

OK-SCORE™ INSTITUTE



The Fifth Empirical Accuracy Assessment of the OK-Score™ Model
for the period 2000 - 2017

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Under supervision of
Het Effectenhuis Commissionairs at Amsterdam
and the external compliance officer
Emeritus Professor Dr. Chr. Lefevbre RFA, University of Louvain

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By W.D. Okkerse MBA
CEO OK-Score™ Institute Rotterdam

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SUMMARY

The OK-Score™ continues to prove a consistently accurate predictor of corporate failure and distress.

If anything, the accuracy of the model has increased in this, the fifth assessment of its reliability. Using empirical evidence, validated by The Supervision Committee, the Model is shown to have a 98.67% success rate of predicting business failure, up to 3 years in advance. This document details the methodology, classification and accuracy of W.D. Okkerse's credit rating system.

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INTRODUCTION

The OK-Score™ Model is a diagnostic tool that can be used for making credit risk assessments of a company. The input consists of the financial statements of a company, with a minimum of five consecutive fiscal years. The output is the **OK-Credit Score™⁽¹⁾**, resulting from a grid position of 81 potential positions to determine its **Material Migration Path**, its **Material Bias** and its **Strategic Options** for each fiscal year. The Model is a learning model, which means that the accuracy of the credit score improves with the number of imputed years: after five fiscal years, the OK-Score™ is considered reliable and is recognized as an official *OK-Score™*.

The OK-Score Model™⁽²⁾ has been developed by Mr. Willem Okkerse through a PhD program (1995-2000) at the University of Amsterdam, Quantitative Economics Department under the supervision of Professor Dr. Nico van Dijk. After the Model became operational in 2000, it has determined 2,930 OK-Scores⁽³⁾ as per the end of 2017, in a mix of real life monitoring⁽⁴⁾ and backtracking⁽⁵⁾. This population includes 75 situations of *Business Failures*⁽⁶⁾. The current accuracy assessment relates to the entire population of these 2,930 credit scores, and more specifically the 75 cases of *Business Failure*. All 75 *Business Failures* relate to the fiscal year ended 31 December 2017 or before.

⁽¹⁾A **credit score** is a number that reflects the creditworthiness and vitality of a company.

⁽²⁾**OK-Score™**. The credit score based on the OK-Score Model™ that has been developed by Mr. W.D. Okkerse during a research PhD at University van Amsterdam in the years 1995 - 2000. OK-Scores are reported on a scale from 1 to 10, where Grade-1 is given to highly creditworthy and healthy companies and Grade-10 to companies facing a **Business Failure**.

⁽³⁾**Input** is monitored by both Het Effectenhuis Commissionairs BV and Emeritus Professor Dr. Chris Lefevbre (compliance supervision) and has been updated until 31 December 2017.

⁽⁴⁾**Real life monitoring**. The computation of an OK-Score™ over a recent period. The accuracy of the credit score cannot be assessed if the rating period is of insufficient substance. (Minimum 4 years). Real time monitoring is usually performed as a part of the global monitoring of an organization by shareholders, bondholders or credit suppliers.

⁽⁵⁾**Backtracking (also: back testing)**. The computation of a credit score over a period, lying in the past. After computing the credit score it can be compared directly to real life developments since. Example: today credit scores could be computed for Enron over the five years' period (1996 - 2000) preceding its Business Failure (2001). With hindsight one can then assess whether these credit scores reflect the increased risk timely and accurately.

⁽⁶⁾**Business Failure**. The situation of Default, Chapter 11 or bankruptcy or strong measures such as Asset Stripping, Forced Recapitalization, Turnaround, or Forced Take-over, in combination with a substantial decline in stock prices of the company. Such strong measures are the responsibility of the Executive and Supervisory Board and they are usually forced on a company by the shareholders and other stakeholders. A timely warning will be of the greatest importance. The OK-Score™ model warns up to three or four years in advance. The substantial decline of the stock price that coincides with most **Business Failure** can cause serious damage to the share/bondholders and other stakeholders. In some cases, fraud can be identified as the main cause of the **Business Failure** as many accounting scandals have shown.

METHODOLOGY

The OK-Score™ Model requires input from the financial statements of five (minimum) consecutive financial years: balance sheet, profit and loss account, cash-flow statement. The Model determines a credit score for every single year, but only from the fifth fiscal year, can this credit score be considered a valid OK-Score™. The Model is a learning model, which means that the reliability of the annual credit scores improves up to and including the fifth year. Due to the OK-Score's™ forecasting quality over two to three years, any backtracking period must be five years, to which, inevitably, the three years for the forecasting period should also be added, in order to compare this forecasting with the real-life outcome.

The OK-Score™ analysis is based upon 125 input fields, 25 per fiscal year and will deliver, alongside a variety of normal Business Ratios, two specific OK-Score™ ratios. The first ratio is the OK-Solvency™, a modified version of the solvency ratio which is divided into 9 classes. The best class (1) consists of companies with an OK-Solvency from 100-49%. The next classes (2-8) have a 49-0% solvency, divided in 7% intervals. The weakest class (9) consists of companies with a negative shareholders' equity. The second ratio is the OK-Ratio™, based on an in-depth analysis of the five consecutive financial statements and is also divided into 9 classes. The best classes (1-2) have positive ratios of [<1 to 0.5] and [<0.5 to 0] respectively. The next classes (3-9) have negative ratios: [-1] [-2] [-4] [-16] [-256] [-65536]. Any OK-Score will be derived from the position on the 9x9 grid of both the OK-Score™ Solvency and the OK-Score™ Ratio. The model can be applied to all sorts of enterprises, except financial institutions and real estate companies. The main reason is that the structure of the financial statements of companies in these industries is very different.

The OK-Score™ is derived from the 81 possible grid combinations of OK-Solvency™ and OK-Ratio™ (9 x 9). Each of them is part of the Material Migration Path, a method to define potential disintegrating or improving strategic choices, since each grid position is linked to twelve internationally recognized "Grand Strategies"⁽⁷⁾.

	9	10	10	10	10	10	10	10	10
	8	9	10	10	10	10	10	10	10
	7	8	9	10	10	10	10	10	10
	6	7	8	9	10	10	10	10	10
	5	6	7	8	9	10	10	10	10
	4	5	6	7	8	9	10	10	10
	3	4	5	6	7	8	9	10	10
	2	3	4	5	6	7	8	9	10
OK-Ratio™	1	2	3	4	5	6	7	8	9
	OK-Solvency™								

⁽⁷⁾Twelve Grand Strategies (Pearce & Robinson 1990 etc.)

Innovation - Conglomerate Diversification - Horizontal Integration - Vertical Integration - Concentric Diversification - Product Development - Market Development - Strategic Alliances - Concentration - Turn Around - Divestiture - Liquidation

CLASSIFICATION

3.1 OK-Score Classes

An OK-Score™ Grade-1 stands for perfect certainty about creditworthiness and health. An OK-Score™ Grade-10 warns of Business Failure. This can be analyzed as follows:

OK-SCORE	STANDARD RATING	MEANING
1	AAA	Almost perfect security. Very large capacity for expansion, also with borrowed capital. All strategies possible.
2	AA	Excellent security. Large capacity for expansion, also with borrowed capital. All strategies possible.
3	A	Solid security. Capacity for expansion, also with borrowed capital. All strategies possible.
4	BBB	Good security. Potential for expansion, also with borrowed capital. Only 5 offensive strategies possible.
5	BB	Normal security. Some potential for expansion, however be watchful of expansion with borrowed capital. Only 5 offensive strategies possible.
6	B	Moderate security. Improvements desirable. Expansion with borrowed capital not wise. Three remaining offensive strategies.
7	CCC	Inadequate security. Improvements necessary. Expansion with borrowed capital strongly discouraged. Three remaining offensive strategies.
8	CC	Worrying security. Improvements needed urgently. Expansion with borrowed capital could be fatal. Only three remaining, now defensive strategies.
9	C	Hazardous situations. Substantial improvements needed by return. Expansion with borrowed capital not possible. Starting platform for either Turn Around or Business Failure.
10	D	Depending on the grid-situation, immediate actions required: either Turn Around, Divestiture (Asset Stripping) or Recapitalization. Otherwise default, Chapter 11, bankruptcy, or state support within one to three years.

Companies with an OK-Solvency™ of >49% won't automatically obtain a OK-Score™ Class ONE. Several companies (such as WorldCom, Lernhout & Hauspie, Tulip) had a top solvency ratio (>49%) in combination with an OK-Ratio Grade-9. The final judgement must always be based on the combination of the OK-Solvency™, the OK-Ratio™ and its **Migration Path**.

3.2 Material Migration Path

It stands to reason that the annual grid positions 1.1 - 9.9 and their annual migration by themselves are **a major indication of improving or deteriorating business processes**. Combined with the strategic options, it will answer any question in relation to the effectiveness of any used or intended strategy by its Board of Directors.

3.3 Strategic Options

Diagram of strategic options by investment capacity and order of organizational complexity. (Low = x and High = xxxxxx). These twelve Grand Strategies are in common use all over the world and consist of:

		AVAILABILITY OF FUNDS	ORGANIZATIONAL COMPLEXITY
1.	Innovation	● ● ● ● ● ●	● ● ● ● ● ●
2.	Conglomerate Diversification	● ● ● ● ●	● ● ● ● ●
3.	Horizontal Integration	● ● ● ● ●	● ● ● ● ●
4.	Vertical Integration	● ● ● ● ●	● ● ● ● ●
5.	Concentric Diversification	● ● ●	● ● ● ●
6.	Product Development	● ● ● ●	● ● ●
7.	Market Development	● ●	● ●
8.	Strategical Alliances	● ●	● ●
9.	Concentration	●	● ● ●
10.	Turn Around	●	● ● ●
11.	Divestiture	●	● ●
12.	Liquidation	●	●

3.4 Material Bias

While determining the credit scores, the OK-Score™ Model will also flag any amounts of value in the financial statements that do not make sense. The sum of these values is identified as **Material Bias** or **NOT ACCOUNTED FOR**.

If the Material Bias is substantial and the OK-Score™ is 7 or worse, immediate investigation is required. It appears from our assessments so far, that in many cases this can be explained by manipulation of the financial statements and/or another material fraud.

3.5 Fraud

The Business Failures Database contains 2,930 credit scores determined in the period 2000 - 2017 (closing date: 31 December 2017). It contains several cases (via real life monitoring or backtracking) where fraud was involved. The Model has flagged all these frauds at least one year before they came out in the media. The Model flags fraud via the item Material Bias (see previous section).

In the enclosed **Business Failures Database**, the various cases of **corporate fraud** have been marked **R** Moulinex, LCI and Enron (2001), WorldCom and **Ahold** (February 2002), Landis (2003), Parmalat (2004), Imtech (2013), Abengoa (2015) and Valeant (2016) and Weyl (2017). There have been some other cases of corporate fraud during these years, but these companies were not monitored by the OK-Score™ and hence were not included in the **Business Failures Database**.

ACCOUNTABILITY

The ability to reproduce research results is a cornerstone of scientific research. Since the OK-Score™ Model became operational in the year 2000, regulators, scientists and journalists have had and always will have the opportunity to verify every public OK-Score™. The following conditions apply to all OK-Scores™ that are included in the published statistics:

- a) Real life monitoring: the OK-Score™ can be reproduced⁽⁸⁾ and compared to the real events;
- b) Backtracking: the OK-Score™ can be reproduced and the backtracking is normally performed under the supervision of qualified external parties.

⁽⁸⁾**Reproduction.** The re-computation of an OK-Score™ by using the same information as in the past. If one can determine that the OK-Score™ Model is unchanged (via hash totals of other checks), one can assess whether the first OK-Score™ had been computed correctly. Reproduction is normally always performed in the presence of another person than the analyst. Reproduction can be real time (self-control, internal control etc.) or via backtracking (regulatory compliance, due diligence etc.)

ACCURACY

5.1 Portfolio

After the OK-Score™ Model became operational in 2000, it has warned of 74 out of 75 (98.67%) **Business Failures** that have occurred in the portfolio by giving an OK-Score™ class 10. The remaining 1 (1.33%) was identified with an OK-Score™ class 9. **Both classes imply that investing in shares or bonds should be prohibited.**

Since the model became operational, 2,930 credit scores (as of 31 December 2017) have been computed by the Model, a mix of backtracking and real live monitoring. This population included 75 **Business Failures**, and 2,855 **non-Business Failures**.

5.2 Errors

Type 1 - The likelihood that a valid and running company will receive an OK-Score™ 10 = $1/2854$ or 0.035%.

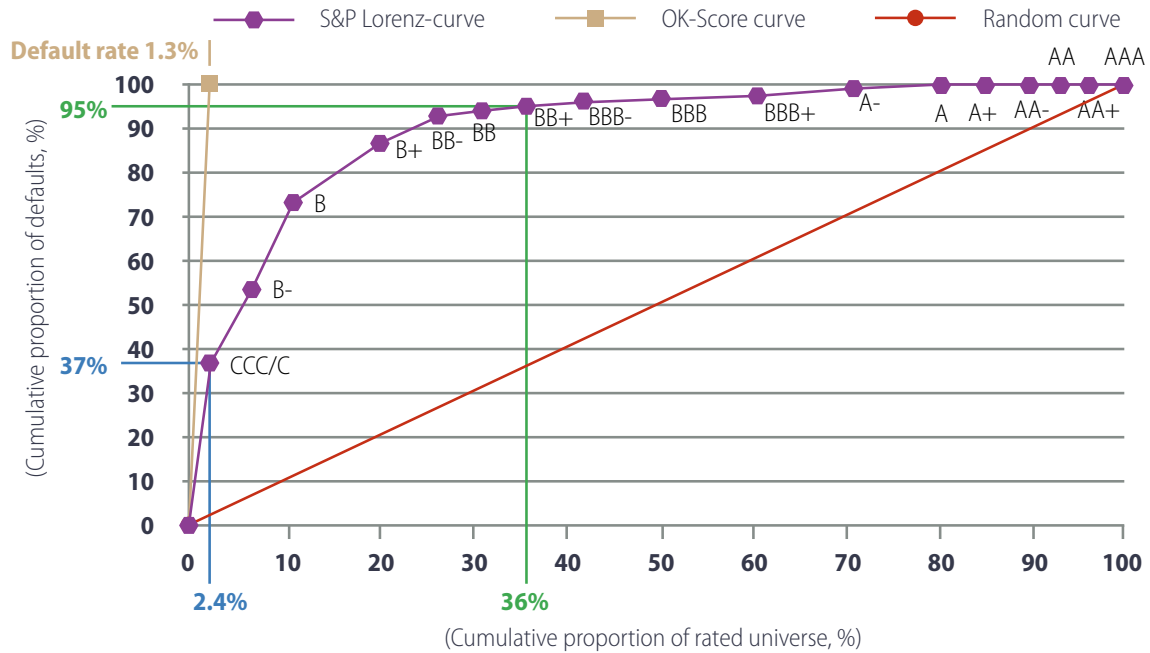
Type 2 - The likelihood that a Business Failure company will not receive an OK-Score™ 10 in the three previous years before the event = $1/75 = 1.33\%$.

The likelihood that an OK-Score 10 will not lead to a **Business Failure** within three years = 1.33%, however:

The likelihood that a Business Failure company will not receive an OK-Score™ 9 or 10 is ZERO %

5.3 Cumulative Accuracy Profile⁽⁹⁾

The reliability of a credit score or a credit rating can also be expressed with the Cumulative Accuracy Profile (CAP), using the so-called **GINI coefficient** which is based on the Lorenz-curve. The 3-year Lorenz-curve for the OK-Score™ Model is as follows.



5.4 Gini-coefficient

The Gini-coefficient of the OK-Score™ Model (**GREEN LINE**) is 98.6% which can be analyzed as follows: 100% minus 1.4% (Type-2 error) minus 0.04% (Type-1 error). It corresponds to the area above the curve divided by the area between the Lorenz-curve and the 45° line (the random curve). As can also be seen from the graph, the CAP of the OK-Score™ Model is following, almost exactly, the ideal curve; if we compare it to the CAP of credit rating agencies or audit firms, we see substantial differences.

The S&P line has been marked with red dots, thus indicating the tremendous improvement by the OK-Score model, viz. the complete area between the red dotted line and the green line.

Credit Rating agencies (CRA) predict default. Audit firms predict going concern issues. The OK-Score™ Model predicts **Business Failure** which is a broader concept. Credit rating agencies and audit firms predict 1-year default and 1-year going concern issues respectively. The OK-Score™ Model has chosen the term that suits the model best: 3 years. This term is also more valuable to stakeholders than the 1-year term that is mandatory for CRA and audit firms.

⁽⁹⁾The cumulative Accuracy Profile is determined by the Lorenz curve and is calculated as follows. The horizontal axis (X) shows the cumulative number of credit-scores as a percentage from 0 - 100%. The vertical axis (Y) shows, counting from the center the cumulative amount of Business Failures also as a percentage, Also counting from the center it starts with the poorest OK-Scores (Class 10) on the Y-axis. The curve shows in which zone of the credit scores ALL Business Failures can be found.



ANNEXES

6.1 Portfolio of real life Monitoring and Back Tracking and Errors

Business Failures Database and legend

This database contains 2,930 credit scores as per that date. In the annex, we only mention the **Business Failures**. The **Business Failures Database** shows all **Business Failures** and all Grade-10 OK-Scores™ that can be reproduced and that have been issued in the period 2000-2017 (closing date 31 December 2017). Within that period (2000 - 2017) we assessed 75 OK-Score™ of Class 10. From these 75 potential **Business Failures**, 74 encountered a real **Business Failures**. These are classified as follows:

6.2 Legend

AS	=	Asset Stripping	=	16%
B	=	Bankruptcy	=	28% incl. 1% Chapter 11 and 18% Fraud
CH	=	Chapter 11	=	0
FR	=	Fraud	=	18% of which 15% ended in Bankruptcy
FS	=	Forced Sale of the company	=	04%
LC	=	Litigation claim	=	03%
R	=	Forced Recapitalization	=	40%
SS	=	States Support	=	03%
TA	=	Turn Around	=	05%

Within the period 2000 - 2017, we assessed 2,855 OK-Score™ Classes better than OK-Score™ class 10. From these 2,855 potential going concern companies, 1 enterprise (a prediction in 1999) went bankrupt with an indicative OK-Score™ of Class 9. However, none of the other 2,854 failed.

During 2017, we assessed 188 companies. Ten of them received a business failure warning. Seven of them are already registered in our enclosed database. Three of them are indicated as future **Business Failures**. All three of them are registered separately with our compliance officers and will be added to the database at the end of their three-year prediction time or at the moment the prediction becomes a reality. If not, obviously it will be recorded as an OK-Score™ failure. Since 2016, the additional 2017 figures have improved the reliability of the OK-Score™ as follows:

Type 1 - The likelihood that a valid and running company will receive an OK-Score™ 10

= 1/2854 or 0.035% (was 0.04%)

Type 2 - The likelihood that a Business Failure company will not receive an OK-Score™10

in the three previous years before the event = 1/75 = 1.33% (was 1.43%)

The likelihood that an OK-Score™ 10 does not lead to a Business Failure within three years = 1.33% (was 1.43%)

Finally

The likelihood that a Business Failure company will not receive an OK-Score™ 9 or 10 is ZERO %.

Nr.	Name	Country	OK-SCORE 10	REAL LIFE/BACKTR, RESULT	YEAR	RESULT	YEAR	REMARKS	SUPERVISOR	
1	MOULINEX	FR	1999	BT	FORCED RECAP	2000	BANKRUPT	2001	FRAUD	ABP
2	LCI	NL	1999	BT	FORCED RECAP	2000	BANKRUPT	2001	FRAUD	VEB
3	NUMICO	NL	1999	BT	ASSET STRIPPING	2001				AUDITOR
4	ENRON	USA	2000	BT	BANKRUPT	2001				FD
5	PARMALAT	IT	2002	BT	BANKRUPT	2003				FRAUD
6	LAURUS	NL	2003	BT	FORCED RECAP	2004	FORCED SALE	2005		NRC
7	NESCHEN	GER	2003	BT	FORCED RECAP	2004				LAURUS
8	VILENZO	NL	2003	BT	BANKRUPT	2004				EVERLING
9	LOCKHEED	USA	2004	BT	STATE SUPPORT	2005				CURATOR
10	COMCAST	USA	2004	BT	LITIGATION CLAIM	2005				DUBASH
11	COMCAST	USA	2007	BT	LITIGATION CLAIM	2008				DUBASH
12	FORD	USA	2004	BT	STATE SUPPORT	2005				DUBASH
13	ASR	BEL	2005	BT	BANKRUPT	2006				FRAUD
14	ANONYMOUS	NL	2008	BT	BANKRUPT	2009				PWC
15	ANONYMUS	NL	2008	BT	BANKRUPT	2009				PWC
16	ANONYMUS	NL	2008	BT	BANKRUPT	2009				PWC
17	ANONYMUS	NL	2008	BT	BANKRUPT	2009				PWC
18	SPRINT	NL	2007	BT	FORCED RECAP	2008				DUBASH
19	WAEYERHAUSER	USA	2008	BT	FORCED RECAP	2010				DUBASH
20	CATERPILLAR	USA	2009	BT	FORCED RECAP	2010				DUBASH
21	EASTMAN KODAK	USA	2009	BT	CHAPT 11	2012	BANKRUPT	2013		DUBASH
22	LANDIS	NL	2000	RL	BANKRUPT	2002				RIENK KAMER
23	GETRONICS	NL	2000	RL	ASSET STRIPPING	2001	FORCED RECAP	2003		TO DAY'S BEHEER
24	GETRONICS	NL	2004	RL	FORCED SALE	2007				TO DAY'S BEHEER
25	UNILEVER	NL	2000	RL	TURN AROUND	2001				TO DAY'S BEHEER
26	AHOLD	NL	2000	RL	FORCED RECAP	2001	FORCED RECAP	2003	FRAUD	TO DAY'S BEHEER
27	AHOLD	NL	2004	RL	ASSET STRIPPING	2005				TO DAY'S BEHEER
28	WOLTERS KLUWER	NL	2000	RL	ASSET STRIPPING	2002				TO DAY'S BEHEER
29	WOLTERS KLUWER	NL	2004	RL	FORCED RECAP	2005				TO DAY'S BEHEER
30	WOLTERS KLUWER	NL	2006	RL	FORCED RECAP	2007				TO DAY'S BEHEER
31	KPN	NL	2001	RL	FORCED RECAP	2003				TO DAY'S BEHEER
32	ASML	NL	2001	RL	FORCED RECAP	2004				TO DAY'S BEHEER
33	NUMICO	NL	2002	RL	ASSET STRIPPING	2003				TO DAY'S BEHEER
34	NUMICO	NL	2004	RL	FORCED RECAP	2005	FORCED SALE	2007		TO DAY'S BEHEER
35	SBM	NL	2004	RL	FORCED RECAP	2005				TO DAY'S BEHEER
36	SBM	NL	2012	RL	FORCED RECAP	2013				FRAUD
37	INNOCONCEPTS	NL	2009	RL	BANKRUPT	2011				FRAUD
38	AIR BERLIN	GER	2009	RL	FORCED RECAP	2012				EFFECTENHUIS
39	ABENGOA	SPAIN	2010	RL	FORCED RECAP	2012	BANKRUPT	2015	FRAUD	EFFECTENHUIS
40	NORSKE SKOG	NOR	2011	RL	ASSET STRIPPING	2012	ASSET STRIPPING	2013		EFFECTENHUIS
41	PRAKTIKER	GER	2011	RL	BANKRUPT	2013				EFFECTENHUIS
42	ALPINE	AUSTRIA	2012	RL	BANKRUPT	2013				EFFECTENHUIS
43	AIRFRANCE	FR	2012	RL	FORCED RECAP	2013				EFFECTENHUIS
44	PORR	AUSTRIA	2012	RL	FORCED RECAP	2013				EFFECTENHUIS
45	IMTECH	NL	2012	RL	FORCED RECAP	2013	BANKRUPT	2015	FRAUD	EFFECTENHUIS
46	WORLDCOM	USA	1999	BT	BANKRUPT	2003	OK-CLASS 9			FRAUD
47	GRONTMIJ	NL	2012	RL	FORCED RECAP	2013	FORCED SALE	2015		EFFECTENHUIS
48	BAM	NL	2010	RL	FORCED RECAP	2011				EFFECTENHUIS
49	ALCATEL	FR	2011	RL	FORCED SALE	2013	FORCED SALE	2014		ERH
50	SCHOLTZ	GER	2012	RL	ASSET STRIPPING	2013				EFFECTENHUIS
51	NEW WORLD	POL	2013	RL	FORCED RECAP	2014				EFFECTENHUIS
52	SIEM OFFSHORE	NOR	2011	RL	FORCED RECAP	2012				EFFECTENHUIS
53	BAM	NL	2012	RL	FORCED RECAP	2013				EFFECTENHUIS
54	WESSANEN	NL	2013	RL	ASSET STRIPPING	2014				ERH
55	GOLDEN OCEAN	BMD	2012	RL	ASSET STRIPPING	2013	FORCED SALE	2014		EFFECTENHUIS
56	WEYL	NL	2005	BT	ASSET STRIPPING	2007	BANKRUPT	2008	FRAUD	EFFECTENHUIS
57	BAM	NL	2014	RL	FORCED SALE	2015				ERH
58	AMG	NL	2013	RL	ASSET STRIPPING	2014				ERH
59	PNE WIND	GER	2013	RL	FORCED RECAP	2014				EFFECTENHUIS
60	WOLTERS KLUWER	NL	2009	RL	NO BUSINESS FAILURE					TO DAY'S BEHEER
61	VEDES	GER	2013	RL	FORCED RECAP	2014				EFFECTENHUIS
62	AIR FRANCE	FR	2014	RL	FORCED RECAP	2015				EFFECTENHUIS
63	HEIJMANS	NL	2014	RL	FORCED RECAP	2015				EFFECTENHUIS
64	VALEANT	USA	2013	RL	ASSET STRIPPING	2016				EFFECTENHUIS
65	TULLOW OIL	USA	2014	RL	FORCED RECAP	2015				EFFECTENHUIS
66	VALLOUREC	FR	2014	RL	FORCED RECAP	2016				EFFECTENHUIS
67	UNDERBERG	GER	2013	RL	FORCED RECAP	2014				EFFECTENHUIS
68	OAD	NL	2012	BT	BANKRUPT	2013				PWC
69	RICKMERS	GER	2011	RL	FORCED RECAP	2013	BANKRUPT	2017		EFFECTENHUIS
70	HELLENIC	GREECE	2013	RL	TURN AROUND	2014				EFFECTENHUIS
71	TESCO	UK	2016	RL	TURN AROUND	2017				EFFECTENHUIS
72	BOURBON	FR	2016	RL	TURN AROUND	2017				EFFECTENHUIS
73	APACHE	USA	2016	RL	ASSET STRIPPING	2017				EFFECTENHUIS
74	TESLA	USA	2016	RL	FORCED RECAP	2017				EFFECTENHUIS
75	NYRSTAR	BEL	2016	RL	FORCED RECAP	2017				EFFECTENHUIS

