

# Breakdown Visualization: Multiple Foci Polyarchies of Values and Attributes

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## ABSTRACT

Breakdown analysis involves decomposing data into subgroups to allow for comparison and identification of problem areas. Good analysis requires the ability to group data based on attributes or values. Breakdown Visualization provides a mechanism to support this analysis through user guided decomposition and exploration of tabular data with a polyarchy structure. This is useful in domains such as sports statistics and corporate financial reports. Breakdown Visualization utilizes a spreadsheet format for comparison of adjacent visualizations.

## Keywords

breakdown visualization, financial visualization, polyarchy structure, multiple foci, visual decomposition

## INTRODUCTION

Overview strategies are important in information visualization because they provide users with spatial organization and add context to the information. As data spaces get bigger, data aggregation is necessary to provide a visual overview [4]. An aggregated overview provides a reduced data presentation where users need to decompose the data into subgroups for more detailed analysis.

A breakdown is a decomposition of some data aggregation. It allows a user to decompose the data and focus on the details. The user moves from a superset of all the data to a particular subset of interest [2, 5]. Multiple breakdown iterations are needed for a user to converge on the details. A hierarchical model can be used for dividing data from supersets into subsets.

Most data sets can have multiple hierarchies associated with them. One example is the financial market. The market can be decomposed iteratively by many different subcategories such as sector, geography, size, product, or financials. Simultaneous hierarchical breakdown can be done on the basis of item aggregation and attribute formulae. For example, in a financial report,

decomposing an item-based aggregation can group values based on factors like sector or geography. Grouping by geography aggregates all records within the same geographic area. For attribute-based breakdown analysis, the financial ratios (attributes) can decompose into related attributes using specified formulae. For example, the return on equity ratio is related to a company's net income, total equity, return on assets and equity multiplier.

## BREAKDOWN VISUALIZATION

The spreadsheet format of presentation allows for comparison of adjacent visualizations. This visual format simplifies the organization of tabular data [1]. Each cell in the spreadsheet consists of a particular visualization corresponding to the intersection of the row and column specifications. Users can assign different visualization components based on the characteristics of the attributes. Such components may include a histogram, scatter plot, or line graph.

The visualization is a modified version of multiple foci with context. In the financial domain, the *vertical breakdown* is based on sector, geography, or product and the *horizontal breakdown* is based on ratios. Due to the differences in the types of hierarchies between the horizontal and vertical axes, different color schemes are used to represent them. The software displays the vertical breakdown in different gray scales, with darker gray corresponding to higher aggregation. In the attribute hierarchy, there is no such logical aggregation. Thus, color-coding levels in the hierarchy solves the problem of showing different depth. Due to the focal nature of the lowest level in the hierarchy, spatial as well as color coding conveys more information. The final hierarchy levels are indented in the vertical and the horizontal breakdown.

An overview is shown to the users at startup. The user selects the path to traverse by clicking on the ratios or the aggregated values and selecting it for a breakdown. At any point in time only two levels of the hierarchy are visible. As the user traverses deeper into the hierarchy, the earlier levels will disappear unless fixed.

With multiple paths available in a hierarchy, the user might want to focus on values available by traversing

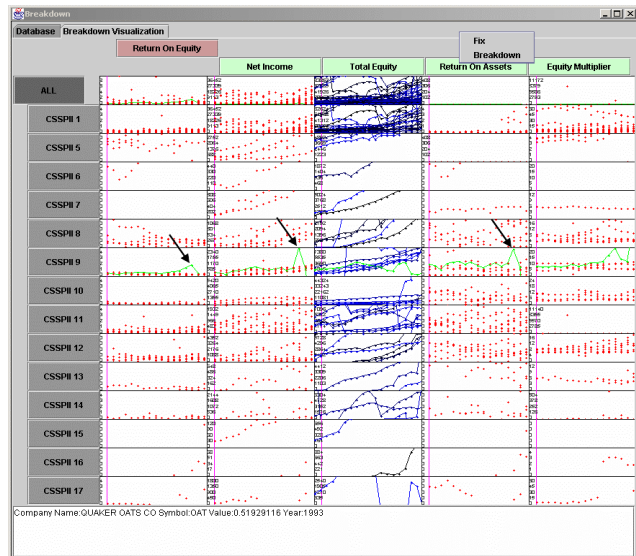
different paths. This problem is not visible with a single decomposition path in isolation, but arises when one node in a hierarchy is to be viewed in comparison with a node in another hierarchy. This presents the problem of displaying multiple foci, which is solved by the *fix and move technique*. The user can fix an attribute or a value in a path. The visualization retains the fixed node even after a totally separate path is chosen for traversal.

The visualization always fixes parent nodes of the hierarchies. When in the middle of a hierarchy decomposition, fixing enables the user to start a new analysis path from a parent level. This prevents backtracking through the entire path needed in other hierarchies. Support for brushing and linking allows the user to identify relationships and request details on demand.

A database table containing the item attributes is used. Grouping by attribute value defines the nodes available at any level in the polyarchy. This table imposes structure on the temporal data table containing all the data values. These tables are dynamically queried to obtain the information needed to build the visualizations.

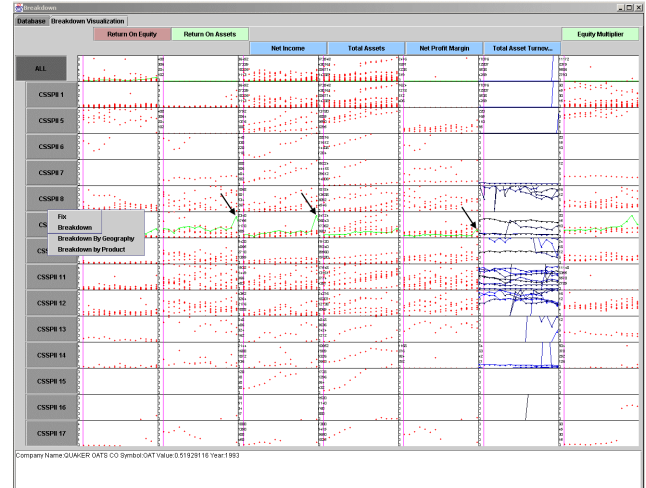
### SCENARIO

The visualization opens with an overview that shows the initial hierarchies at startup. Financial analysts are interested in using Breakdown Visualization to perform a DuPont Analysis [3]. In Figure 1, the analysts interact with the visualization by brushing relationships and requesting details for specific points. They notice a spike in the return on equity for Quaker Oats™. They see that is an effect of the increase in net income and return on assets (ROA) and want to breakdown the ROA ratio. They fix equity multiplier as a focal point and select ROA for a breakdown based on attributes.



**Figure 1:** An overview identifying interesting patterns that might need further investigation.

The analysts now are able to compare the children of return on assets along side the previously fixed foci. They identify the spike in net profit margin as the causality for the behavior in return on equity. They now want to perform a value breakdown based on product to identify the product providing the high margins.



**Figure 2:** Attribute and value breakdowns allow the identification of causalities.

### CONCLUSIONS

The ability to select any hierarchy for breakdown allows the user to traverse the tabular data with polyarchical structure. This gives the user the flexibility to choose a path of decomposition based on attributes or aggregated values. The fix and move technique solves the problem of comparison of visualizations with multiple foci. Together, they provide an interaction technique for visually decomposing a polyarchy.

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