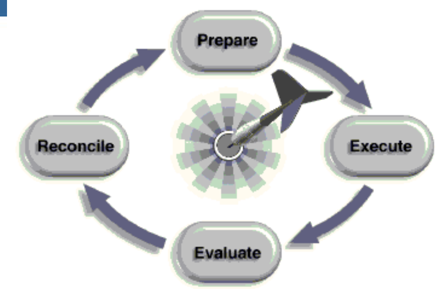

Improved Forecasting Tools for Large Datasets Point the Way to Lower Inventories

Hans Levenbach, Delphus, Inc.

ISF 2011, Prague, Czech Republic, 26 – 28 June, 2011

DELPHUS

Agenda
– Some Principles for “Best Practices’

- Embrace “change and chance” while creating more *flexible demand forecasting* tools for demand planners
- Recognıze empirical data analysis as an essentıal ingredient to creating more realistic forecast modeling while while achıevıng greater *efficiencies in demand cycles*
- Utilize large data sets in a structured data framework to enhance *effectiveness* in decision support.

A Forecast Is NOT Just A Number!

Most forecasts are stated as a single number, as in *"next year generics sales in top eight markets is expected to reach $xxB, with growth of 14.5%"*

- Is it 14.5% (+/- 0 %) ?

or

- 14.5% (give or take 0.5%)?

or

- 14.5% (plus 2% or minus 1%)?

Worst Practice #2

Having unrealistic accuracy expectations

1. Not separating forecasting from planning

2. Gaming metrics -

- ☑ SKUs (subaggregates) tend to be less accurate than product level forecasts (aggregates)
- ☑ Forecaster reports results only at the most aggregate level

Bad practice because what gets measured gets done

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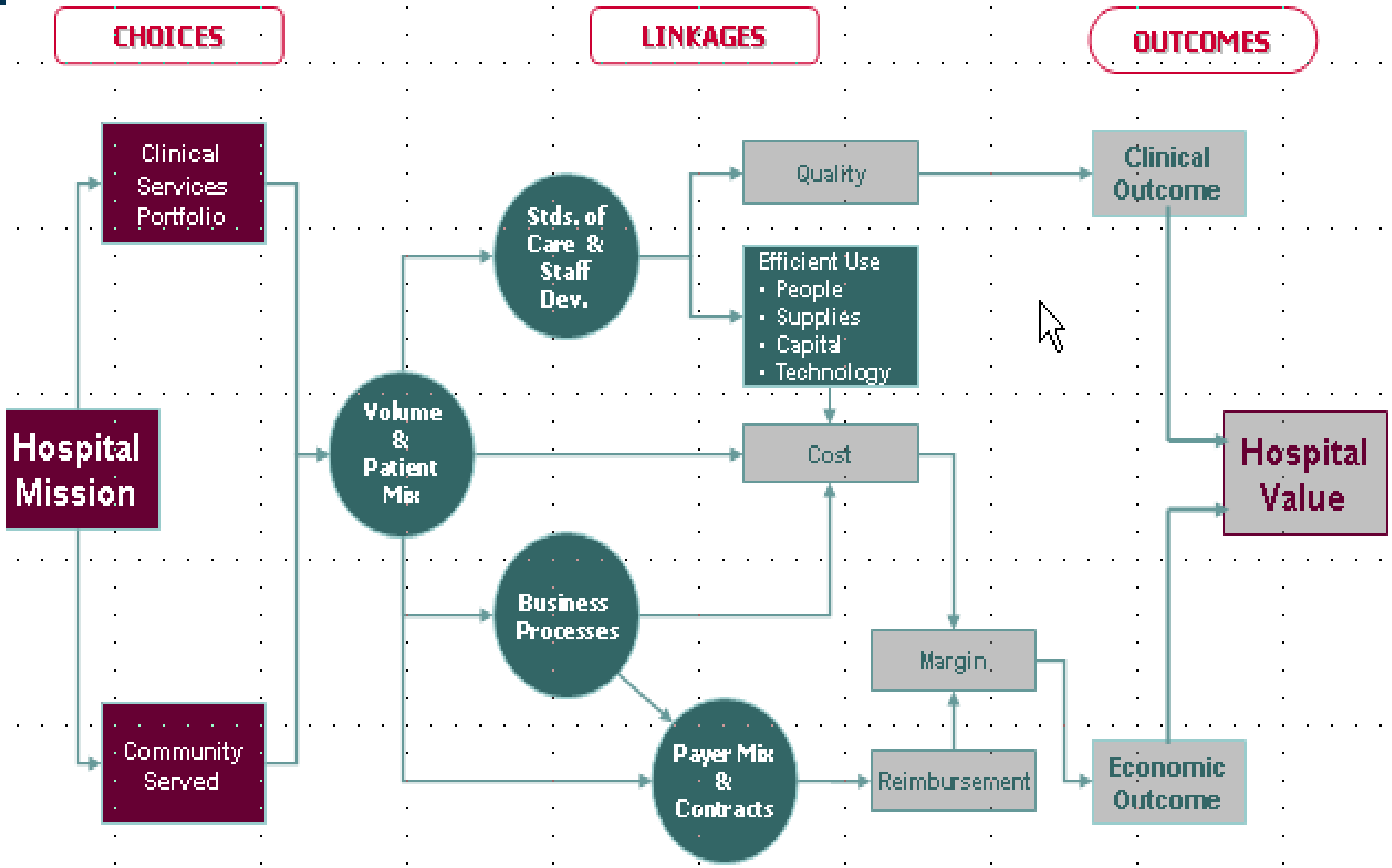
Key Job Challenges for Demand Forecasters and Planners

- Data Proliferation
  - Leads to large unstructured datasets, spreadsheets or flat files
- Spreadsheet Migration

Because of
  - Lack of data integrity
  - Lack of scalability
  - Lack of collaboration
- Job Complexity Requires Standards and Checklists

Supporting The Hospital Value Chain:
Demand Links in a Supply Chain



Creating “Safety Stock” for Staffing Nursing Stations

Classical formulation

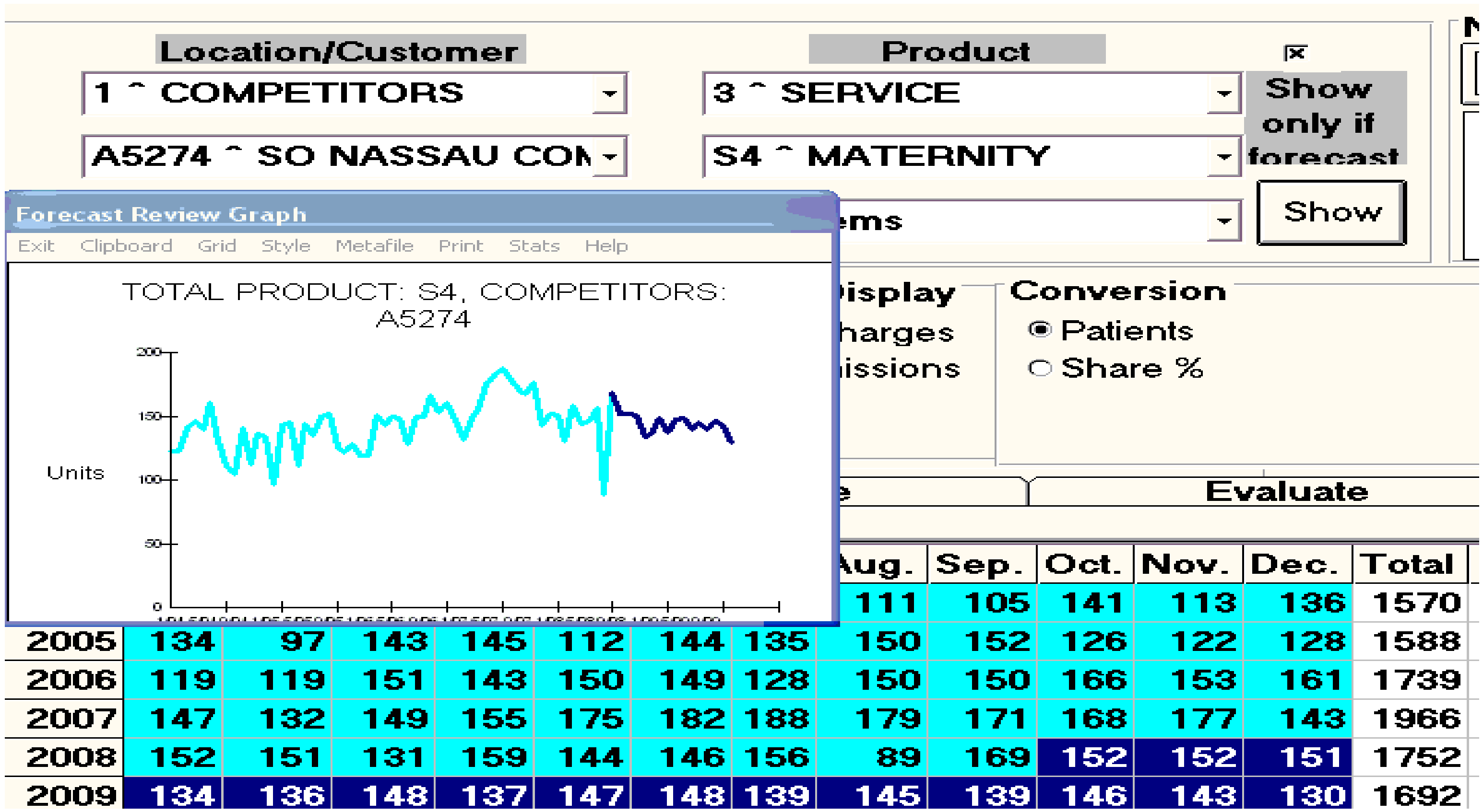
- Level of extra nursing staff that is maintained to buffer against “stockouts”
- Normality of error distribution is assumed

Alternative empirical data-driven approaches

- Sacrifices Normal optimality for Non-normal reality
- Resistant estimates minimize impact on outlier issues
- Model robustness protects against departures from a Normal benchmark

Safety stock for staffing nursing stations

Monthly Maternity Admissions Are Seasonal



Pediatric Admissions Can Be Intermittent

Location/Customer	Product	Show only if forecast
1 ^ COMPETITORS	3 ^ SERVICE	
B5638 ^ ST FRANCIS	S3 ^ PEDIATRICS	
All ^ Items	All ^ Items	Show

Display
- Year By Period
- YTD
- % Total
- ADC

Type
- History Only
- + Stat Forecast
- (selected) + Combined Fc

Dmd Display
- (selected) Discharges
- Admissions

Conversion
- (selected) Patients
- Share %

Prepare + | Execute | Evaluate

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
2004	2	2	0	0	0	2	0	2	1	0	0	1	10
2005	0	1	0	1	2	1	0	0	4	0	0	1	10
2006	0	0	0	0	1	0	0	2	1	0	1	0	5
2007	0	2	2	2	2	2	1	0	1	2	0	1	15
2008	0	3	1	1	0	1	0	0	1	0	0	0	7
2009	0	2	1	1	2	1	1	0	1	1	0	0	10

Classical Spreadsheet Approach

	A	B	C	D	E	F	G	H	I	J
1										
2	Assumptions			Past Sales					Forecasted Sales	
3		Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07	Jan-08	Jan-08	Jan-08
4		5.91	5.01	5.03	5.29	5.97	5.89	5.5	5.5	5.5
5										
6		Lead time (months):		3			© Locad			
7		Service level:		0.9						
8	Calculations				Formulas			Comments		
9		Lead time demand:		16.5	SUM(H4:J4)			Summing the forecasts		
10		Standard Deviation:		0.457063	STDEV(B4:G4)			Deviation in the past sales		
11		Service factor:		1.281552	NORMSINV(D7)			Inverse of the normal distribution		
12		Lead time factor:		1.732051	SQRT(D6)			Square root of lead-time to forecast ratio		
13		Safety stock:		1.014549	D10*D11*D12			Combining factors		
		Reorder point:		17.51455	D9+D13			Lead time demand + safety stock		

Reorder point = Leadtime demand + safety stock

Replace with

$$m(\underline{Ld}) \quad + \quad SF * s(\underline{Ld}) * \sqrt{L}$$

A Family of Exponential Distributions

Replace Normal with a broader family of Exponential distributions (one parameter form)

$$f_{Ld}(Ld,\theta) = \exp[a(Ld)+b(\theta)+c(Ld)\ d(\theta)]$$

where a(.), b(.), and c(.) are known functions. The value θ is called the parameter of the family

- Is positively skewed
- Includes Normal, Gamma, Poisson, Compound Poisson and others
- Allows zero values with non-zero probability

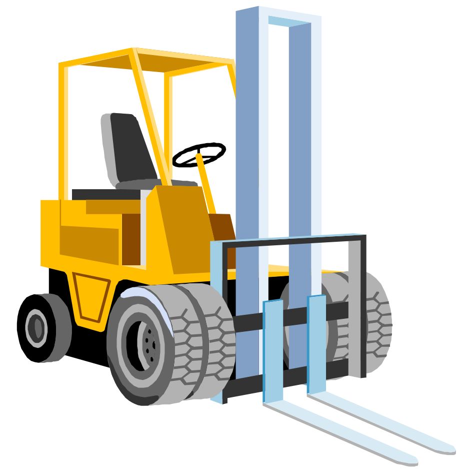
Cf. Wikipedia

Determining a Safety Factor

- The reorder point is Leadtime demand + safety stock

$$m(\underline{Ld}) + SF * s(\underline{Ld}) * \sqrt{L}$$

The "safety factor" SF is derived from a percentile of a posterior distribution for the location parameter in a leadtime distribution. Then SF can be estimated from a posterior distribution:



$$SF = \{\mu_{0.95} - m(\underline{Ld})\}/s(\underline{Ld}) * \sqrt{L}$$

where $\mu_{1-\alpha}$ = desired percentile in marginal posterior distribution for μ based on the exponential family

- The s(Ld) is a resistant scale statistic

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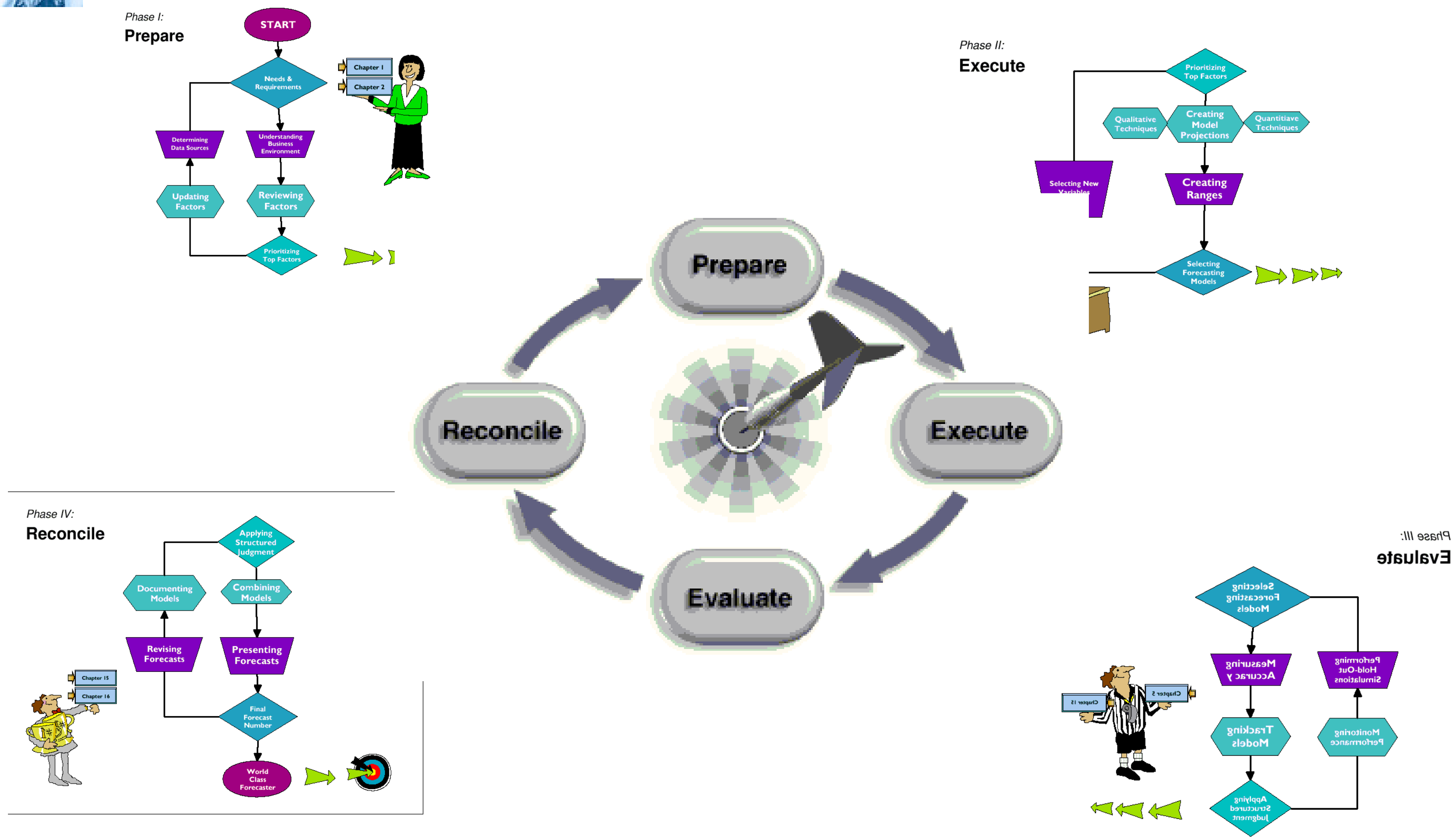
Standards: Create A Four-Step Demand Forecasting Cycle –The PEER process



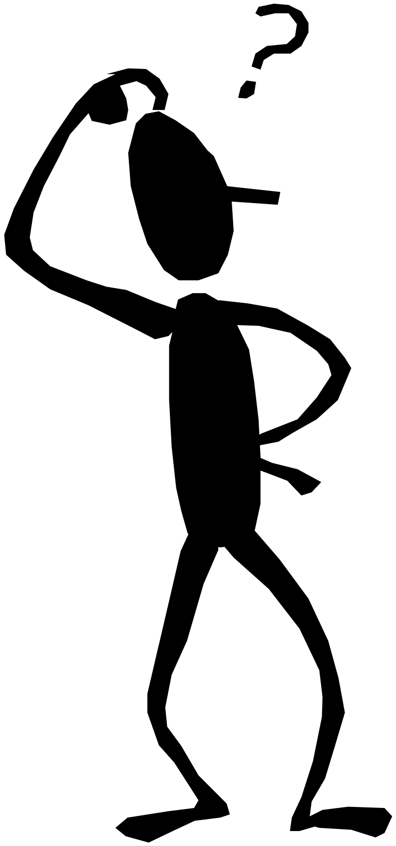
Conclusions

• Demand forecasters and planners need to make more *explicit statements of uncertainty* for all forecasts

• For large data sets, *data-driven methods* can yield more realistic and robust forecast modeling results

• Creating a *structured data framework* up front for large volume forecasting is key to becoming more credible and effective as a forecaster.

Questions or Comments?



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