Qualitative and Quantitative Factors in Risk Models

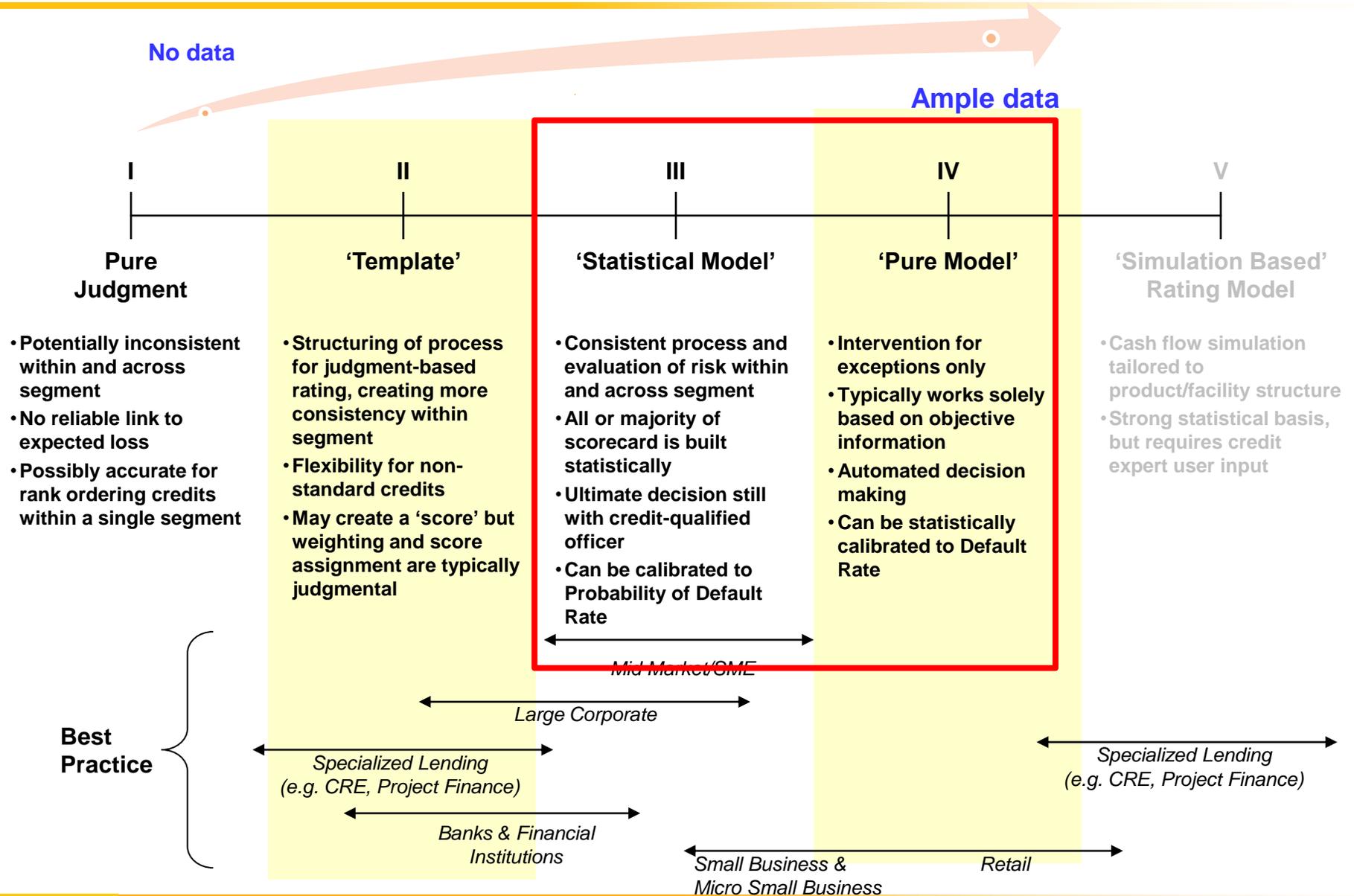**Presented by:**
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EVP, Model Development

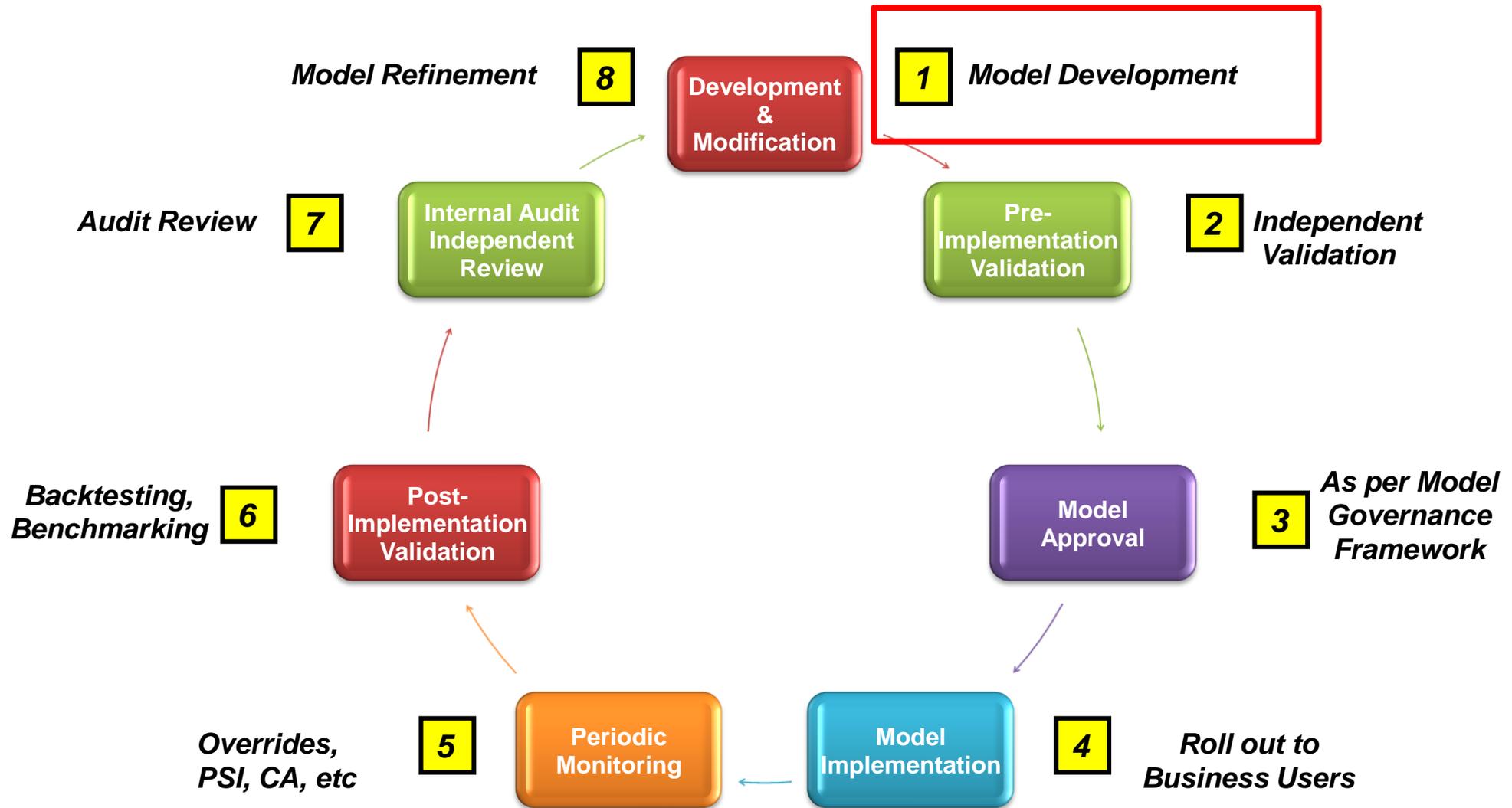email: zihan@maybank.com.my

AGENDA

- Modeling Approaches

- Model Development Life Cycle and Worksteps

- Data for Model Development

- Data Source and Types of Data

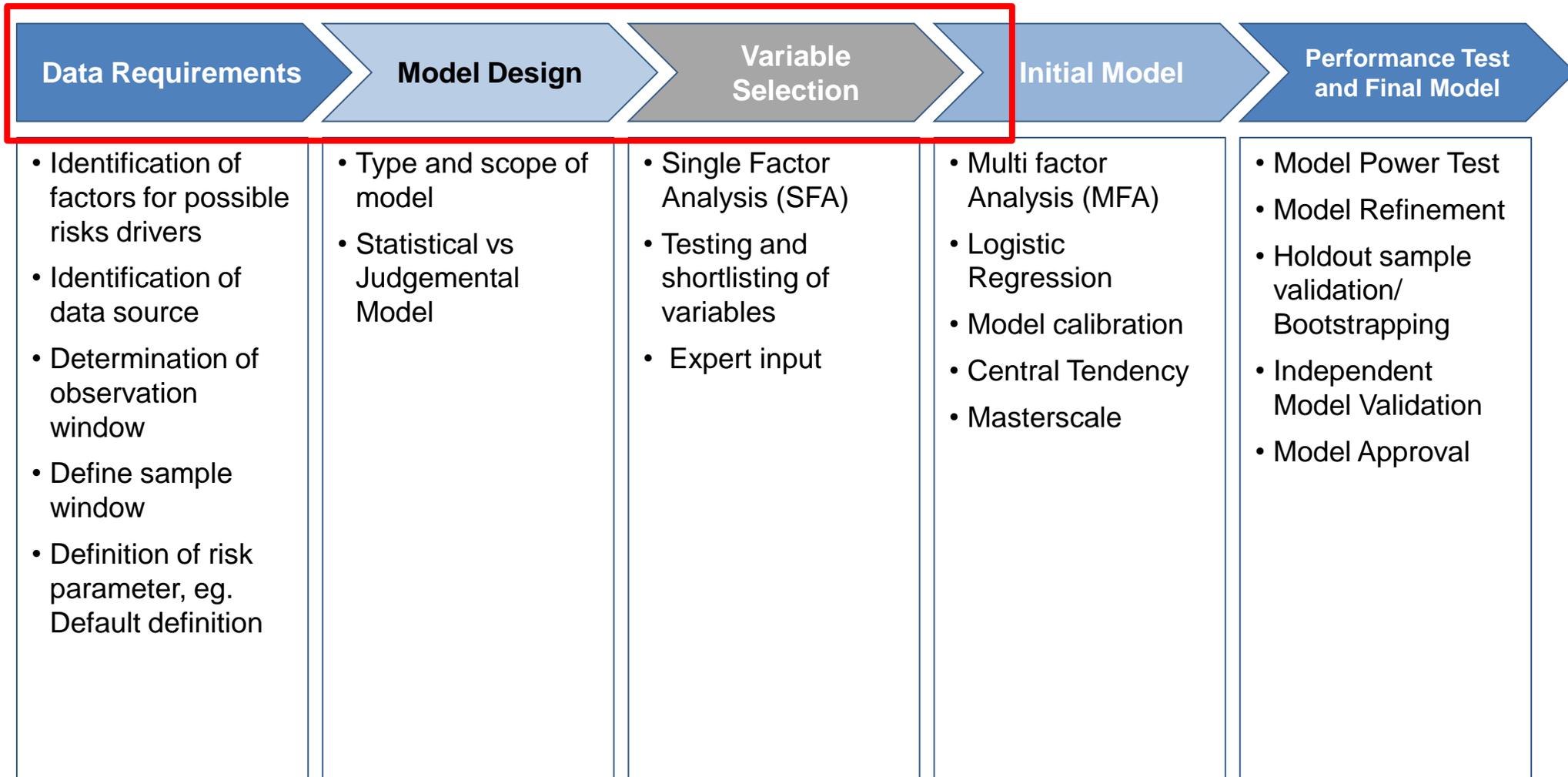- Factor Selection and Considerations

- Model Finalisation

Approaches in Model Development

Ample data

I	II	III	IV	V
Pure Judgment	**'Template'**	**'Statistical Model'**	**'Pure Model'**	**'Simulation Based' Rating Model**
• **Potentially inconsistent within and across segment** • **No reliable link to expected loss** • **Possibly accurate for rank ordering credits within a single segment**	• **Structuring of process for judgment-based rating, creating more consistency within segment** • **Flexibility for non-standard credits** • **May create a 'score' but weighting and score assignment are typically judgmental**	• **Consistent process and evaluation of risk within and across segment** • **All or majority of scorecard is built statistically** • **Ultimate decision still with credit-qualified officer** • **Can be calibrated to Probability of Default Rate**	• **Intervention for exceptions only** • **Typically works solely based on objective information** • **Automated decision making** • **Can be statistically calibrated to Default Rate**	• **Cash flow simulation tailored to product/facility structure** • **Strong statistical basis, but requires credit expert user input**

Best Practice

Mid Market/SME

Large Corporate

Specialized Lending (e.g. CRE, Project Finance)

Specialized Lending (e.g. CRE, Project Finance)

Banks & Financial Institutions

Small Business & Micro Small Business

Retail

Model Development Life Cycle

Model Refinement [8] Development & Modification

[1] Model Development

Audit Review [7] Internal Audit Independent Review

Pre-Implementation Validation [2] Independent Validation

Backtesting, Benchmarking [6] Post-Implementation Validation

Model Approval [3] As per Model Governance Framework

Overrides, PSI, CA, etc [5] Periodic Monitoring

Model Implementation [4] Roll out to Business Users

Model Development Worksteps

Data Requirements	Model Design	Variable Selection	Initial Model	Performance Test and Final Model
• Identification of factors for possible risks drivers • Identification of data source • Determination of observation window • Define sample window • Definition of risk parameter, eg. Default definition	• Type and scope of model • Statistical vs Judgemental Model	• Single Factor Analysis (SFA) • Testing and shortlisting of variables • Expert input	• Multi factor Analysis (MFA) • Logistic Regression • Model calibration • Central Tendency • Masterscale	• Model Power Test • Model Refinement • Holdout sample validation/ Bootstrapping • Independent Model Validation • Model Approval

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G I G O

Garbage　　In　　Garbage　　Out

Data for Model Development

Major underlying assumption for statistical modeling is **past data is a reflection of future behaviour**

BUT

PERFECT DATA DOES NOT EXIST

Modeler to use combination of statistical tool and expert judgment to produce best final model out of available data

Expert Input in Model Development Worksteps

Input from subject matter (SME) experts to ensure data is correctly interpreted
SME involvement in the process will facilitate buy-in and usage upon model deployment

Worksteps

1

List possible risk drivers

2

Factor short-listing

3

Model Finalisation

4

Calibration
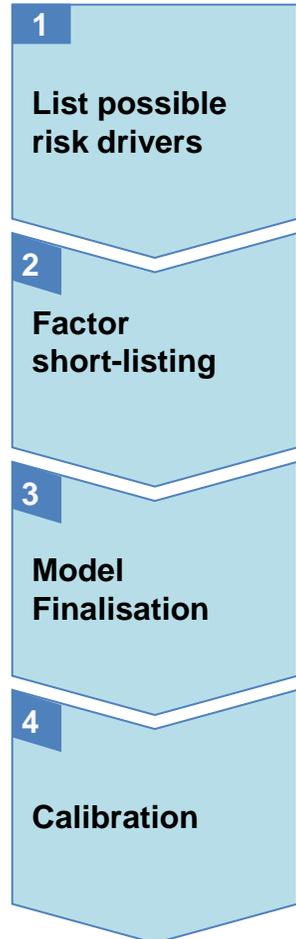
- List potential risk drivers gathered from modellers' experience and from expert feedback

- Statistical analysis to identify risk factors which best differentiate levels of risk (eg default)
  - Factor Analysis for first-pass selection and factor "transformation"
  - Multi-factor regression analysis

- Review with bank experts for interpretation and intuitiveness

- Determination of optimal combination of factors to produce robust and meaningful model using combination of statistical analyses and expert judgment

- Review with bank experts

- Determination of long run default rate expectation and downturn adjustments for LGD

- Assignment of PD, LGD and EAD estimates to individual risk segments

- Review with banks experts for default experience over economic cycle

Data Source

Data for model development can be sourced from internal or external sources
Good data system infrastructure is key in supporting modeling

Internal Source

- Performance or "Behaviour type" data
- Application & Demographics data
- Financial data
- Cross product data

External Source

- Consumer Credit Bureau
- Business Credit Bureau
- External Rating Agencies
- Newspapers & Industry Reports
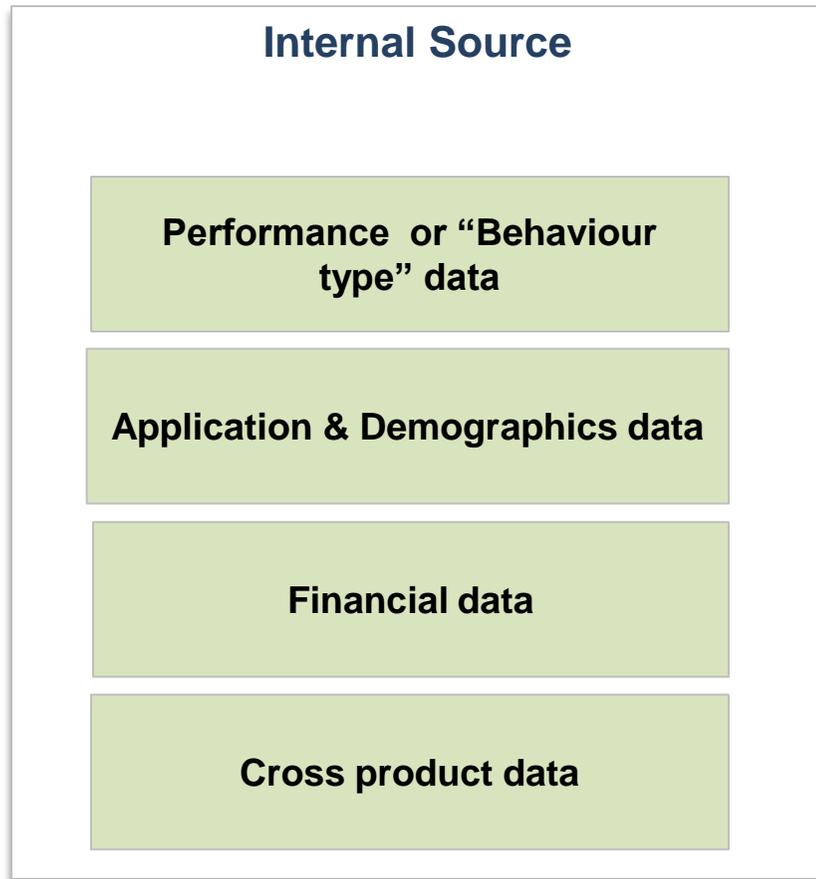
Financial Data

For business borrowers models, financial statement forms the important source of data for risk drivers

The reliability of the financials however generally differs across different business size and types of legal incorporation

Types of business
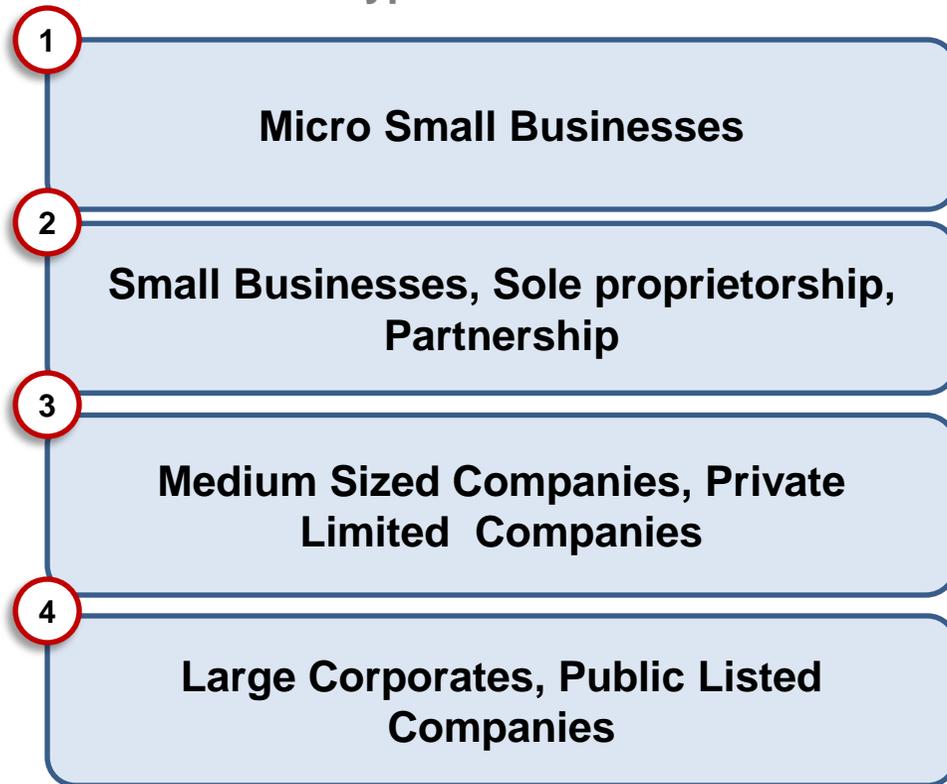
Reliability of Financial Statement

1. **Micro Small Businesses**

2. **Small Businesses, Sole proprietorship, Partnership**

3. **Medium Sized Companies, Private Limited Companies**

4. **Large Corporates, Public Listed Companies**

Financial Data – Example of Factor Long List

Ratios generated from financial statement can be put into a few categories:

Activity & Turnover
- Net sales / Total assets
- Net sales / Tangible Networth
- Trade Debtors/ Total Liabilities
- Trade Creditors/ tangible networth
- Trade Creditors/ Net sales

Profitability
- Pretax Profit / net sales
- (Pretax Profit +Depreciation)/Total Asset
- (Pretax Profit +Depreciation)/(Total Asset –Cash)
- EBIT/Total Assets

Debt Capacity & Debt Service
- EBIT / Interest Charge
- (EBIT + Depreciation) / Interest Charge
- (EBIT + Depreciation) / (current Liabilities – Cash)

Gearing
- Total Liabilities / Total Asset
- Total Liabilities / Tangible Networth
- Long Term Liabilities / Capitalisation
- Total asset / Tangible Networth
- Current Liabilities / Total Asset

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Financial Data – Example of Factor Long List (ctd)

Ratios generated from financial statement can be put into a few categories:

Liquidity

- Current asset / Current Liabilities
- Cash / Current Liabilities
- (Capitalisation – Fixed Asset) / Total Liabilities
- 365 * Trade Debtors / Net Sales

Solvency

- Tangible Networth / Total Asset
- Tangible Networth / Total Banking Facilities
- Total Banking Facilities / Total Assets

Capital Usage & Durability

- Current Asset / Total Asset
- Tangible Networth / Fixed Assets
- Net Working Capital / Total assets
- Fixed Asset / Total Asset (Capital Intensity)

Size

- Total Assets
- Turnover
- Pretax Profit
- Retained Earnings
- Total Banking facilities
- Fixed Assets

Qualitative Factors - Example of Factor Long List

Large Corporates, Medium Sized Companies and Small Businesses

Project Based Companies such as Contractors and Real Estate

Large Corporates, Medium Sized Companies and Small Businesses	Project Based Companies such as Contractors and Real Estate
One Man Show	Professional Management
Qualified Accounts	Age of Company
Accounts Audited by Big Four	No. of Projects in hand by Company
Succession Plan	Total No. of Projects completed by Company/Management
Age of Business	Total Value of Projects completed by Company/Management
(Average) Age of Management (yrs)	Value of Largest Project completed by Company/Management
Average Experience of Management (yrs)	Experience of Key Person(s)
Industry Analysis	Paid up Capital
Conduct of Current Account	Conduct of Current Account
Conduct of Related Accounts	Conduct of Related Accounts
Prompt Repayment of Term Loans	Prompt Repayment of Term Loans and Trade Bills
Prompt Repayment of Trade Bills	Duration of Customer Relationship
Duration of Lending Relationship	Duration of Lending Relationship
Duration of Customer Relationship	
Average OD Utilisation	

The challenge with the qualitative factors are in the data capture to enable modeling
Clear and structured guidance to be provided so interpretation is consistent

Management Style

ILLUSTRATIVE

You are given 3 options in this field. The definition of each of the options is as follow:-

Aggressive

Management is considered aggressive if they venture into high-risk/high-return type of businesses which they are not experienced in and are considered as high risk-takers. They diversify and expand rapidly into non-core businesses.

Neutral

Management that have a combination of aggressive and conservative management styles.

Conservative

Management that focus more on core business and exercise prudence. Generally they stick to their core business and/or maintain the their traditional businesses

Data Source for Retail Portfolios

Different types of data from Retail/Consumer borrowers:

1

Account Performance and Behaviour Data

- Month In Arreas
- Maximum delinquency in last 6 months
- No of times delinquent in last 6 months
- Amount outstanding/ Limit
- No of full payment in past 6 months (Credit Card)

2

Application and Demographic Data

- Age
- Gender
- Occupation
- Income
- Debt Service Ratio
- Type of car financed (HP)
- Property location (Mortgage)
- Distance from branch (SME)

3

Credit Bureau Data

- No of application in past 3 months (Credit hungriness)
- Account status at other financial institutions
- Total no. of delinquents in past 12 months
- Total Revolving Facility Balance / Total Limit

Considerations During Data Preparation

Missing Values
Tolerable amount of missing data
Treatment

Applicability
Will data be available going forward?

Correlation
with other factors

Outliers
Identification
Treatment

"Cherry Picking"
Possible bias in data due to underwriting process

Factor Predictive Power

Statistical measurement for predictive power: eg Accuracy Ratio, Gini, etc

Accuracy Ratio measures the factor's discriminatory power between a sample of good and bad customers
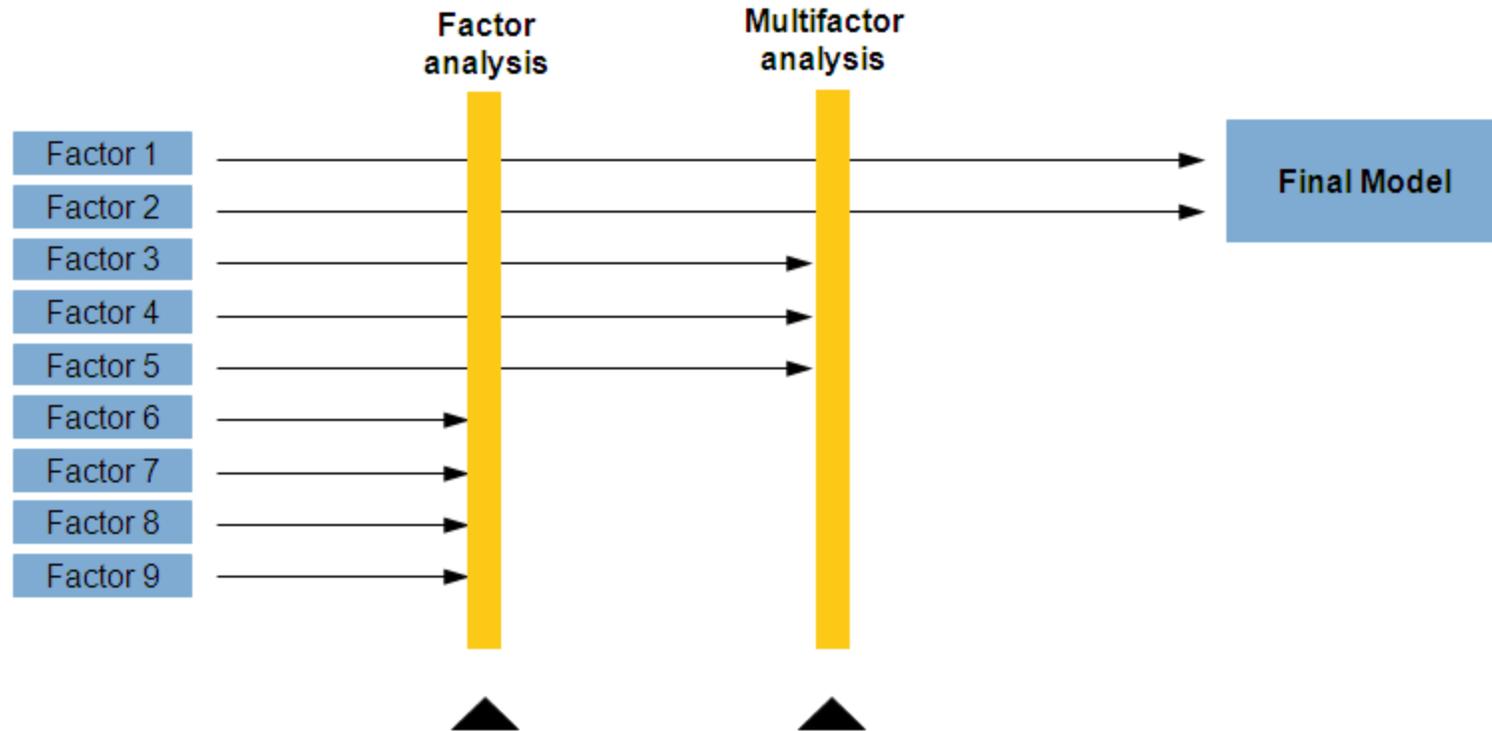
Accuracy ratio

Illustrative
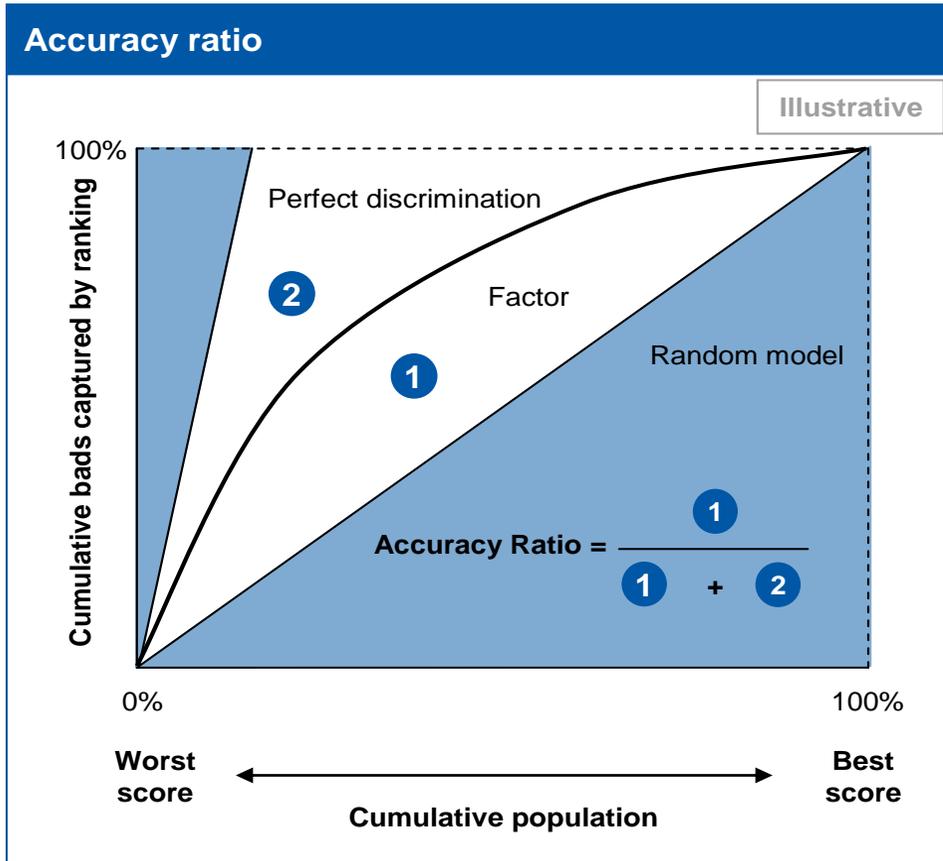
- AR ranges between 0% and 100%
  - AR = 0% for a random factor with no discrimination
  - AR = 100% for a perfect factor (but these do not exist in the real world)

AR benchmark for single factors

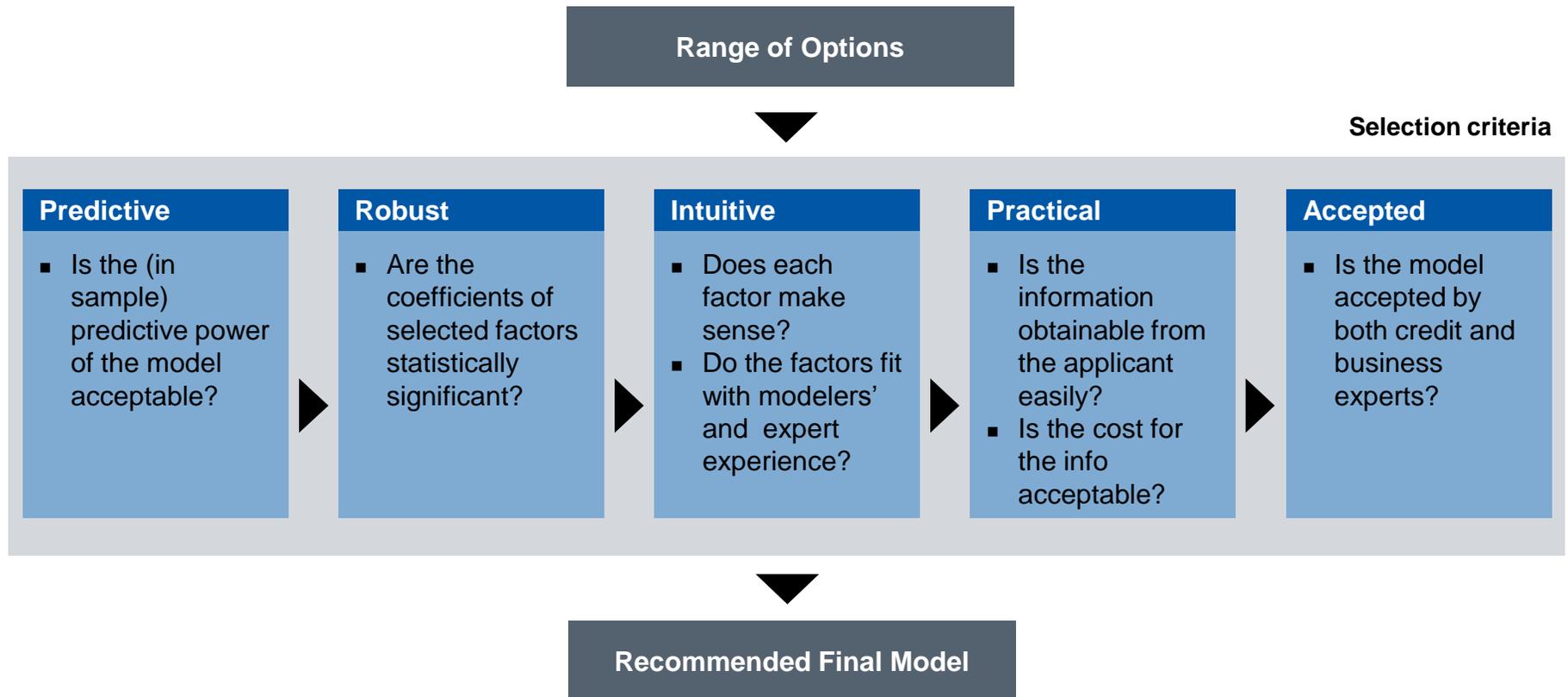|	Acceptable	Good	Execellent
Single factor	5-15%	15-20%	20%+

Single and Multifactor Analysis

In the **Factor Analysis**, we
- Test the ability of each factors to distinquish levels of risk (within sample)
- Factors short-listed in consultation with expert panel

In the **Multi Factor Regression stage**:
- Regression used to identify a minimum set of factors which together best distinquish levels of risk

The final factor selection is made via a combination of statistics and judgment

Range of Options

▼

Predictive	**Robust**	**Intuitive**	**Practical**	**Accepted**
▪ Is the (in sample) predictive power of the model acceptable?	▪ Are the coefficients of selected factors statistically significant?	▪ Does each factor make sense? ▪ Do the factors fit with modelers' and expert experience?	▪ Is the information obtainable from the applicant easily? ▪ Is the cost for the info acceptable?	▪ Is the model accepted by both credit and business experts?

▼

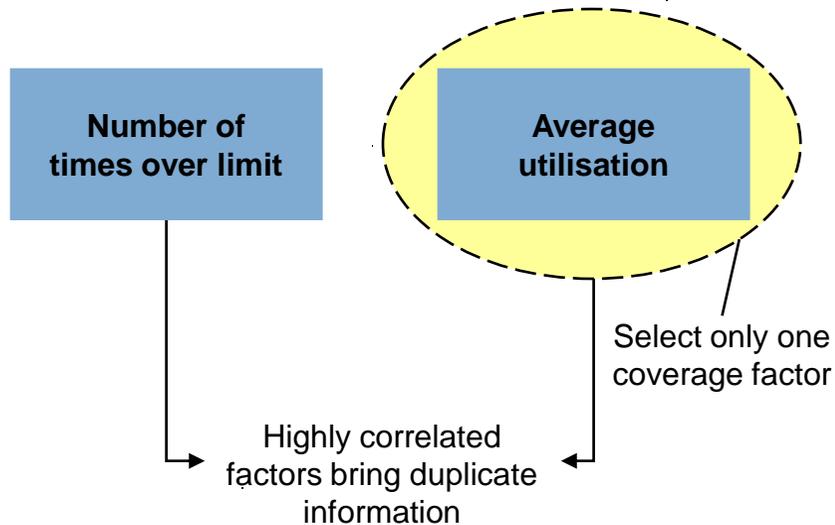**Recommended Final Model**

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Considerations for Final Factors

- The objective of scorecard development process is find a core set of information which can be used to consistently identify borrowers of similar risk
- Many "good" factors will not be used because they do not add significant predictive power once the "core" factors are accounted for
- Furthermore, the more factors are included, the greater likelihood that the model will be "overspecified", and performance will deteriorate more rapidly

1. Avoid selecting factors which don't bring unique information as they do not improve the model
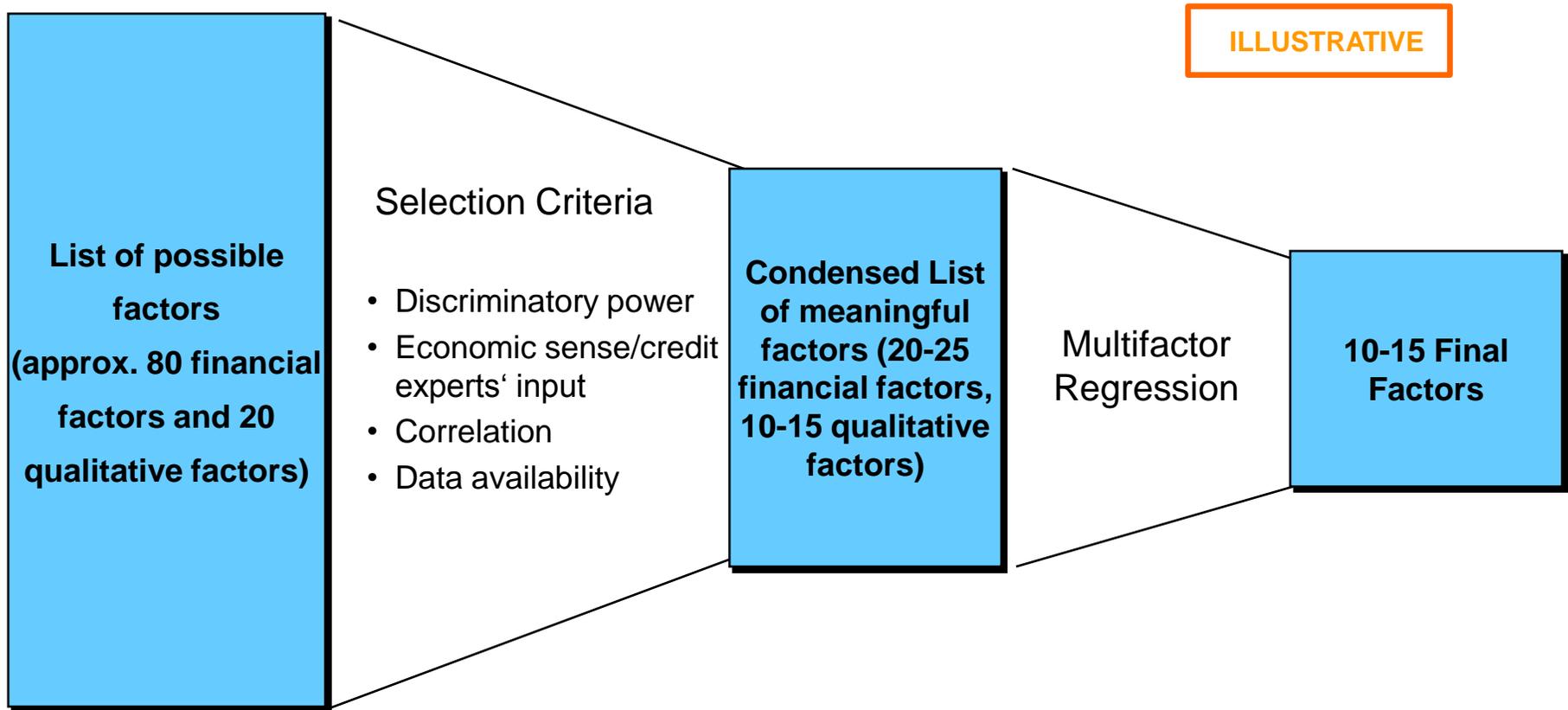
Example

Number of times over limit

Average utilisation

Highly correlated factors bring duplicate information

Select only one coverage factor

2. Add factors to final model only until predictive power of the model is optimised

Illustrative

Theoretical maximum

Predictive power of model

Number of factors in model

1   2   3   4   5
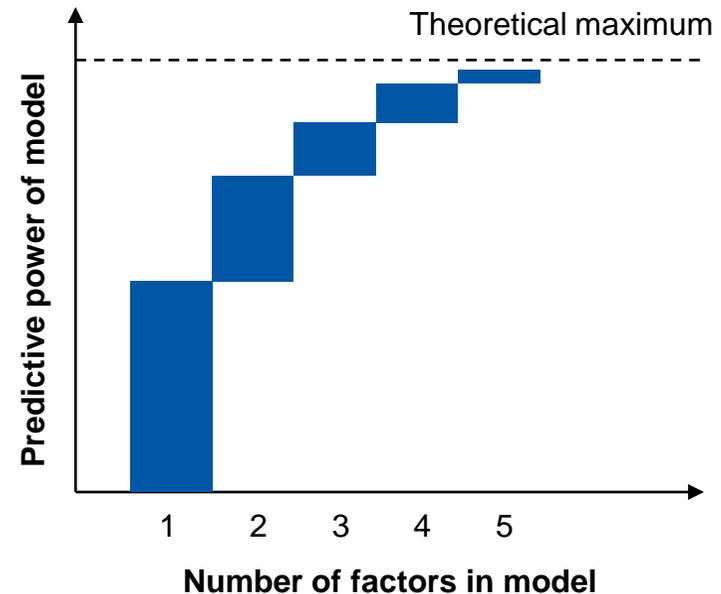
Shortlist of factors

The number of factors is reduced in order to perform the regression analysis

ILLUSTRATIVE

List of possible factors (approx. 80 financial factors and 20 qualitative factors)

Selection Criteria

- Discriminatory power
- Economic sense/credit experts' input
- Correlation
- Data availability

Condensed List of meaningful factors (20-25 financial factors, 10-15 qualitative factors)

Multifactor Regression

10-15 Final Factors

Recap

- Different modeling approaches to be considered based on data availability, complexity and objective of model development

- Even when data is available, modelers need to employ a combination of statistical measurement and expert judgment to detect biasness in data and correct it

- At Single Factor Analysis (SFA), factors are tested and filtered
    - Long list is narrowed down to short list for Multiple Factor Analysis (MFA)

- Involvement from Subject Matter Experts (SME) is crucial throughout the model development process for feedback and **buy-in** upon model implementation.

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Maybank Background
Who Are We?

Maybank has always been the leader in financial services in Malaysia, and is rapidly becoming a more visible presence across Asia. Our Vision, Mission and Core Values are at the Heart of what we do:

Our Vision: To be a Regional Financial Services Leader

Our Mission: Humanising Financial Services Across Asia

Our Core Values: T.I.G.E.R.

Teamwork We work together as a team based on mutual respect and dignity	**Integrity** We are honest, professional and ethical in all our dealings	**Growth** We are passionate about constant improvement and innovation	**Excellence & Efficiency** We are committed to delivering outstanding performance and superior service	**Relationship Building** We continuously build long-term and mutually beneficial partnerships

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Maybank Background
Who Are We?

The Maybank Group is Malaysia's financial services leader with a network of over 2,100 offices in 17 countries worldwide.

We have 2,100 Offices Worldwide	**Maybank Group is Established in 17 Countries**	**With 42,000 employees globally servicing our clients**
We serve 21 million customers in the markets which we operate in	**We have a market capitalization of US$22 billion**	**Total assets of US$135 billion**

Thank you