

Rating Resilience System™ User Guide

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Market: WALL STREET
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1.INTRODUCTION

The Rating Alert System™ (RAS) system offers pre-computed measures of business complexity and resilience of public companies listed at the NYSE. Publicly available Quarterly Balance Sheet statements are used for the purpose. Resilience provides a new means of measuring not only the state of health of a corporation but also the degree of intricacy or complexity of its business. This is of paramount importance since, as the Quantitative Complexity Theory confirms, excessively complex systems not only have the capacity to deliver surprising behaviour but they can also fail in countless often non-intuitive ways.

Resilience takes on values from 0 to 100%.

Low resilience implies uncertainty-dominated behaviour.

High resilience points to more stable and predictable conditions.

The Resilience Rating™ of a business is stratified as follows:

Business resilience is very low.

The business structure is weak. Exposure is very high and the business is inefficient and difficult to manage. It is impossible to make forecasts. The business is a candidate for default.

Resilience: 0-50% - Rating: ★

Business resilience is low.

The business is difficult to manage and control. Exposure is high as well as inefficiency. The structure of the business is vulnerable. It is difficult to make forecasts.

Resilience: 50%-70% - Rating: ★★

Business resilience is medium.

The structure of the business is fairly robust. Performance predictability is acceptable. Exposure is moderate.

Resilience: 70%-80% - Rating: ★★★

Business resilience is high.

This indicates a robust business structure. Predictability is high, exposure is low. Business sustainability and efficiency are quite high.

Resilience: 80%-90%-Rating: ★★★★

Business resilience is very high.

This business structure is very strong. Exposure is very low. The business is manageable and it is possible to make credible forecasts. The business is potentially highly sustainable and efficient.

Resilience: 90%-100% - Rating: ★★★★★

For a discussion of the basic concepts in the Quantitative Complexity Theory and resilience, refer to the Appendix.

The RAS system is available at the following URL:

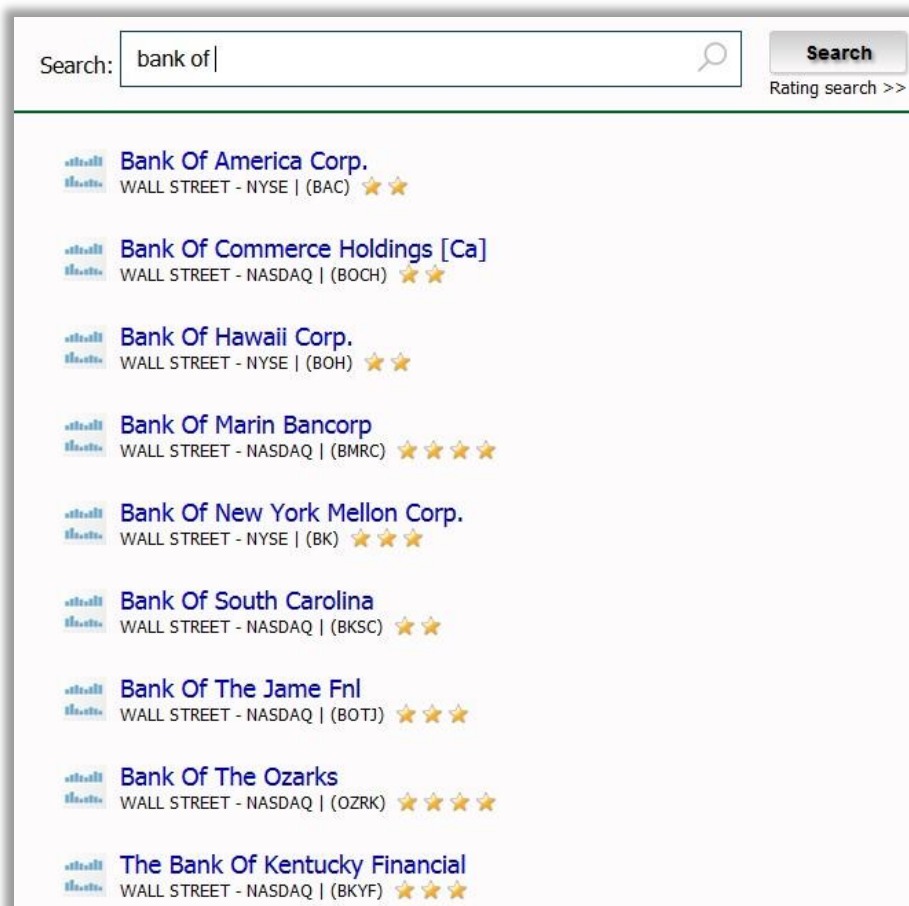
<http://ras-ontonix.qbt.ch/>

In order to access the system it is necessary to register. Once the account has been approved and activated users may login and perform their analyses.

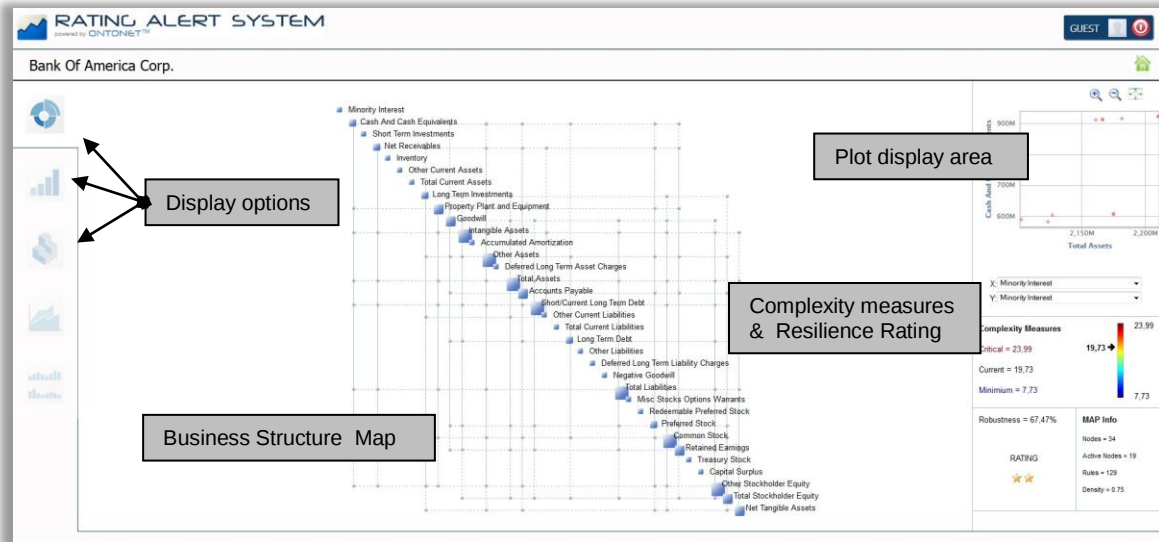
The system is connected in real-time to US markets and analyzes exclusively the companies that are listed in those markets. Should users desire to analyze stocks or portfolios containing stocks not listed on US markets, they should write to CustomerService@ontonix.com

2.ANALYZING A CORPORATION

Analyzing a listed company is simple – it is sufficient to type its name in the search area. The system proposes a list of possible companies once the User starts typing a name:



In the list, the system indicates the corresponding Ticker Symbol, as well as the corresponding Resilience Rating™. Clicking on a company from the list – in the example below the Bank of America (BAC) has been selected – the following window is displayed.



The Resilience Rating™ and Complexity Measures area provides the following information:



The significance of the various entries is the following:

- Current complexity: the actual business complexity. The value ranges between minimum and critical complexity and is measured in bits.
- Critical complexity: maximum complexity which a given business is able to reach. At this level of complexity the Business Structure Map becomes extremely fragile while the relationships (generalized correlations) between Balance Sheet entries become very low. The situation is dominated by chaos, it is very difficult to make forecasts.
- Minimum complexity: minimum complexity which a given business is able to reach. At this level of complexity the Business Structure Map becomes very robust and is characterised by high generalized correlations.
- Robustness (resilience): capacity of the business structure to resist shocks and extreme events (see APPENDIX for details). Value ranges from 0% to 100%.
- Map Nodes: number of Balance Sheet entries.
- Active Nodes: Number of Balance Sheet entries that are correlated to other entries. The difference between “Nodes” and “Active Nodes” corresponds to the number of entries which evolve independently of the others.
- Rules: number of significant generalized correlations between entries (i.e. links in the map, se APPENDIX for details).

Scatter plots, reflecting the relationships between any two Balance Sheet entries, or evolutions of a single entry, may be obtained by simply placing the mouse over a link or a node of the Business Structure Map see below.

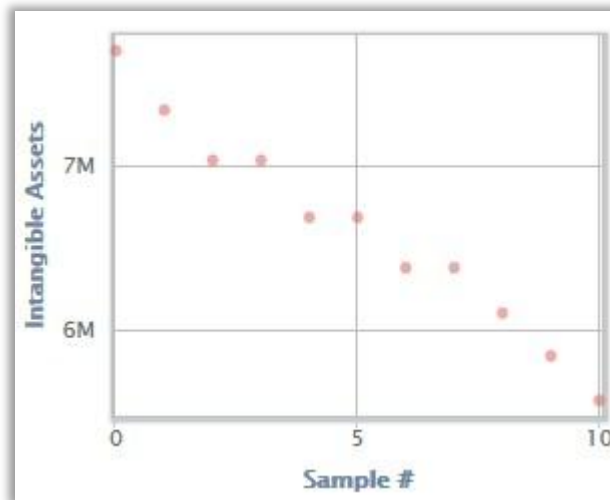


Figure 1. Evolution of “Intangible Assets” of the Bank of America. Analysis performed on April 20-th, 2014.

The Business Structure Map displays the interdependencies between the various Balance Sheet entries and is crucial towards understanding how the underlying data is structured.

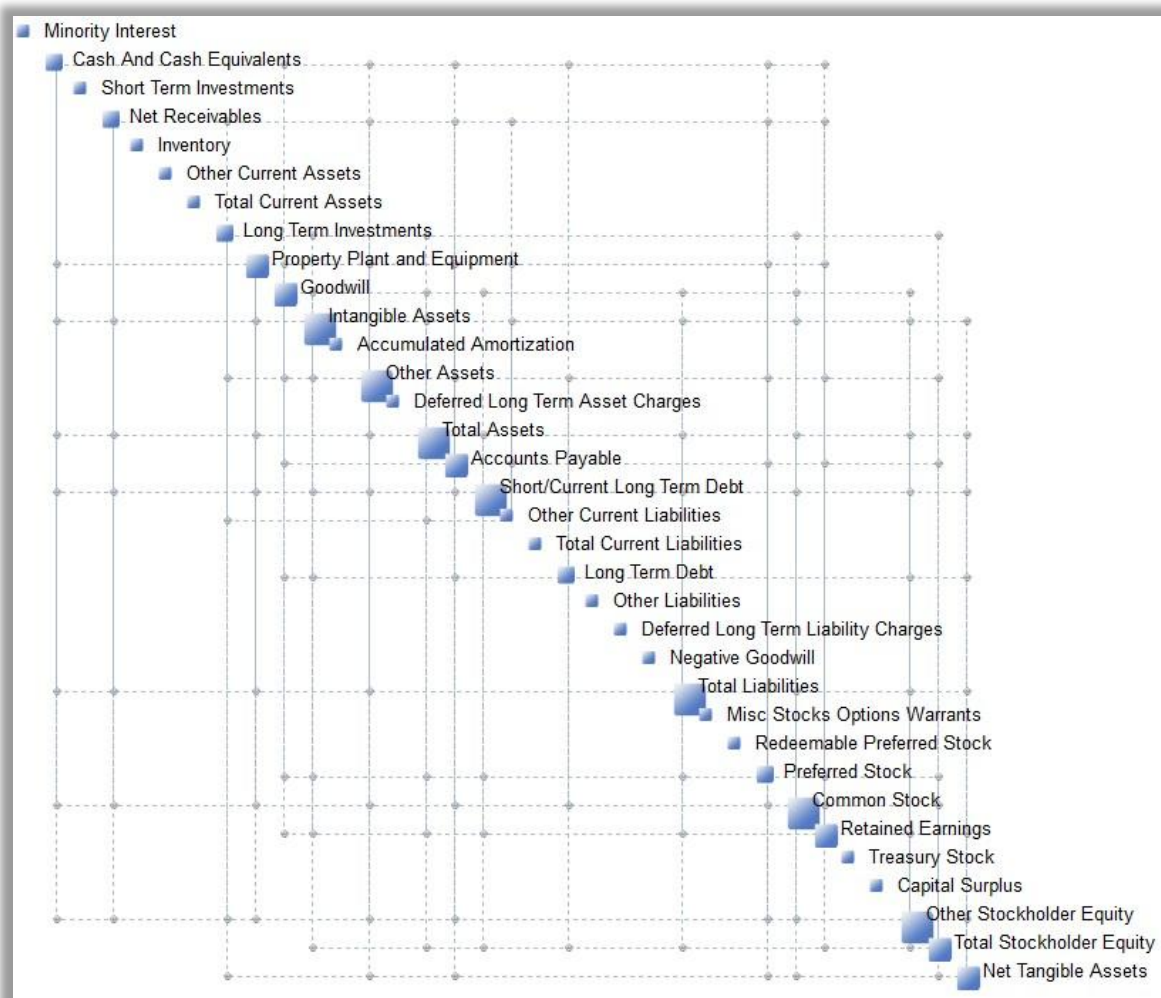


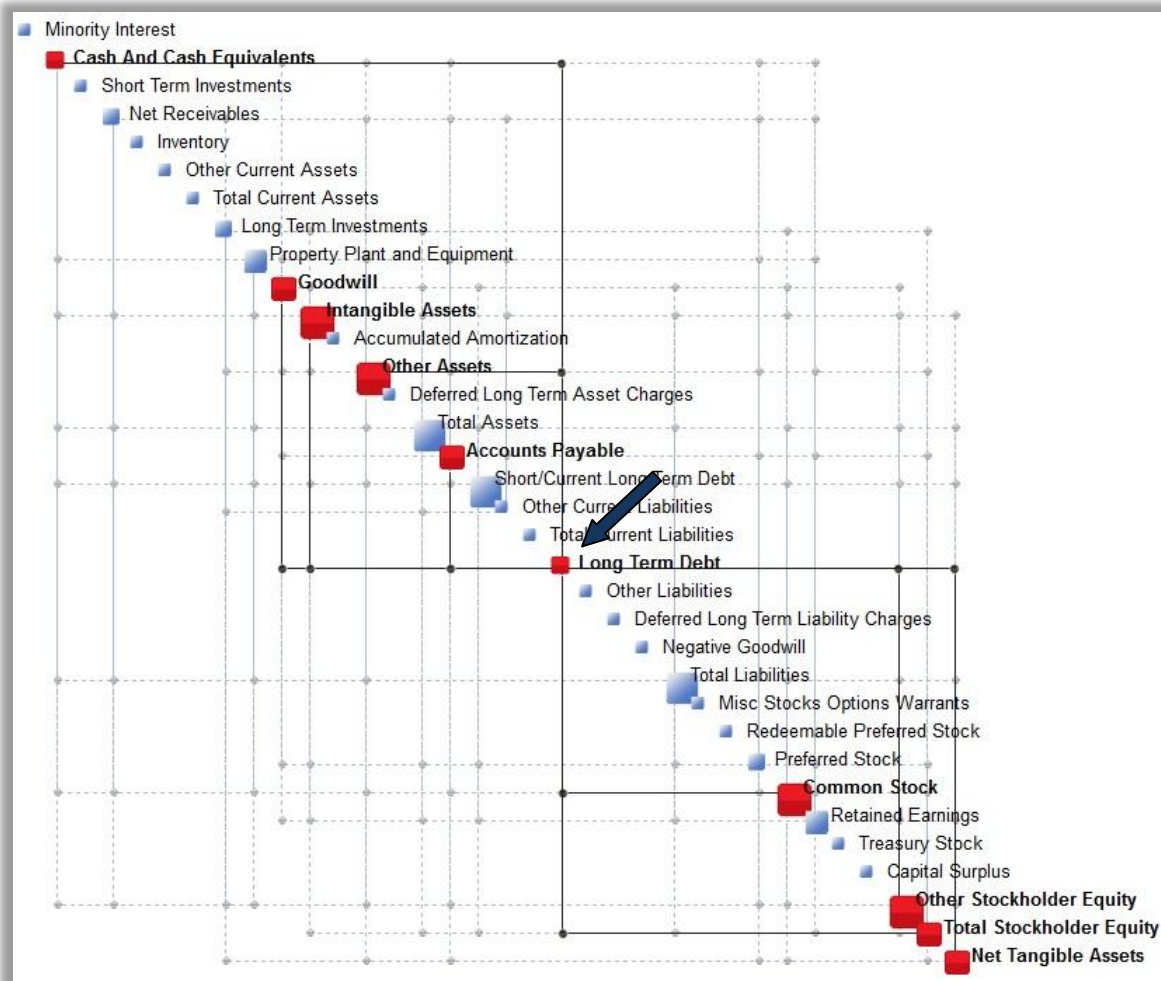
Figure 2. Business Structure Map of the Bank of America. Analysis performed on April 20-th, 2014.

Business Structure Maps are interactive and may be navigated by:

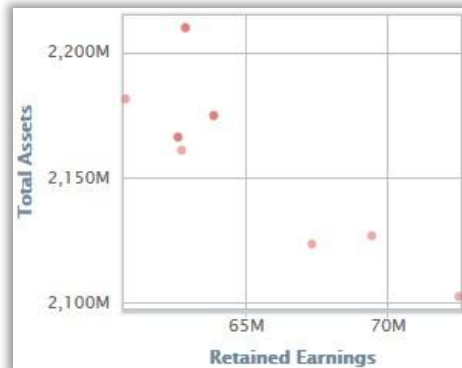
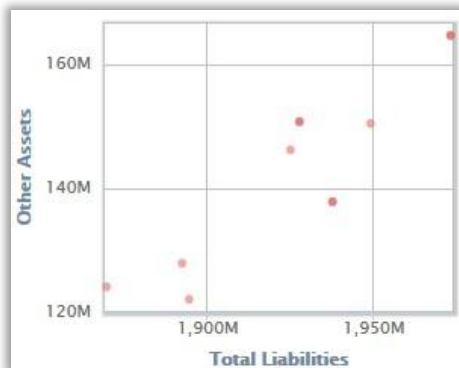
- Positioning the mouse pointer over the nodes on the diagonal. This indicates the entries correlated with the one in question.
- Positioning the mouse pointer over the links joining any two entries. This displays the corresponding two-dimensional scatter plot in the plot display area.

When the mouse pointer is located on top of a node, the system will illuminate the links to those entries that are correlated with the one in question.

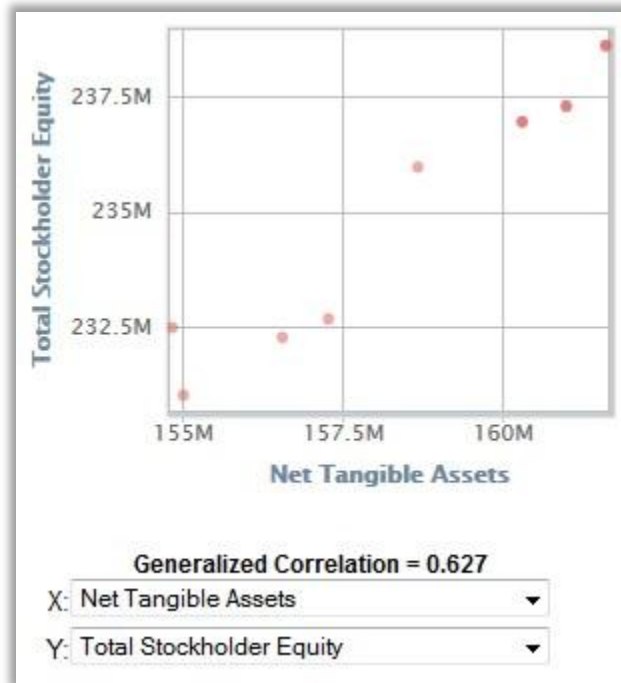
In the example below, the mouse pointer has been placed over the “Long Term Debt” node in the map as indicated by the arrow.



Scatter plots, reflecting the relationships between any two entries may be obtained by simply placing the mouse over a link see below.



When scatter plots are displayed, the system indicates the corresponding generalized correlation between the two Balance Sheet entries in question, as indicated below.



On the left of the main display the following icons may be found:

	Business Structure Map
	Complexity Profile
	Quarterly Financial Statements
	Complexity, Resilience evolution (currently inactive)
	Complexity Profile evolution (currently inactive)

Positioning the mouse over any of the icons will display the corresponding information in the main display area. The so-called Complexity Profile indicates how much each Balance Sheet entry contributes to the complexity of the business. As business complexity impacts its resilience, it is clear why the Corporate Complexity Profile is so important. An example is illustrated below.

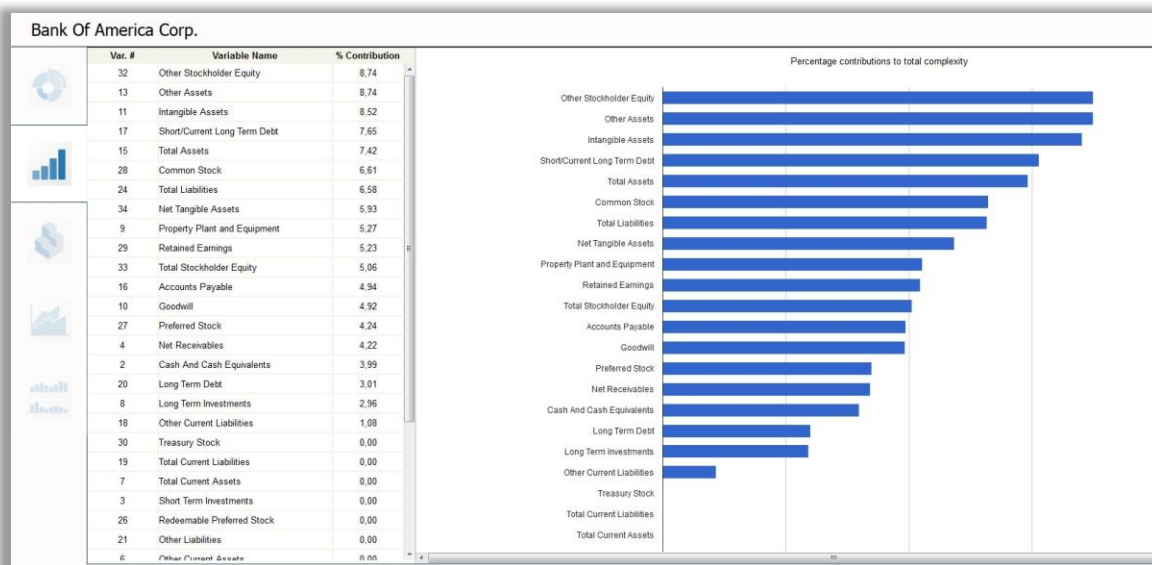


Figure 3. Corporate Complexity Profile of the Bank of America. Analysis performed on April 20-th, 2014.

The table on the left indicates in percentage terms the contribution of each Balance Sheet entry to the overall complexity of the business.

Bank Of America Corp.			
	Var. #	Variable Name	% Contribution
	32	Other Stockholder Equity	8,74
	13	Other Assets	8,74
	11	Intangible Assets	8,52
	17	Short/Current Long Term Debt	7,65
	15	Total Assets	7,42
	28	Common Stock	6,61
	24	Total Liabilities	6,58
	34	Net Tangible Assets	5,93
	9	Property Plant and Equipment	5,27
	29	Retained Earnings	5,23
	33	Total Stockholder Equity	5,06
	16	Accounts Payable	4,94
	10	Goodwill	4,92
	27	Preferred Stock	4,24
	4	Net Receivables	4,22

In the above example, the first three entries contribute approximately 26% of the total complexity of the Balance Sheet (business). This means that these items (Other Stockholder Equity, Other Assets and Intangible Assets) are the “key players” in the case in question and have a considerable footprint on the business as a whole. In actual fact, the Complexity Profile provides a ranking of all the Balance Sheet entries in terms of their relative impact on the business.

The information in the Complexity Profile is used to determine the size of the nodes in the Business Structure Map so that the identification of the driving Balance Sheet entries is possible by simply glancing at the map.

Quarterly Financial Statements may be examined by hovering the mouse over the corresponding icon on the left of the main display area.

Bank Of America Corp.

Income Statement

Balance Sheet

Period Ending	Dec 31, 2013	Sep 30, 2013	Jun 30, 2013	Mar 31, 2013
Assets				
Current Assets				
Cash And Cash Equivalents	589,333,000	603,544,000	582,068,000	606,940,000
Short Term Investments	-	-	-	-
Net Receivables	59,448,000	60,065,000	67,526,000	70,981,000
Inventory	-	-	-	-
Other Current Assets	-	-	-	-
Total Current Assets	-	-	-	-
Long Term Investments	1,499,652,000	1,510,394,000	1,585,132,000	1,544,309,000
Property Plant and Equipment	18,475,000	10,703,000	10,836,000	11,085,000
Goodwill	69,944,000	69,891,000	69,530,000	69,530,000
Intangible Assets	5,574,000	5,843,000	6,104,000	6,379,000
Accumulated Amortization	-	-	-	-
Other Assets	124,090,000	122,068,000	127,880,000	137,792,000
Deferred Long Term Asset Charges	-	-	-	-
Total Assets	7,403,373,000	7,430,283,000	7,433,390,000	7,434,846,000
Liabilities				
Current Liabilities				
Accounts Payable	1,455,173,000	1,455,173,000	1,455,173,000	1,455,173,000
Other Current Liabilities	-	-	-	-
Total Current Liabilities	1,455,173,000	1,455,173,000	1,455,173,000	1,455,173,000
Long Term Liabilities				
Long Term Debt	5,948,200,000	5,975,110,000	5,978,217,000	5,979,673,000
Other Long Term Liabilities	-	-	-	-
Total Long Term Liabilities	5,948,200,000	5,975,110,000	5,978,217,000	5,979,673,000
Total Liabilities	7,403,373,000	7,430,283,000	7,433,390,000	7,434,846,000
Equity				
Common Stock	1,455,173,000	1,455,173,000	1,455,173,000	1,455,173,000
Retained Earnings	5,948,200,000	5,975,110,000	5,978,217,000	5,979,673,000
Other Equity	-	-	-	-
Total Equity	7,403,373,000	7,430,283,000	7,433,390,000	7,434,846,000
Total Liabilities and Equity	7,403,373,000	7,430,283,000	7,433,390,000	7,434,846,000

Cash Flow

Similarly, the Cash Flow and Income Statements may be examined by simply placing the mouse pointer over the information of interest. In all these cases, only the last four available quarters are displayed.

3. SEARCHING AND RATING ALERTS

The system offers two search functions as illustrated below.

Search

Search

Rating search >>

★★★★★

★★★★★

★★★★

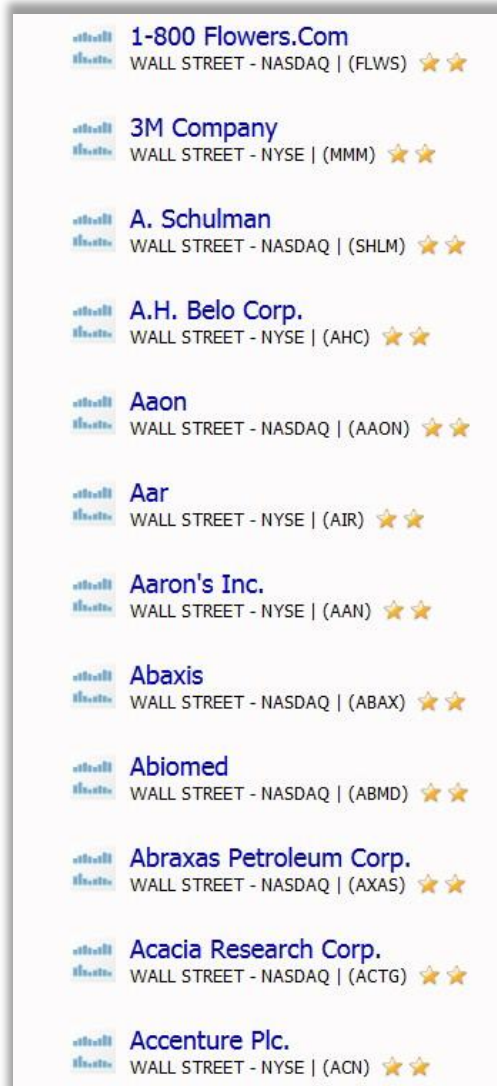
★★★

★★

★

The first is simple search, whereby the User types a sequence of characters and the system lists dynamically all those companies whose names contains the said sequence.

The Ratings Search allows Users to identify quickly which companies have a given Resilience Rating™. It is sufficient to hover the mouse over “Rating search” for the system to display a list of rating classes, ranging from one to five stars. Selecting a given class will display a list of companies having that particular rating. An example is illustrated below, in which two-star rated companies have been selected.



A rating of one star (50% resilience or below) constitutes an important alert as it points to an unstable, fragile and potentially defaulting business. Unlike conventional PoD (Probability of Default) ratings, which are provided on a yearly basis, the Rating Alert System delivers a high-frequency quarterly rating.

APPENDIX. COMPLEXITY AND RESILIENCE

Resilience is a characteristic to which economists refer with increasing frequency. Resilience is a *physical quantity* which can be measured and in engineering, for example, there exist specific machines which enable one to measure the resilience of materials, which corresponds to the capacity of withstanding impacts (shocks). This important property may also be measured for generic systems or artefacts, including corporations, asset portfolios, markets and national economies.

The computation of resilience for a given systems is based on the concept and measure of *complexity*. Complexity is a fundamental physical characteristic of every system that may be found in Nature. Its importance is similar to that of energy. The functionality of a given system is proportional to its complexity. More complex systems are able to perform more functions, a characteristic which is evident in our biosphere. However, high complexity implies also an increase of management effort and energy. When taken to extremes, excessive complexity becomes a formidable source of exposure. This is because excessively complex systems are inherently fragile. This last statement becomes clear after we will have introduced the concept of *critical complexity*.

The complexity of a system having state vector $\{x\}$ of N components, is defined as a function of *Structure* and *Entropy*.

$$C = f(S \circ E)$$

Where S represents an $N \times N$ adjacency matrix, E is an $N \times N$ entropy matrix, $\circ$ is the Hadamard matrix product operator and f is a norm operator. Given that S has no units and since entropy is measured in bits the units of C are also bits. The above equation represents a formal definition of complexity and it is not used in its computation. Instead, the adjacency matrix is determined via a proprietary multi-dimensional approach which is used to determine if entry S_{ij} is 0 or 1. This establishes the structure of the system in question.

Structure is represented by means of graphs (maps) such as the one illustrated below. There exist numerous means of representing graphs or maps. A common approach is illustrated in Figure 1.

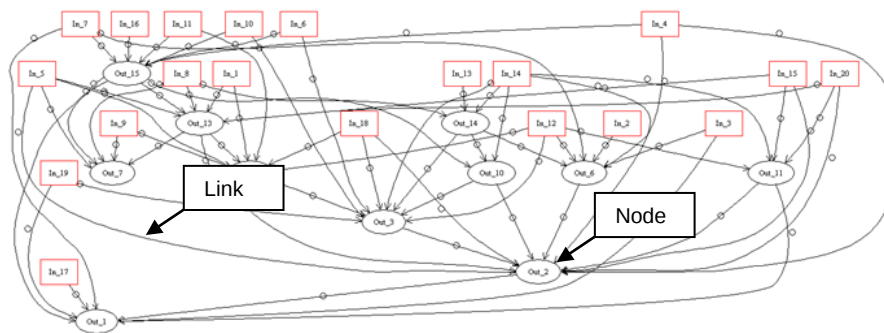


Figure 1. Conventional representation of a map, composed of nodes and links.

A conventional map representation becomes quickly unreadable as the number of nodes and links increases. An alternative approach to displaying maps is depicted in Figure 2. The great advantage is that maps with a very large number of nodes and links are still easily readable.

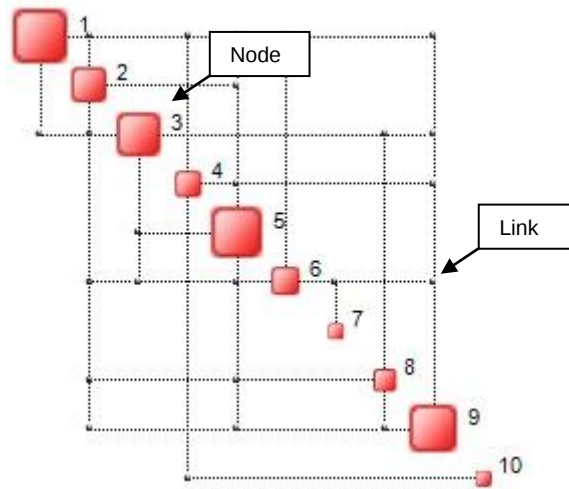


Figure 2. Modern representation of a map. The nodes (state-vector components) are aligned along the diagonal. Such maps are known as Complexity Maps.

The intensities of the relationships between pairs of nodes are obtained via a proprietary model-free approach which determines the so-called *generalized correlations*.

Once the entropies of all relationships have been obtained they become the corresponding entries of the entropy matrix $\mathbf{E}$. This approach has been chosen because it avoids the drawbacks of conventional model-based techniques whereby one attempts to describe data via regression models, statistical analysis or other conventional methods. The huge advantage of our approach is that it is independent of numerical conditioning of the data and its ability to identify the existence of structures where conventional methods fail.

Once the entropy matrix and the adjacency matrix have been obtained, one may compute the complexity of a given system as the following matrix norm:

$$C = \|\mathbf{S} \circ \mathbf{E}\|$$

A fundamental property of systems related to complexity is the so-called *critical complexity*, C_u which corresponds to the upper bound of the complexity metric. Critical complexity may be defined formally using the above expression,

$$C = \|\mathbf{S} \circ \mathbf{E}_{\max}\|$$

where $\mathbf{E}_{\max}$ is the entropy matrix in which the relationships between state vector entries are “saturated”. Saturation of relationships is performed using a proprietary algorithm.

In a similar fashion, the lower bound of complexity, C_L , may be computed as $C = \|\mathbf{S} \circ \mathbf{E}_{\min}\|$.

In proximity of the lower complexity bound, the system in question is almost totally deprived of uncertainty and functions in a deterministic *structure-dominated* fashion. In proximity of the upper complexity bound the system in question is uncertainty-dominated and relationships between the

various state vector entries are fuzzy and therefore characterized by very low generalized correlations. Both situations are illustrated in Figure 3.

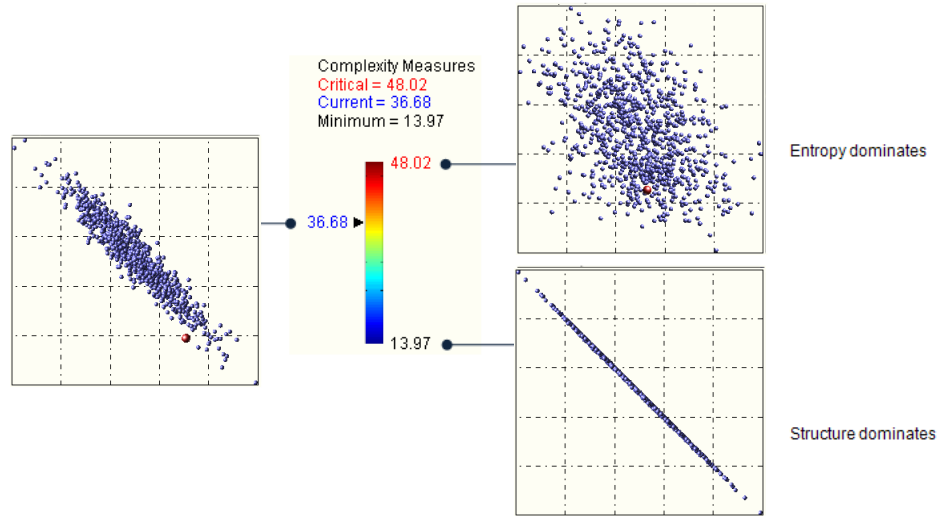


Figure 3. Illustration of lower and upper complexity bounds and examples of typical relationships at these limits. Without loss of generality linear relationships have been used to convey the concepts.

At this point the measure the resilience of a system may be defined. Since a Complexity Map represents the structure of a given system (portfolio) it is of interest to measure how well will the structure of the map withstand the presence of endogenous and exogenous disturbances and/or shocks. Resilience is defined as follows:

$$R = f(C_L; C; C_U)$$

where C_L , C and C_U represent, respectively, the lower complexity bound, the current system complexity and the upper complexity bound. The function f in the above equation is a second-order polynomial function such that:

$$\begin{aligned} \text{if } C = C_L &\rightarrow R = 1 \\ \text{if } C = C_U &\rightarrow R = 0 \end{aligned}$$

An example situation is illustrated in Figure 4, in which $C_L = 13.97$, $C = 36.68$ and $C_U = 48.02$. Resilience in this case is 74.5%.

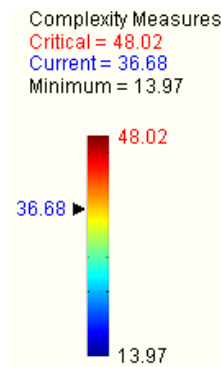


Figure 4. Example of measure of resilience of a system based on its current, lower and upper complexities.

The resilience function is illustrated in Figure 5. A second order function has been chosen so as to penalize strongly situations in which complexity is close to critical complexity.

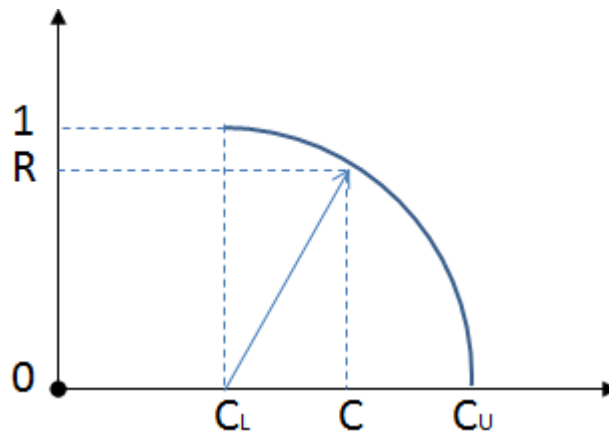


Figure 5. Definition of the resilience function of a system based on its current, lower and upper complexities.

The choice has been dictated by the fact that when a system finds itself in proximity of its critical complexity the following may be observed:

- Most relationships (generalized correlations) between variables are close to “saturation”. This means they are fuzzy and therefore weak.
- A small increase in entropy (uncertainty) can cause these relationships to actually vanish.
- Managing a system in which the variables are linked via weak relationships is risky.
- Systems close to criticality cannot evolve unless drastic measures are taken.
- Close to criticality, no single variable may be expected to govern the behaviour.

Resilience rating stratification is operated on five levels: Very Low, Low, Medium, High and Very High. In highly turbulent environments, such as our global economy, defining more classes of risk is of little relevance. Examples of systems with 1 to 5-star ratings are illustrated in Figure 6.

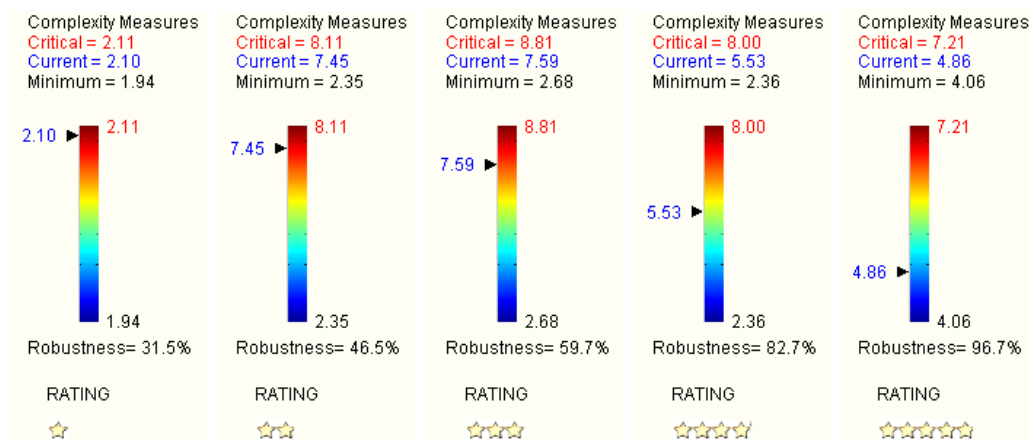


Figure 6. Example of five-level complexity-based resilience rating stratification. The system on the far left operates close to its critical complexity. The system on the far right operates close to its lower complexity bound and therefore behaves in a nearly deterministic fashion.

The Resilience Rating™ classes correspond to businesses with the following characteristics:

Business resilience is very low.

The business structure is weak. Exposure is very high and the business is inefficient and difficult to manage. It is impossible to make forecasts. The business is a candidate for default.

Resilience: 0-50% - Rating: ★

Business resilience is low.

The business is difficult to manage and control. Exposure is high as well as inefficiency. The structure of the business is vulnerable. It is difficult to make forecasts.

Resilience: 50%-70% - Rating: ★★

Business resilience is medium.

The structure of the business is fairly robust. Performance predictability is acceptable. Exposure is moderate.

Resilience: 70%-80% - Rating: ★★★

Business resilience is high.

This indicates a robust business structure. Predictability is high, exposure is low. Business sustainability and efficiency are quite high.

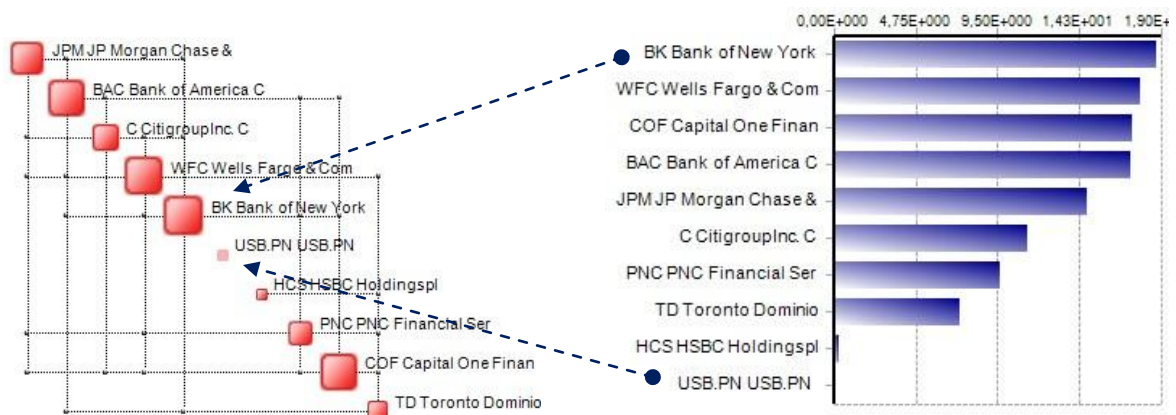
Resilience: 80%-90%-Rating: ★★★★

Business resilience is very high.

This business structure is very strong. Exposure is very low. The business is manageable and it is possible to make credible forecasts. The business is potentially highly sustainable and efficient.

Resilience: 90%-100% - Rating: ★★★★★

The *Complexity Profile* provides a quantitative breakdown of the total system complexity per variable. The example below is relative to a stock portfolio.



Complexity profiling is computed using the so-called knock-out technique. A possible correspondence between conventional rating stratification and complexity-based resilience rating is illustrated in Figure 8. Resilience values ranging from 0% to 50% are assigned one star, while values above 50% are assigned one additional star per every 10% increment.

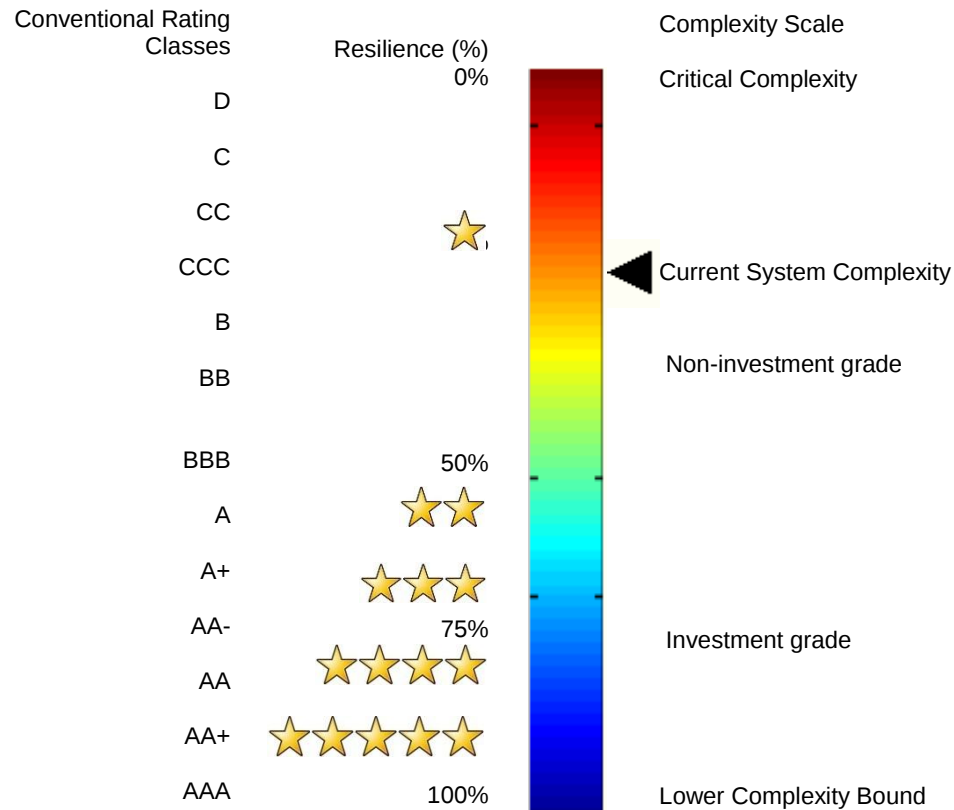


Figure 8. Correspondence between conventional rating stratification and Resilience Ratings™. Resilience values of 50% or less can be regarded as non-investment grade.

The correspondence indicated in Figure 8 is merely indicative.