

R!SK MANAGEMENT

EARLY WARNING MODELLING

Disclaimer



**Parental guidance
advised**

ALL CHARACTERS AND
EVENTS IN THIS SHOW--
EVEN THOSE BASED ON REAL
PEOPLE--ARE ENTIRELY FICTIONAL.
ALL CELEBRITY VOICES ARE
IMPERSONATED.....POORLY. THE
FOLLOWING PROGRAM CONTAINS
COARSE LANGUAGE AND DUE TO
ITS CONTENT IT SHOULD NOT BE
VIEWED BY ANYONE



**P A R E N T A L
A D V I S O R Y
E X P L I C I T C O N T E N T**

PG

Parental
guidance
recommended

X 18+

RESTRICTED

Restricted
to 18 and over

R

RESTRICTED

**UNDER 17 REQUIRES ACCOMPANYING
PARENT OR ADULT GUARDIAN**

**STRONG LANGUAGE, THOUGHTS
AND IDEAS**

Experience

Stats

- Nils Foyen Kjærside
- I'm not 29 yo
- 17 yrs xp in Risk Management
- Work in Risk Analytics - a part of Group Risk Management

Danske Bank



DnB NOR



FIH|ERHVERVSBANK
GE Capital

ANZ
We live in your world

From

**MAKING
PEOPLE
WANT
MODELS**

To

**MAKING
MODELS
PEOPLE
WANT**



Early Warnings i Risk Management



Bunker



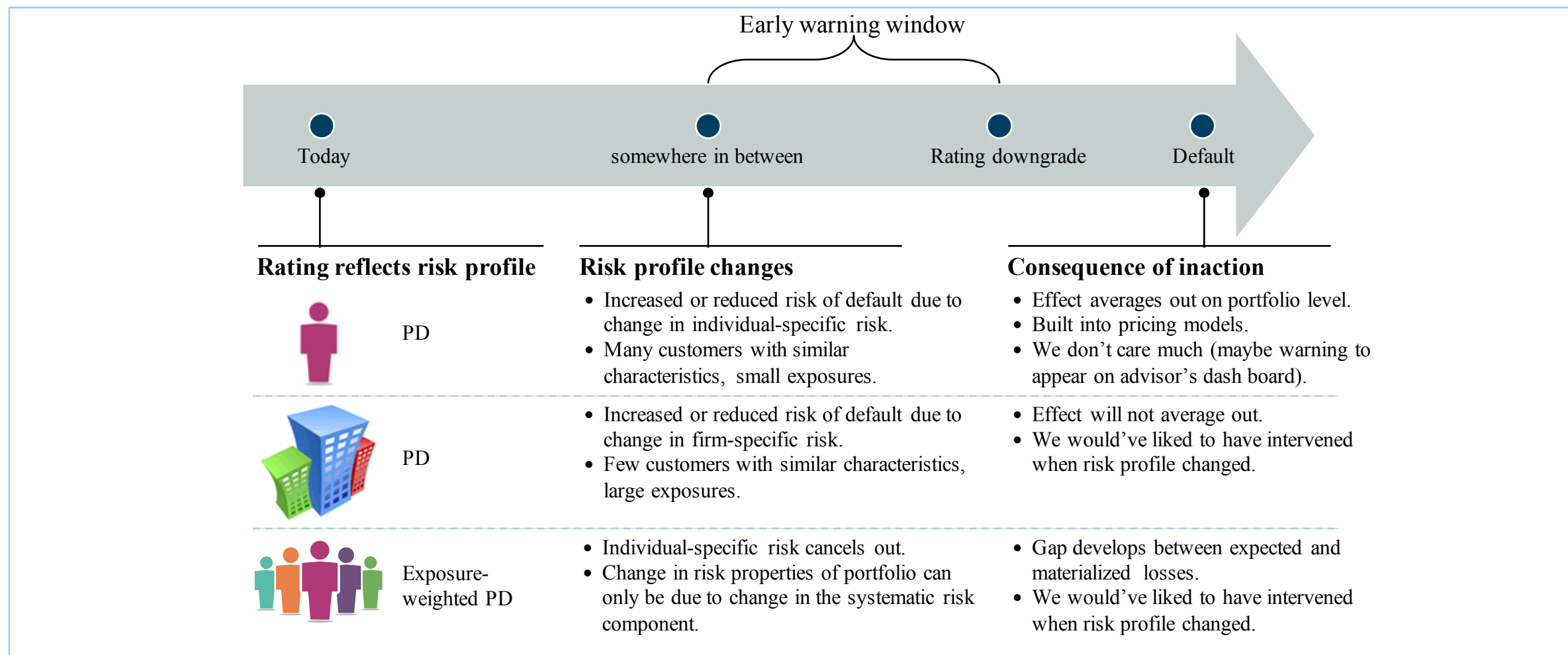
EARLY WARNING
TODAY

RE-ACTIVE
EVENT
BASED

EARLY WARNING
TOMORROW

PREDICTIVE
BEHAVIOUR
BASED

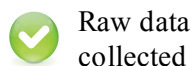
Early detection of changes in behavior, inflow and outflow



Modeling Methodology for Benchmark Model

1 Data

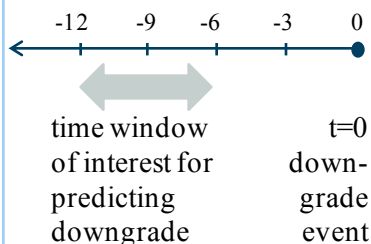
- Customer list from large corporate PD model (1,395 customers).
- Historical rating data from 2009 and onward.
- Historical annual financial statements from 2009 and onward.
- Consolidated statements chosen where available.



Raw data collected

2 Modeling target

- Migration from investment grade to non-investment grade.
- Defaults excluded.
- Features extracted from financial statements with end period falling 6-12 months before migration event.



Modeling dataset constructed

3 Pre-processing

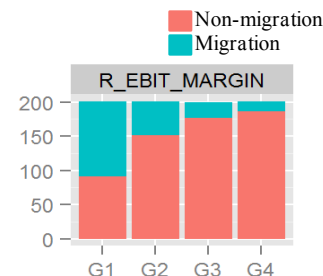
- Include features that capture change in key financial data (e.g. year-over-year revenue).
- (optional) Cap outliers.
- (optional) Standardize features by industry (at industry portfolio level 2).
- Discard features with >30% missing values.



Pre-processing completed

4 Univariate analysis

- Categorize features and construct distribution of migrated and non-migrated customers per group. Example:



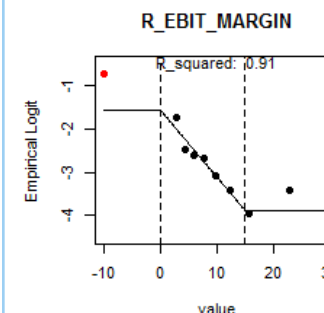
- Calculate information value and discard features with little explanatory power (information value < 0.05).



Univariate analysis completed

5 Transformations

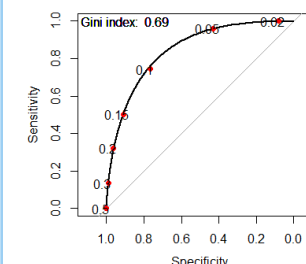
- Apply a transformation that captures the relationship between independent variable and target variable.
- Transformation caps variable above (below) some limit.



Transformation completed

6 Multivariate analysis

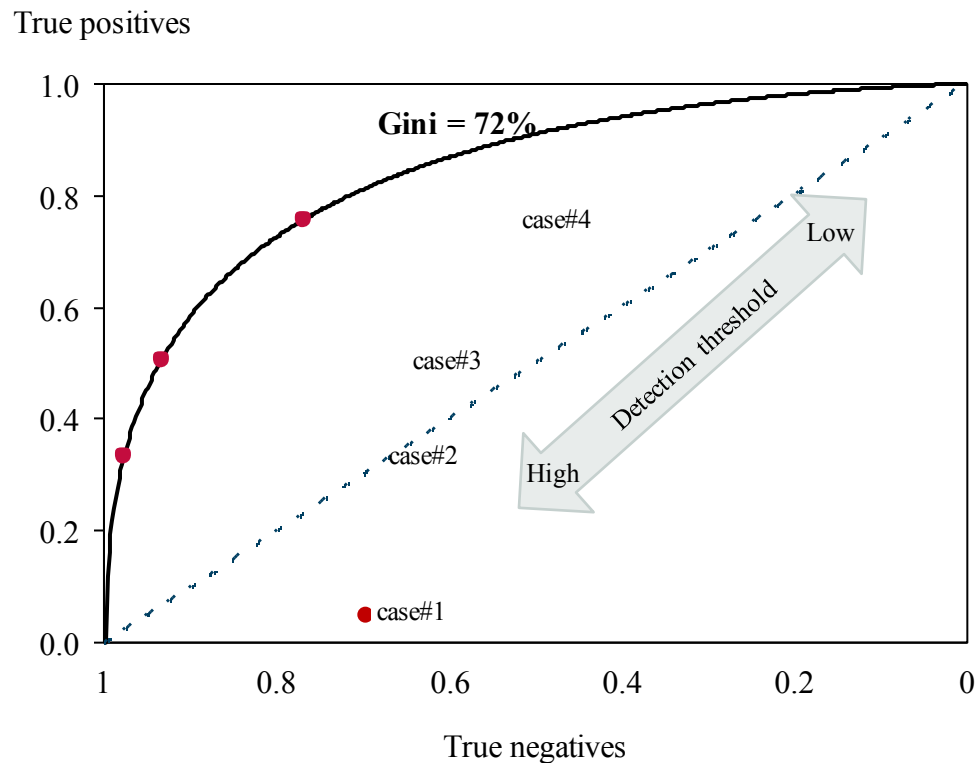
- Narrow down feature list by eliminating highly correlated features (threshold of 0.95).
- Replace missing values with median.
- Fit target variable using a logistic regression (regularization by Lasso method).



Logistic regression built

The model was optimized by maximizing area under the curve for the training dataset

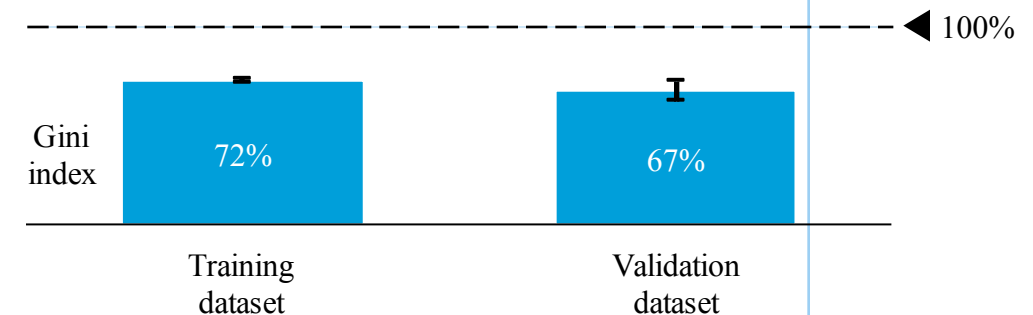
ROC curve



Note: cases are described on the next slide

Description

- The ROC curve shows the trade-off between true and false detections as detection threshold is varied.
- Ideally, it's desired to have a curve that climbs with vertical steepness from (1,0) to (1,1); such curve has a Gini index of 100%.
- A Gini index above 60% is considered a good result as benchmarked against industry best practices.
- The Gini index for the training and validating set averaged over 20 different samples is shown below.



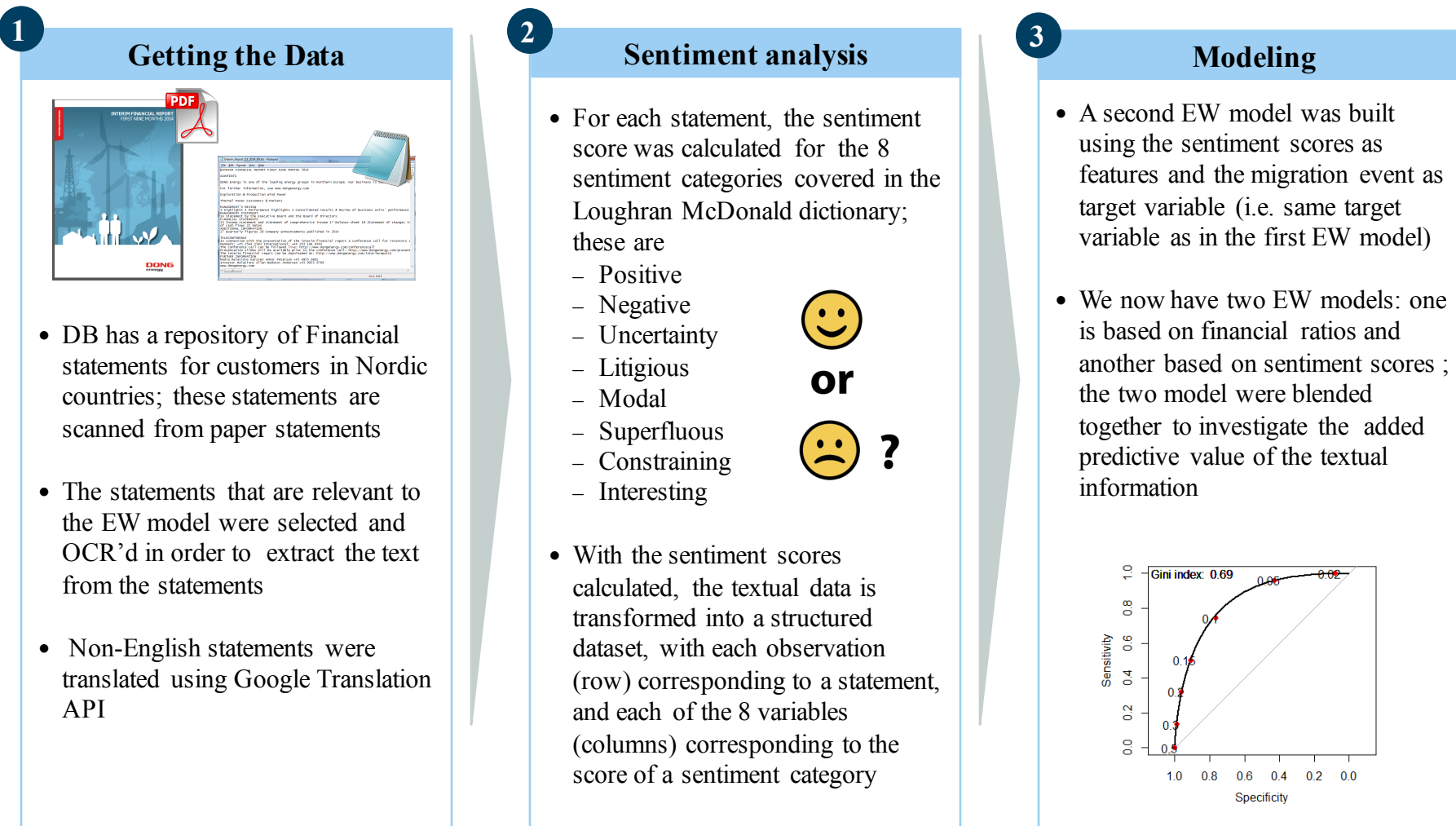
READING TEXT

WHAT YOU
SEE IS
WHAT YOU
GET

ANALYZING TEXT

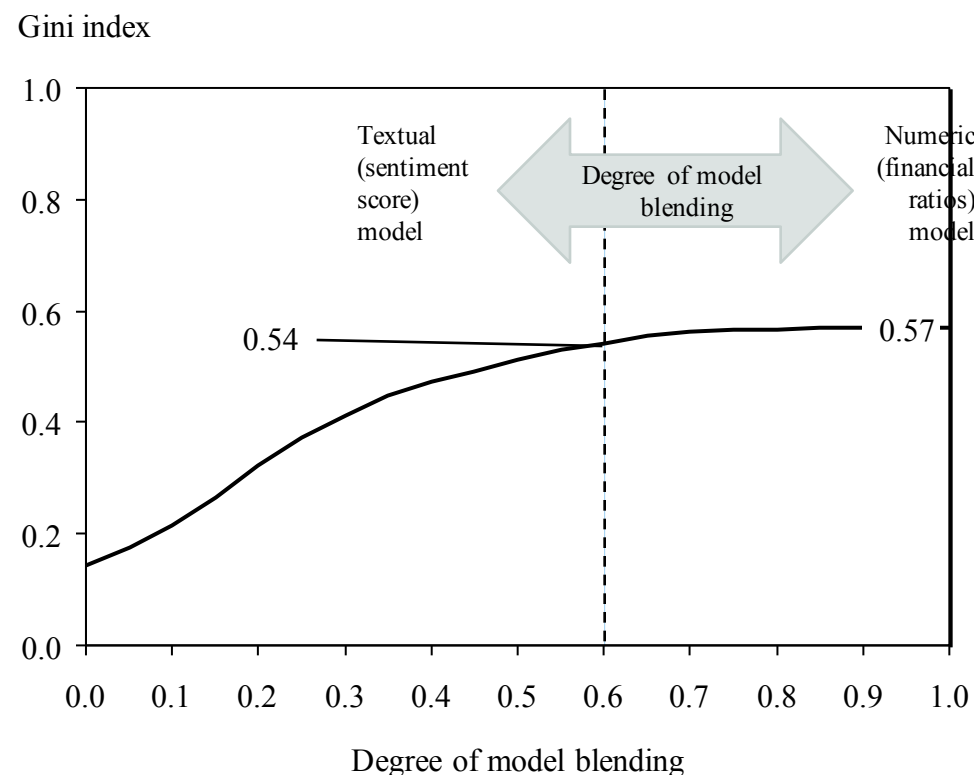
WHAT YOU
WRITE IS
WHAT I
GET

In the next phase, we investigated the added predictive value of using textual information from the financial statements



Not too optimistic results based on text analysis

Model performance



Description

- The performance of the combined model as function of degree of blending (i.e. proportion of numeric part included) reveals that the overall performance does not improve by combining the two models
- This is expected because the two models are not independent (i.e. text in the statement is correlated with reported financial figures)
- However, the plot also reveals that the textual model carries information equivalent to the numeric model (a 40%-60% split is nearly as good as a 100% numeric model)
- To reap the full benefits of a combined model, the textual model should not be based on financial statements, but should consider information from external sources (e.g. financial new feeds); this's the motivation for the next proof-of-concept

TRANSACTIONS
TODAY

OVERDRAFT

TRANSACTIONS
In FUTURE

**CUSTOMER
EXPERIENCE**

Overview of the transaction project

We have a wealth of information on every transaction that is carried out to or from a Danske account. This information can provide an up to date view on how the account is being managed, track trends over time, identify whether there are any changes in behaviour



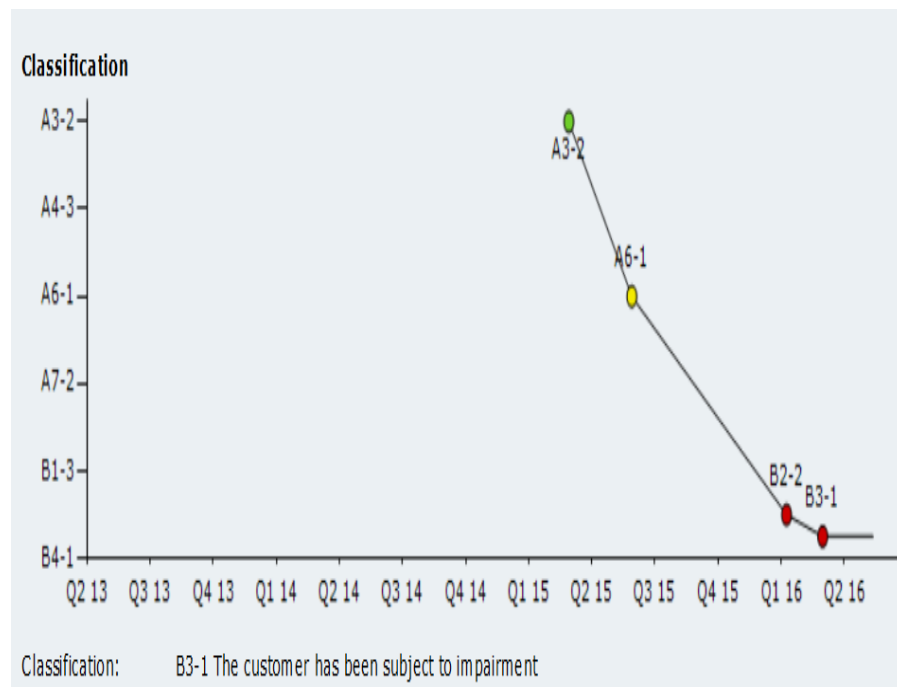
Transaction occurs every time you make a payment or receive a payment

Case 1

Employees: 120 employees

Risk Classification: The customer is impaired

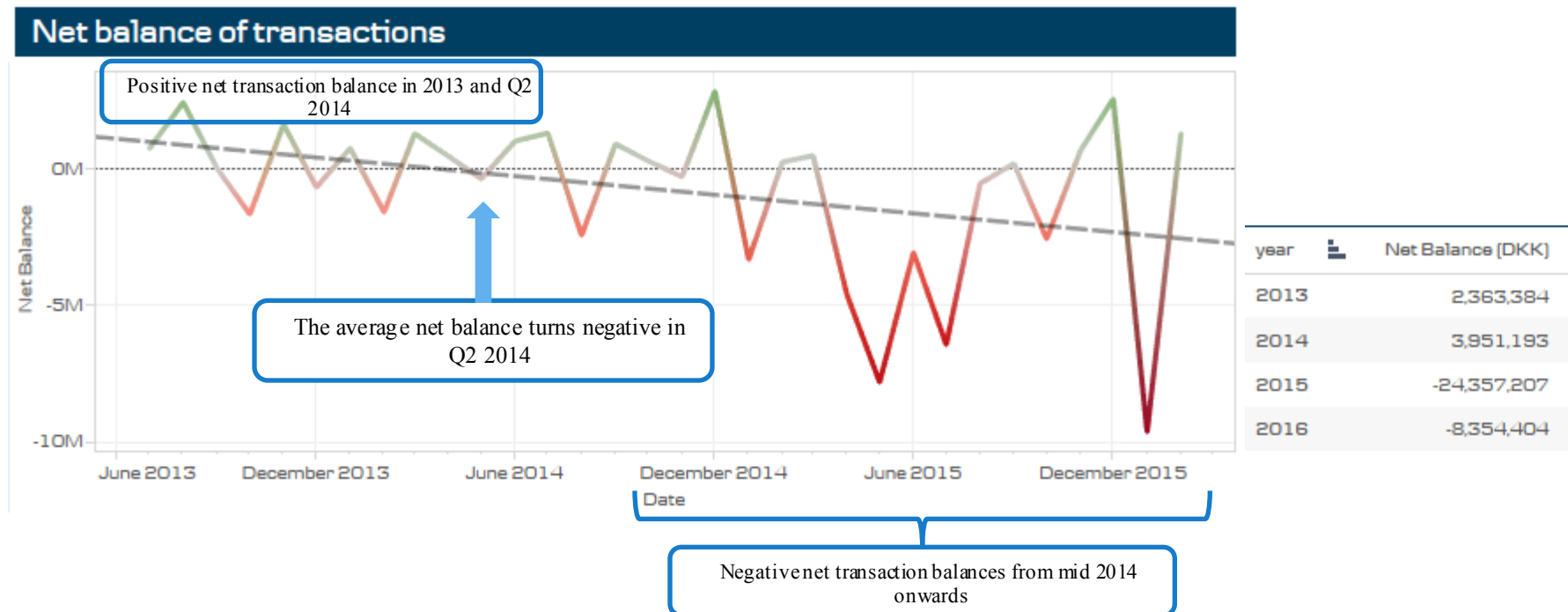
Approval: Customer's first approval in June 2015



Beløb i DKK 1.000	31.05.2012	31.05.2013	31.05.2014*	31.05.2015
EBITDA			51.675	29.708
Betalt skat				367
Finansieringsomkostninger, netto				-6.364
Ændring i arbejdskapital				-10.051
Operationelt cash flow (CFO)				13.660
CAPEX				-36.730
Nettoinvesteringer ekskl. CAPEX				-9.008
Frit cash flow (FCF)				-32.078
Gældsoptagelse/-nedbringelse				30.168
Netto cash flow				-1.910
Beløb i DKK 1.000	31.05.2014*		31.05.2015	
EBITDA	51.675		29.708	
Resultat efter skat	27.439		7.255	
Egenkapital	27.519		34.774	
Aktiver i alt	175.958		232.153	
Rentebærende gæld, netto (NIBD)	104.707		136.785	
NIBD/EBITDA	3,04		4,60	
Soliditetsgrad	15,64		14,98	

Case 1

- Relationship between free cash flow and net transactions
- Downward trend on transaction balance
- **2013 to Q2 2014** positive net transactions with a deteriorating trends
- **2015** – negative net transactions, would infer that the free cash flow is expected to be significantly more negative in 2015



Questions



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