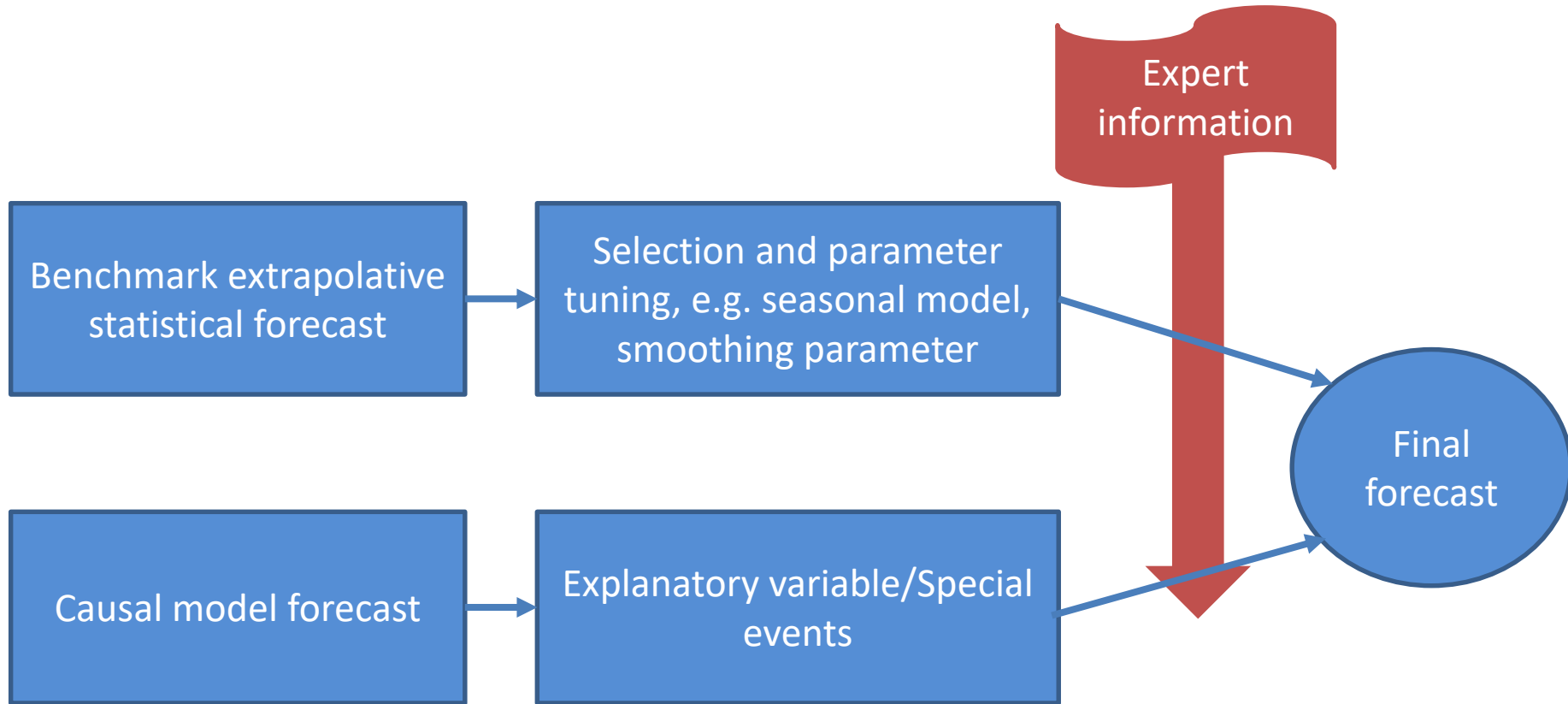
It's 'horses for courses'!

How are forecasts typically produced?

Method	Study				Average
	Sanders & Manrodt (2003)	Fildes & Goodwin (2007)	Weller & Crone (2012)	Fildes & Petropoulos (2015)	
Judgment alone	30%	25%	24%	23%	23%
Statistical methods exclusively	29%	25%	32%	29%	29%
Average statistical and judgment	41%	17%	-	18%	18%
Adjusted statistical forecast		33%	44%	38%	38%
Sample size	240	149	59	42	

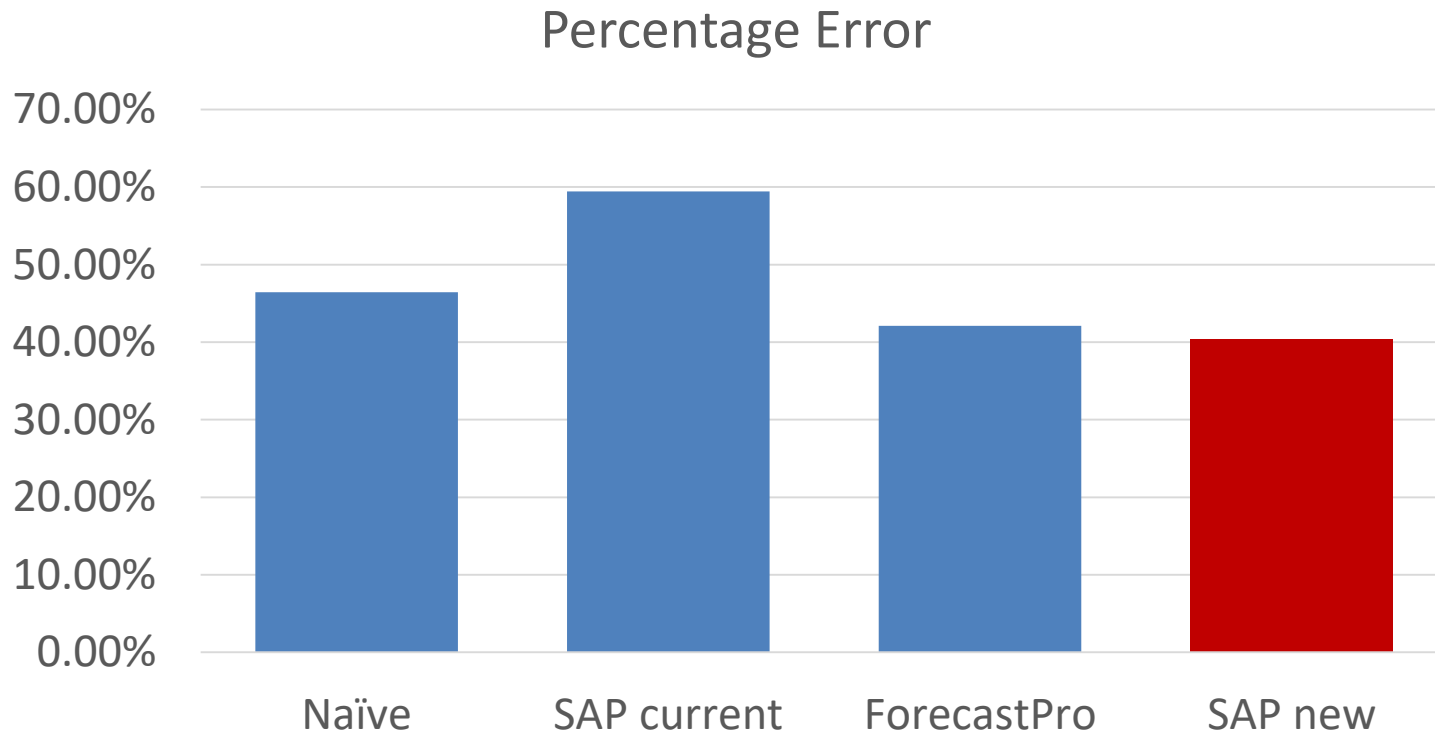
Even in macroeconomic and weather forecasting, judgment is added to a (complex) statistical model

How are forecasts typically produced?



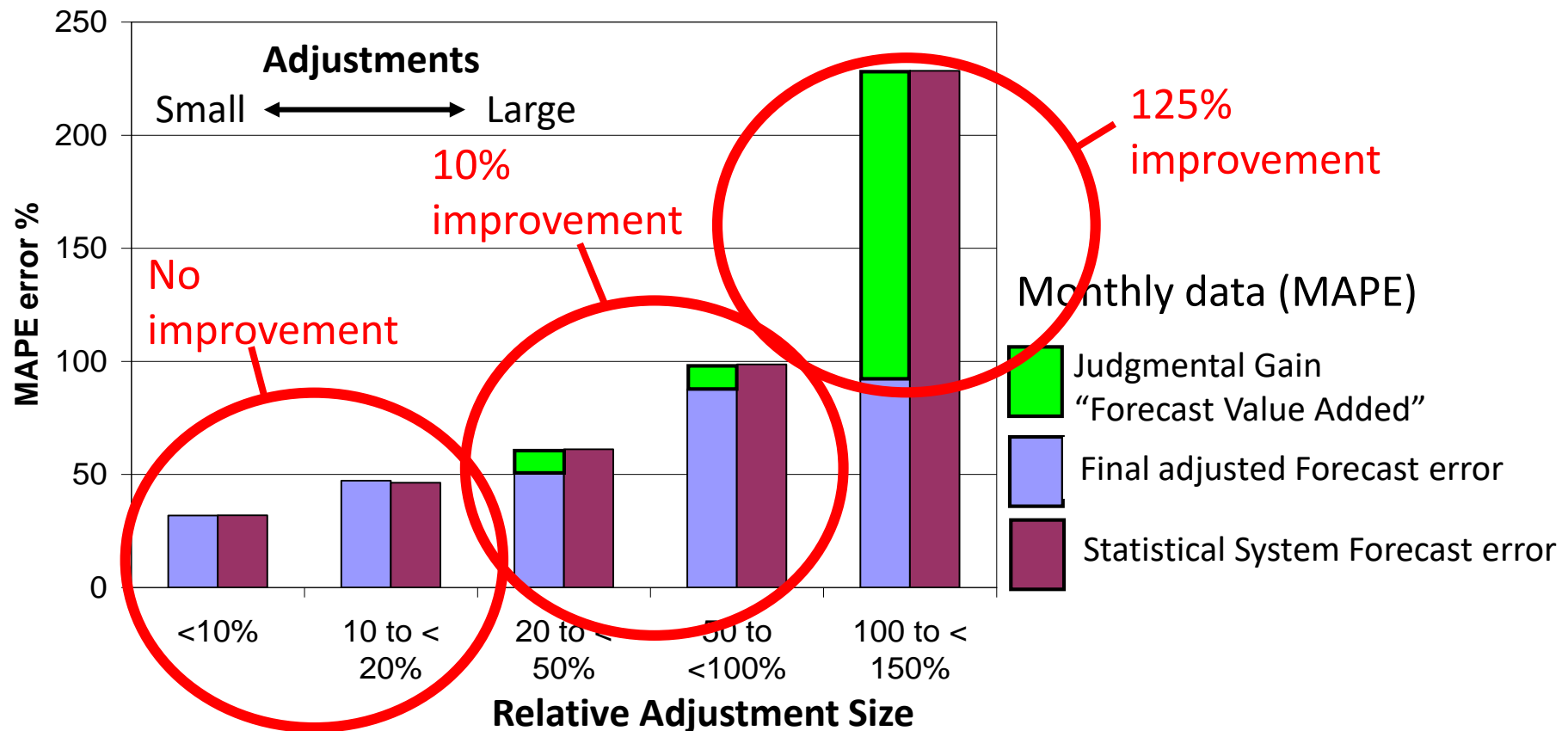
Improving the process

- Improving on default automatic settings
 - Benchmark against: naïve, other software.
 - Improving setup within existing software.



Improving the process

- Current SAP-APO
 - Evaluate accuracy: statistical vs 'final' gives value added
 - Only some judgmental adjustments increase accuracy



Improving the process – model choice

Current (e.g., SAP APO automatic)

- Modify parameters and method choice algorithms (within SAP)
- Accuracy Improvements? Sanofi-Aventis gains are 35%

Implementation

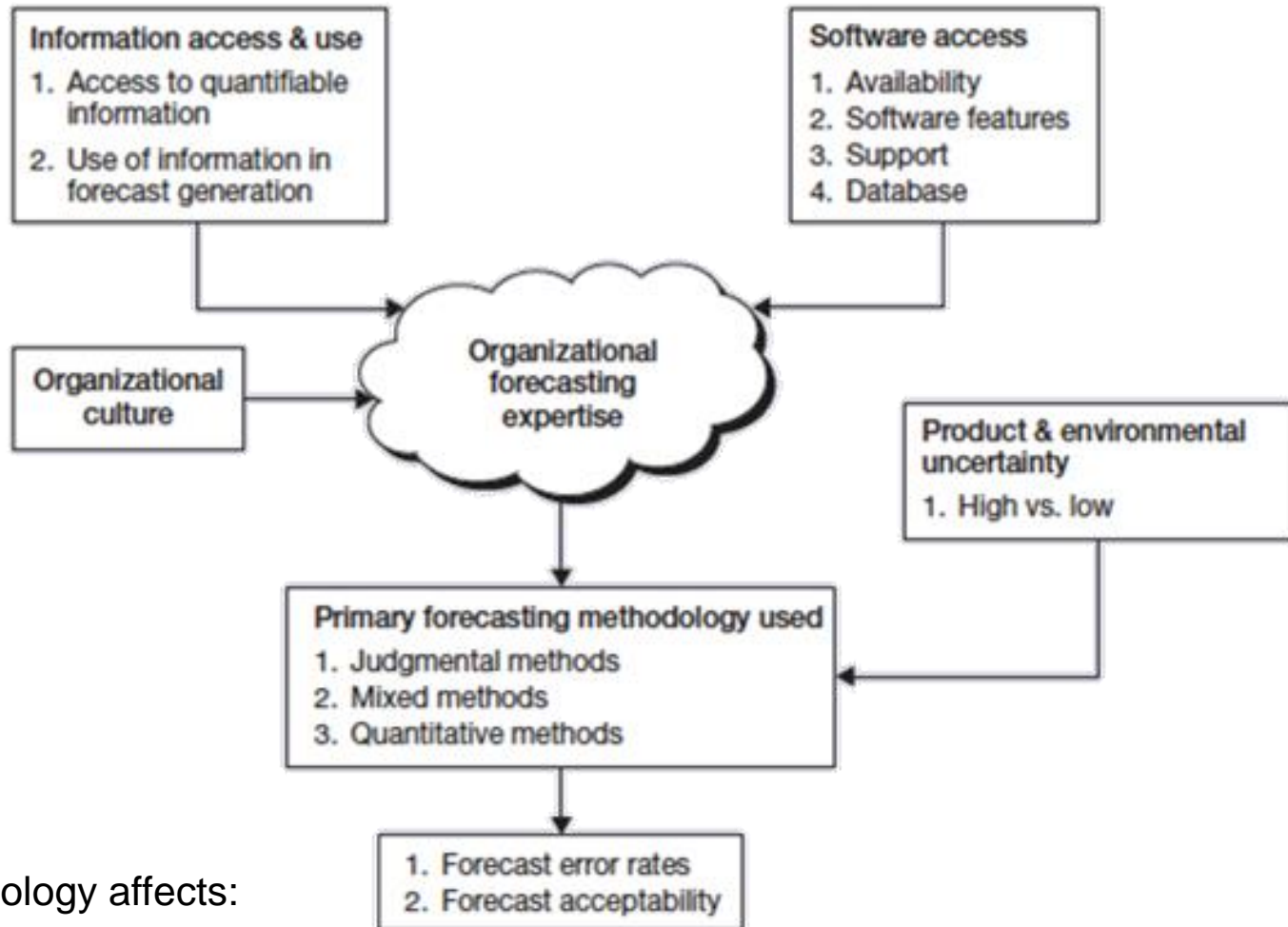
- Modified SAP + choice algorithm
- Judgmental feedback on value added
 - Fewer adjustments (only with substantive knowledge)

Benefits (Sanofi-Aventis)

- Fewer adjustments, fewer meetings!
- \$3M savings
- Improved service to customers



Factors affecting the use of different forecasting methodologies



Choice of methodology affects:

- the forecast error rate.
- the acceptability of the final forecast to users.

Software dimensions

- Software and hardware requirements
- Data handling
 - Integrates with other programming languages (e.g., R)
- Forecasting features
 - Selection of estimation and hold out
 - Rolling origin evaluation
 - Error measures
 - Benchmark forecasting e.g., random walk
 - Multiple seasonalities
 - Prediction intervals
- Hierarchical forecasting
- Judgmental forecasting/ adjustments

Software dimensions

- Exploratory analysis and graphics
 - Time series and seasonal plots
 - Autocorrelation
 - Transformations
 - Decomposition (into trend, seasonal and noise: Census X-13 ARIMA)
 - Explanatory variables
- Forecasting methods
 - Exponential Smoothing methods and ETS models
 - ARIMA
 - Intermittent demand
 - Growth and diffusion curves
 - Regression (Lasso)
 - Machine learning and AI

Can we get software cheap?

- Open source: zero cost (?)
 - Support
 - Licenses
 - Open source ethics!
- Quality of implementation and scalability
- State-of-the art
 - Often packages are from inventors of methods/models
 - Designed for research and/or production systems?

Forecast as a service

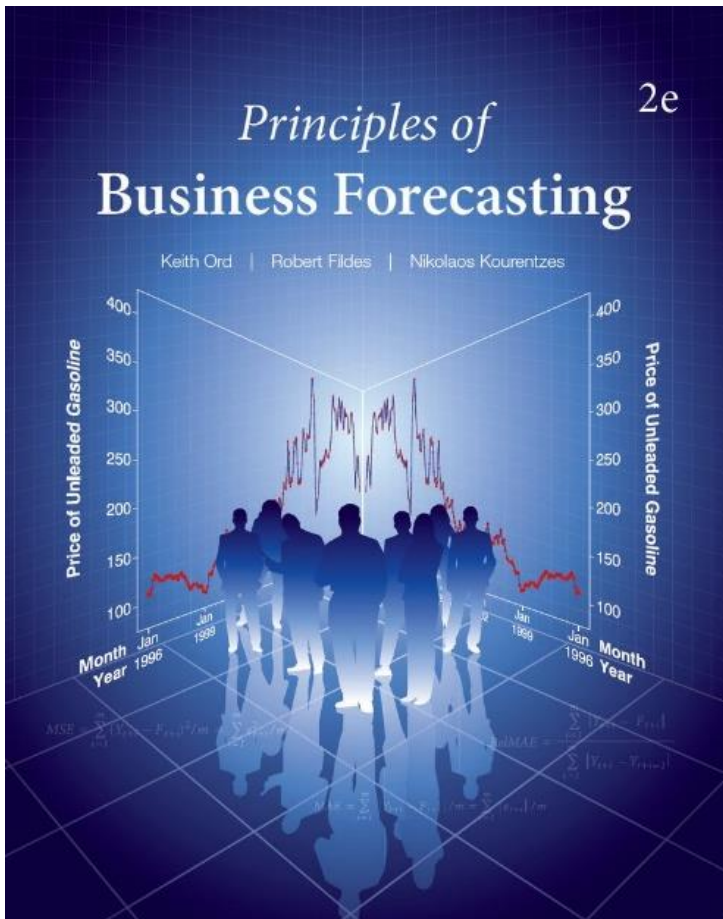
- Outsource forecasting
 - Specialist companies/consultants
 - Online services (e.g. Amazon)
- Transparency of forecasting?
 - Appropriate models/methods or forced to what is available?
 - Integration with in-house expertise and use of soft information?
- Cost
 - Running cost
 - Organisation cost – analytics as a competitive advantage

Choosing the supplier

- Must haves
- Would likes
- Technical requirements
 - Input limitations
 - Computational limitations (e.g. for the retailer, 40K SKUs x 400 stores, daily)
- Validity of methods and comparative accuracy
- Support
 - Technical
 - Training
- Price!

Resources

Centre for Marketing Analytics and Forecasting (forecasting-centre.com)



CMAF R forecasting packages:

- **MAPA**: forecasting with multiple temporal aggregation;
- **thief**: forecasting with temporal hierarchies
- **nnfor**: (shallow) neural networks for time series forecasting
- **smooth**: ETS and ARIMA (incl. high frequency data and explanatory variables)
- **tsintermittent**: forecasting intermittent series
- **diffusion**: life-cycle modelling
- **TStools**: supporting functions for time series modelling (available on Github)
- **greybox**: supporting functions for time series modelling
- **GTT**: handle Google Trends data

Take-aways

- Software choice must match organizational processes
 - Data
 - People
 - Decision requirements
- Software quality variable!
 - Models must be benchmarked & tuned
- Managerial intervention a key feature of forecasting
 - Model selection
 - Parameter tuning
 - Adjustments

Delivering the final forecast

Thank you for your attention!

Questions?

Robert Fildes

email: r.fildes@Lancaster.ac.uk

Nikolaos Kourentzes

email: nikolaos@kourentzes.com

twitter [@nkourentz](https://twitter.com/nkourentz)

Blog: <http://nikolaos.kourentzes.com>

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