Improving Value Driver Trees to Enhance Business Data Analysis

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ABSTRACT

In this work, we focus on improving data exploration for the specific multivariate graph application case of value driver trees (VDTs). Based on value drivers and an underlying model, VDTs are used to assess business's performance of companies. Taking into account the specific challenges of VDTs, we present an improved node representation using embedded visualizations as well as interaction concepts for local semantic zooming and simulations or predictions within these trees.

1 INTRODUCTION

In corporate finance, value driver trees (VDTs) are used to model (parts of) a business and visualize the calculation of a business's value drivers, i.e., key performance indicators measuring the value added by a company's business activities. Originally, this type of representation was used in DuPont analysis (orig. DuPont-System of Financial Control) to evaluate a company's return on equity (ROE), its profitability on investment and growth. From this, the VDT has been extended to incorporate a whole range of analysis models to support decision making and understand the relationships and components that make up a business's revenue and profitability. As a result, these trees now make up an essential tool to allow the comprehension of a business as a system model. For example, VDTs have been used to support measuring the return of investment on IT investments within businesses [6], but also to visualize and support measurement of value-to-client solution quality [1]. As a flexible tool to represent financial models and calculations, VDTs are already incorporated in professional business software, e.g., the SAP Analytics Cloud[1].

However, VDTs and their current implementations face multiple challenges. In this work, we first describe the specific characteristics of the VDT which lead to those challenges for visualization and interaction. We then present concepts addressing these challenges by focusing on the presentation and navigation within the VDT visualization as well as visualization and interaction for simulation using the VDT. Finally, we summarize the work that has been done so far and seek to provide an outlook for future work.

2 VALUE DRIVER TREE: CHALLENGES

The VDT is a multivariate graph [2, 4] in which individual value drivers and measures (nodes) are connected by operators (edges) to calculate business indicators, revenues, or costs. These can be profits or losses but also measures of quantity, such as number of cars in production, cost of certain metal, or amount of metal needed per car. Thus, each node has a title, a unit, and one to multiple values, e.g., values of past years as well as predictions for upcoming years.

The models used behind VDTs are, indeed, not necessarily trees but multivariate graphs in which nodes can influence more than one node, i.e., have multiple parents. Generally, the VDT itself is used as

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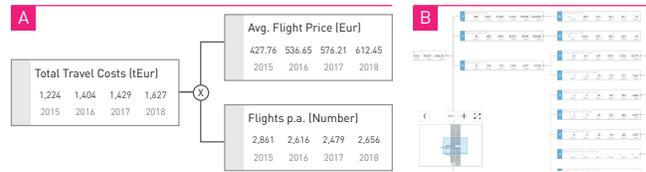‡e-mail: raimund.dachselt@tu-dresden.de

Figure 1: Basic VDT layout: (a) nodes incorporate multiple values and often place child nodes to the right; (b) in existing systems (e.g., SAP Analytics Cloud[1]) VDTs can provide a mini-map to ease navigation.

an abstraction of the model and therefore presented as a tree. Thus, the general aspects of tree visualizations [5] can be applied and also the key issues of tree layout and graph navigation [3] persist for this application case, including challenges regarding graph size. As the VDT can be used for very diverse business models, sizes of up to a few thousand nodes need to be considered. Frequently, VDTs are set up with the root node to the left and sub-graphs to the right (Fig. 1a).

Main tasks for the exploration of a business model using the VDT are the investigation of values and trends of specific measures (nodes) and the full understanding of a measure's influence on nodes at a higher level of the hierarchy and of at the overall graph (i.e., a node's weight). Hence, an **appropriate node representation** visualizing the nodes' multivariate data and their weight is required. In existing solutions, values are often only presented as a simple list per node (Fig. 1a), thus making it hard to apprehend their implications quickly.

As it's often the case for large data visualizations, it is important to **provide a general overview while investigating details**, i.e., to find a balance between occupied screen space per node and space used for visualizing the structure of the graph. Common solutions support (geometric) zoom allowing to investigate smaller components of the visualization. However, the effect of the node's value on the measures of higher level nodes in the hierarchy, i.e., its context within the graph, is lost when zooming in. Existing solutions include a mini-map to allow basic orientation within the data space (Fig. 1b), but due to its size it cannot provide the necessary information on the nodes' influence on values of the upper hierarchy, especially as operators connecting the measures are not visible anymore.

Furthermore, the VDT can be used to simulate variations, decisions and predictions within a business model. Changing individual measures, i.e., node values, supports assessment of repercussions and impact. For example, assuming that flight prices will increase drastically, the cost of travel increases and profits decline if turnover remains the same. Being able to simulate changes of travel costs in the VDT, especially to balance those by manipulating other components (e.g., reducing the number of allowed flights per employee), supports decision making and efficient planing. However, this requires the ability to **easily track implications of value simulations** within the VDT, thus how changes are propagated through the graph.

3 PRESENTATION AND NAVIGATION

In this section, we discuss the node representation according to the needs of VDTs as well as an interactive level of detail manipulation to improve the visibility of details, trends, and context structure.

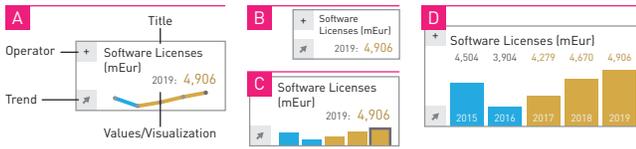---

[1]https://www.sapanalytics.cloud

Figure 2: (a) Basic components of a node and (b-d) node representations at different levels of detail.

3.1 Node representation with embedded visualizations

To improve the visibility of individual values and trends of measures over the presented time period, we embed basic visualizations within each node representation (Fig. 2a). Considering the possible number of nodes presented in the graph, these visualizations need to be simple and must allow a quick comprehension of the presented values or trends. We use bar charts and line charts for these representations. Therein, we distinguish fixed values from predicted values by color.

As described in the previous section, a balance is needed between seeing those details and being able to understand the structure of the graph, especially considering space limitation and information overload. Hence, we suggest a visual reduction of displayed content and size by adapting visualizations to smaller screen space and representing nodes at different levels of detail (Fig. 2b-d). Depending on the current detail level, nodes are presented as reduced to the core information (see b), with basic trend visualization (c) or including detailed information per quarter or year (d). A node's initial level of detail can be automatically adapted according to the weight or impact the node has on the overall calculation, creating a default VDT representation for a first overview of the data.

3.2 Semantic zooming in local focus regions

Further, the level of detail can also be influenced on demand as users can trigger semantic zooming locally for a region of interest. In the most basic adaptation, this region of interest can be defined as a radius around a cursor focus point. Alternatively, the structure of the graph should be taken into account: When focusing on a node, children and nearest siblings should be considered as a *region of influence* for semantic zooming.

To reduce the previously discussed loss of relation to context, we propose replacing geometric zooming with this form of semantic zooming. Using either a mouse wheel or pinching on a touch device, the level of detail of the focused node is stepwise increased (Fig. 2b-d). Furthermore, increasing the zoom also extends the region of influence: the level of detail of nodes inside this region also increases, but graduated by the distance to the node in focus (Fig. 3a). Geometric zoom is only applied when the zoom level exceeds the highest level of detail. An indicator on the node in the center of the region of influence represents a handle that supports moving and removing the zoom region from the visualization (here a magnifier icon). Zooming can be done for multiple regions of interest in the visualization where the highest level of detail is used when overlaps

occur. This allows a completely user-dependent setting of detail level of the VDT visualization.

4 SIMULATION AND PREDICTION IN VDTs

To support the use of the VDT visualization for simulation, solutions are required to interactively manipulate values as well as to effectively present predicted values and their impact on other nodes. To start a simulation, a node's attribute value can be changed by either clicking on the value label to input the number or simply drag the bar or line to manipulate it. This results in an additional simulation data value at the point of interaction (see Fig. 3b) and possibly further data points if this value influences the attribute values of following years (in Fig. 3b also affecting 2019). Both the originally predicted value and the simulated value are presented next to each other to ease comparison and keep track of the manipulation.

By definition, the manipulation of a node's attribute value will influence connected nodes' attribute values within the VDT. To be able to follow the impact of the simulated value, parent and child nodes that change according to this attribute also display the resulting value of the simulation. The change is propagated to these nodes and highlighted consistently. While propagation to parent values can be done using the presented operators, the distribution within lower level nodes might not necessarily be defined. For example, simulating the reduction of total labor cost might be equally propagated onto all departments, or may require a decision to reduce work hours in specific, less essential ones. To make these options visible in the lower hierarchies, we propose to allow manipulating the apportionment for a more detailed simulation.

5 CONCLUSION AND FUTURE WORK

In this work, we investigate various improvements for the specific application case of value driver trees, which are a tree-like graph structures describing business models by connecting measures through operations. We describe challenges of this type of business visualization and present first ideas and concepts solving these issues using representation of the nodes at different levels of detail, an interactive local semantic zooming function, and visual adaptations to simulation within the VDT. We already started to further develop these concepts by realizing a prototype implementation that will also serve as a basis for future work. We aim to develop advanced solutions for this specific use case by adapting existing solutions for graphs and trees as well as evaluating their applicability to this specific data type and use case.

REFERENCES

[1] R. Akkiraju and R. Zhou. Measuring service solution quality in services outsourcing projects using value driver tree approach. In *Proc. SRII Global Conference*, SRII '12, pp. 191–200. IEEE Computer Society, 2012. doi: 10.1109/SRII.2012.30

[2] S. Hadlak, H. Schumann, and H.-J. Schulz. A survey of multi-faceted graph visualization. In *EuroVis-STARs*. Eurographics Association, 2015.

[3] I. Herman, G. Melançon, and M. S. Marshall. Graph visualization and navigation in information visualization: A survey. *IEEE Trans. Vis. Comput. Graphics*, 6(1):24–43, Jan. 2000. doi: 10.1109/2945.841119

[4] A. Kerren, H. C. Purchase, and M. O. Ward, eds. *Multivariate Network Visualization*, vol. 8380 of *Lecture Notes in Computer Science*. Springer, 2014. doi: 10.1007/978-3-319-06793-3

[5] H.-J. Schulz. Treevis.net: A tree visualization reference. *IEEE Comput. Graph. Appl.*, 31(6):11–15, Nov. 2011. doi: 10.1109/MCG.2011.103

[6] C. Tian, R. Cao, W. Ding, H. Zhang, and J. Lee. Business value analysis of it services. In *IEEE Int. Conf. Services Computing (SCC 2007)*, pp. 308–315, 2007. doi: 10.1109/SCC.2007.36
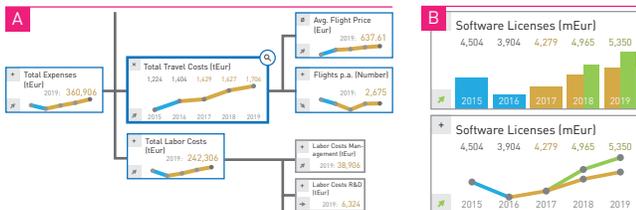
Figure 3: (a) Local semantic zooming: enlarging a specific node as well as (partly) its closest neighbors; (b) manipulating values allows an in-place simulation and comparison to the original numbers.