Evaluation of Taxonomy of User Intention and Benefits of Visualization for Financial and Accounting Data Analysis

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Abstract. In this paper we evaluate the taxonomy model for multidimensional data visualization for accounting data analysis. This taxonomy takes into consideration users' intentions and also, the benefits of visualization for analysts, businessmen and managers who use financial and accounting data. We also explain the proposed taxonomy as well as the taxonomic framework which contains three groups of attributes. They are classified according to visual techniques and their capabilities. We have analyzed several multidimensional and multivariate visualization techniques, each presented in a table according to the proposed taxonomy. This table will determine their capability and capacity to solve specific visual problems.

Evaluation of this taxonomic model for visualization of multidimensional and multivariate financial or accounting data implies the possibility for introducing an automatic selection of a visualization techniques and the best visual representation.

Keywords: data visualization, taxonomy evaluation, financial and accounting data, multidimensionality

1 Introduction

Many taxonomy methods and techniques, used in data visualization start from data and used techniques. We proposed taxonomy for data and information visualization which have a different focus of interest and take in consideration the user's preferences in the process of visualization and refers of financial and accounting data. We believe that this taxonomy will be very useful to handle with everyday's data and information overflow and it's analysis for the managers and analytics. We proposed the proactive policy of gaining visual reports in the phase of data preparation and effective manner of presentation. This proposed coherent review and conceptual framework will be elaborate in this paper and will gain design classification and selection of techniques dependent of the users' intention, its capability and the benefits given to the end users. The end users can have different level of

foreknowledge which has to be taken into consideration in the process of selection. We will analyze some of the most popular visualization techniques for multidimensional and multivariate (mdmv) data visualization.

The evaluation of this taxonomy's model can help understanding the usefulness of this taxonomy for evaluations of each technique for particular user's group and specified level of foreknowledge as well as creation of user's manuals for usage of each proposed visualization techniques appropriate for end user's group. The implementation of this taxonomic model will help for more efficient, faster and better future prepared visual information and for bridging the gap between necessary and expected results for some user groups. Also, we intend to propose some strategy for selecting technique and creating multidimensional and multivariate visualization for financial and accounting end users which will be the base for some automation in the business oriented information systems.

If we analyze the taxonomies in the whole visualization area, we can say that many classifications have been made. It is assumed that from taxonomy data, which means, its characteristics, the number of independent variables, variable sets, data types (scalar, vector or more complicated structures, discrete or continuous, nominal, interval or numerical, indexes and other). But, none of this taxonomy is focused on user intention, gained effects and interaction with data. This taxonomic framework for mdmv visualization is focused on the specific user groups of financial and accounting data and its preferences.

The paper is organized as follows. The second section, after the introduction, is dedicated to the short introduction in the proposed taxonomy and its dimensions. The following section takes in consideration most used visualization techniques and the subsequent explains in detail the evaluation of the proposed taxonomy for these visualization techniques. The following section discusses results with specific usage and examples for the effects of used taxonomy. The conclusion depicts remarks for future work.

2 Explanation of the Proposed Taxonomy

The proposed taxonomic model is created for mdmv data visualization for financial and accounting data analysis. According to this taxonomy, three dimensions are created: user intention [1], effect of visualization techniques and the interaction possibility. The additional dimension refers to the user groups and each combination of these four dimensions is a single vector in the four-dimensional space.

For better understanding, we can present the taxonomy's dimensions on the axes in the 3D Cartesian system, but it is useful to make a coding of all values, which the independent variables can take all three axes. The first dimension can take discrete coded data values for: data overview, hypothesis confirmation and insight, delve into the data and make new decisions (Table 1). The second dimension is the visualization technique effects (visibility, interpretability and delve into data -Table 2). The coding of the third dimension, visualization techniques effects are shown on Table 3. The interaction possibilities are classified according to data selection from the beginning. In the end, the fourth dimension - the user groups and its coding is presented on Table 4. Taking into consideration this taxonomic model, we can evaluate the most used

mdmv techniques and gaining the results - effect with some sample of accounting and financial data.

Table 1. The first dimension coding – User intention

1	**Data Overview**	UI/DO
2	**Hypothesis Confirmation**	UI/HC
3	**Delve into (the data) and making new decisions**	UI/DID&MND

Table 2. Coding of dimension VTE -Visualization technique's effects

Visualization techniques effect	**Type of variable**	**Variable rang**	**Used code**
Visibility	One screen or n-screen	data are shown on one, two or n-screens	S_1, S_2 ,…. S_n
	Object selection (slider, tab or radio button, combo box, command button)	Possibility to select data with object	SL, TB, RB, CB, COM, NO
	Analytical or aggregated data	Analytical data are shown or data aggregations are shown	AN, AG
	a) Relations are visible b) Relations aren't visible	The relations between data are or are not shown	RV, RNV RELV, RELUNV
Interpretability	The level of data understanding	The data understanding is at the: Low, Middle or High level	LL,ML,HL
	Relationship understanding level	Strong capability, middle, weak or no possibility for correlation discovery	SC, MLC, WC, NoC
	The aggregation understanding	There is visible: clustering, classification, association, rule detection, there is not visible rule	NoVIS, VCLU, VCLA, VASS, VRD
Insight in data	Possibility for ordinary statistical, mathematical data analysis, no possibility	Statistical or mathematical data analysis possibility or no possibility	IDAS, IDAM, IDAN
	Possibility to discover correlation	Correlation discovering level (1-5)	ICORR 0-5
	Possibility for cluster analysis	The level of clusters (1-5)	ICLU 0-5
	Possibility for classification	Possible classification level (1-5)	ICLS 0-5
	Possibility for pattern recognition	The possibility level of pattern recognition (1-5)	IPR 0-5
	Possibility for discovering associations	Association discovering possibility	IAD 0-5

3 Overview of the mdmv techniques and its coding according to the proposed taxonomy

When it comes to the analysis of financial and accounting data, it is important to note that the techniques used for effective visualization should be classified into eight groups of requirements of the visualization [3]. They are: Overview & detail on demand, Hierarchical structures and relations, Multivariate data attribute views for a time period, Analysis of objections to the plan (or plan disagreements), Additional detail for disagreement as drill-down possibility, filtering ability (information of interest, the level on detail, subsets for data analysis, comparison sets), Ability for

relation and attributes changing in time or time series for attributes and relationships as well as company graphs for accounting period following attributes or Adjusting periods for data analysis. The techniques which will be of interest for analysis for proposed taxonomy for mdmv data visualization are shown on the Table 5.

Table 3. Possibility for selection data, attributes and interaction with data

Interaction possibility	**Type of variable (Nominal, Ordered, Quantitative)**	**Variable rang**	**Used code**
Selection of subsets from the visualization dataset	With previous data preparation, In the visualization screen, No selection possibility	The visualization is prepared with already selected data set, on a whole data set and selection is enabled, Selection is not enabled	SELP, SELV, SELNO
	Enabled selection – filter for data/ There is only time filter/ Enabled with some object (slider, tab, combo or radio button)	There is data filter for all dimensions, Only for time period, Select data set with given object for data selection	SFIL 1-n, STFIL, SOBJ 1-n
	Zoom, Selection, Distortions, Linking and brushing	Data can be selected with zooming, distortion, linking and brushing or interactive filtering	SZOOM, SDIS, SLB, SIF, SNO
Selection of desired data attributes	With previous selected attribute (query or alias)	Previous prepared data set with selected attribute – number of selected attributes	SAP 1-n
	Selection of attributes on the visualization screen: Aggregated Analytic- data with drill-down possibility, Selection of attribute with object selection, Selection with slider or pointer	Embedded drill-down possibilities for aggregated data, Selection of attribute with selection of object dedicated to the desired attribute (radio button, tab, combo box or check box…), Selection with slider or pointer	SAVDD 1-n, SAVOS 1-n, SAVSP 1-n
Possibility of interaction with data in the given visualization	Possibility for selection analytical data/aggregated data/ No possibility interaction	Analytical data selection/ Aggregated data selection/ No interaction	ISAND, ISAGD, ISNO
	Only data navigation, Possibility for zooming, for linking and brushing, for interactive filtering	Possibility for: navigation only, zooming, linking& brushing, interactive filtering	INAV, IZOOM, ILB, IIF

3.1. Analysis of time histograms with displays and possibility select and zoom

The mentioned visual display may be set in the dashboards class with the “Overview & detail on demand” [3] class. It can be used as the base of many MIS, EIS, ESS and BI systems, as dashboards views for various manager’s levels and business analytic staff. The number of screens is bounded with the users’ demands and data visibility and clearance for the analysis. The proposed taxonomy for this visualization technique is shown on the Table 5.1a.

Table 4. User groups with specified tasks and level of information and analytical knowledge

Users' group	Specified tasks	Information knowledge	Used code
Top managers	Strategic management and planning activities	High level	SMHI, SMMI, SMLI
	Planning and control activities	Middle level	PCHI, PCMI, PCLI
	Region management activities	Low level (informational and analytical knowledge)	RMHI, RMMI, RMLI
Tactical (middle level) managers	Sector's planning and control	High level of	SPHI, SPMI, SPLI
	Management by exception	Middle level of	MEHI, MEMI MELI
		Low level of (information and knowledge)	LEHI, LEMI, LELI
Operative managers	Standard procedures control	High level of informational and analytical knowledge	SPCHI, SPCMI, SPCLI
	Operation management	Middle level of informational knowledge	OPHI, OMMI, OMLI
	Problem detection and solving	Low level of information and knowledge	PDSHI, PDSMI, PDSLI
Analytical staff	Specific analytic task	High level	SATHI, SATMI, SATLI
	Exception analysis	Middle level	EAHI, EAMI, EALI
	Perception analysis	Low level (information and knowledge)	PAHI, PAMI, PALI

Table 5 - Proposed Multidimensional and multivariate Visualization technique used for data analysis of financial and accounting data

Dashboards with time slabs – analysis using histograms, scatter plots or line plots as Ds
Parallel coordinates
Hierarchical parallel coordinates
Pixel-oriented display
Hierarchical pixel-oriented display
Glyphs
Hierarchical glyphs
Scatterplots
Hierarchical scatterplot
Dimensional stacking
Hierarchical dimensional stacking
Nodes and links techniques (cone trees, information landscapes, hyperbolic spaces etc.)
Polar coordinate – Kiviat's diagrams

Table 5.1a. Analysis according to the proposed taxonomy with the properties visibility, interpretability and insight in data

	Visibility				Interpretability			Insight in data					
Technique	I	II	III	IV	I	II	III	I	II	III	IV	V	VI
Dashboard(THWS&Z)	S2	SL	AG	RELUNV	HL	NoC	NoVIS	IDAN	ICORR0	ICLU2	ICLS0	IPR2	IAD1

The example below describes visualization with visibility defined as two windows in the screen, the first windows with slider. In the windows on the top it shows the aggregated data from database but relations between data are not visible. The

interpretability is described as a high level of data understandability, no visible correlations and clusters or associations, and no rules. Insight in data property is explained as "No statistical or mathematical possibilities for data analysis". No visible correlation in some dimensions, no visible classification, and rules will only be drown based on the seasonal natures and associations, are possible only with a selected dimension – time chunks and another dimension. The possible improvements aimed in increasing the possibility for filtering with a slider or pointer [5, 6], as well as a data filter with object which can increase the number of observed dimensions [8].

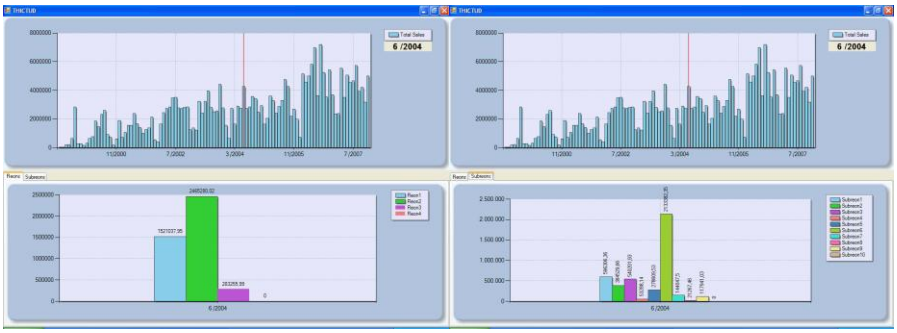

Figure 1: Time histograms with interactive selection of time unit and dimension

Next table 5.1b shows the analysis of this combination type of visualization techniques forming the aspect of interaction with data, selection of attributes which will be visualized and with direct interaction possibilities.

Table 5.1b. Analysis under the proposed taxonomy and possibility for selection and interaction

	Possibility for data selection			Attribute selection		Interaction with data	
Technique	I	II	III	I	II	I	II
Dashboard (THWS&Z)	SELV	SFIL2	SND	SAP3	SAVOS3	ISAGD	INAV/IZOOM

In this analysis, the selection possibility is on the screen in the first window, one dimension (time slab) can be selected with a slider (or a pointer) as a data selection. No direct zoom, linking & brushing or distortion or interactive filter possibility on the first window. The attribute selection is done with tabs or sliders (or radio buttons, or check boxes). The direct interaction with data is data selection from aggregated ones with the slider on the first windows in the screen. This technique only offers the possibility to navigate through data. This methodology is desirable for non informatics staff, but requires prior programming to the preparation of the data. The main purpose is that the systems are business oriented, especially for managers of a higher level and control to perform operational management tasks. By incorporating automated alert, efficiency in the operation can be improved a lot for this user group types.

3.2. Analysis of technique parallel coordinates and hierarchical parallel coordinates

The technique of parallel coordinates allows the detection of relationships between variables which are analyzed and are shown on the N-dimensional parallel axes in the 2D space. According to their purpose, we can classify them as presentation techniques of hierarchical structures to demonstrate links or Hierarchical structures and relations [3]. There are many tools for multidimensional and multivariate analysis which allows data analysis with this technique. The advantage is that all data is in the same screen and the number of sets axes are limited only by data visibility on the screen surface for data presentation. This technique actually represents the reflection of N-dimensional Euclid space in to 2-dimensinal surface. The proposed taxonomy, its application for multidimensional and multivariate visualization for this technique is shown on the Table 5.2a.

Table 5.2a Analysis under the proposed taxonomy for the technique parallel coordinates, taking in consideration visibility, interpretability and insight in data

	Visibility				Interpretability			Insight in data					
Technique	I	II	III	IV	I	II	III	I	II	III	IV	V	VI
PARCOR	S1	SL	AN	REL V	HL	SC	VCLU	IDAS	ICORR1	ICLU5	ICLS3	IPR3	IAD1
HPARCOR	S1	SL	AG	REL V	M L	SC	VoVIS	IDAS	ICORR1	ICLU0	ICLS0	IPR0	IAD0

The example described in this table is visualization with visibility as all dimensions are shown in one display, data visibility is provided with navigation through the axes with a slider and the analytical data values can be also obtained. The relation between data is visible because of the lines which connect the axes. This visualization is high interpretable. There is a high degree of perceived correlation between data in the axes and some cluster that can be detected. Some groups of clusters can also be noticed. The awareness in data can be also explained as possible statistical analysis with hierarchical parallel coordinates, correlation in a scale of 1 to 5 is four, excellent cluster detection, middle level of possibility for classification (three) and pattern recognition possibility in the low level (one from the scale of 1 to 5).

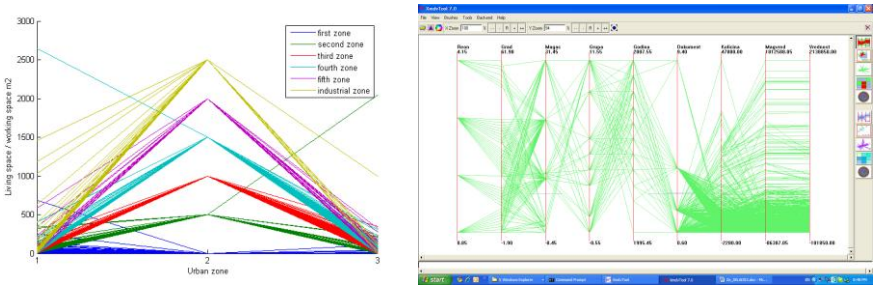

Figure 2: Parallel coordinate techniques as technique for hierarchical structures and relations presenter

If we take into consideration the hierarchical parallel coordinates, they have a decreased level of interpretability because there the means data values are shown on

the display and the rules cannot visually be detected. There isn't a possibility for a high degree of discerning in data because of data aggregation [7] (Figure 2). The possible improvement can be done with increasing interpretability with introduction of colors; visual primitives for the lines [4] (dashed or dotted lines etc).

Table 5.2b. Analysis for selection and interaction possibilities of ParCor techniques

	Possibility for data selection			Attribute selection		Interaction with data	
Technique	I	II	III	I	II	I	II
PARCOR	SELP	SFIL1	S*	SAPn	SAVSP1	ISAND	I*
HPARCOR	SELP	SFIL1	S*	SAPn	SAVSP1	ISANG	I*

Table 5.3a – Analysis under the proposed taxonomy on the techniques for multidimensional and multivariate visualization – visibility, interpretability and insight in data

	Visibility				Interpretability			Insight in data					
Technique	I	II	III	IV	I	II	III	I	II	III	IV	V	VI
PIXELDIS	S1	NO	AN	REL UNV	LL	WC	VRD	IDAN	ICORR0	ICLU1	ICLS1	IPR3	IAD3
HPIXELDIS	S1	SL	AG	REL UNV	LL	NoC	VCLU	IDAN	ICORR0	ICLU6	ICLS0	IPR0	IAD0
GLYPHS	S1	NO	AN	REL UNV	LL	WC	NoVIS	IDAN	ICORR0	ICLU0	ICLS0	IPR2	2
HGLYPHS	S1	SL	AG	REL V	ML	MLC	VASS	IDAN	ICORR0	ICLU3	ICLS1	IPR3	2
SCATMAT	S1	SL	AN	REL V	HL	SC	VRD	IDAS	ICORR5	ICLU5	ICLS5	IPR5	5
HSCATMAT	S1	SL	AG	REL UNV	ML	SC	NoVIS	IDAS	ICORR3	ICLU3	ICLS3	IPR1	1
DIMSTACK	S1	SL	AN	REL UNV	LL	WC	VCLU	IDAS	ICORR0	ICLU2	ICLS0	IPR1	0
HDIMSTACK	S1	Sl	AG	REL UNV	LL	NoC	NoVIS	IDAN	ICORR0	ICLU1	ICLS1	IPR1	0

Table 5.3b shows the analysis under the proposed taxonomy for data, attribute selection and direct interaction possibilities.Table 5.2b analyzes the aspect of data selection, attribute selection and data interaction for these visualization techniques. The possibility to select data is in the phase of data preparation (time – the possibility to observe the presented data in a timetable or having the possibility to see different dimensions at the same time). The column "interaction with data" shows that all known interaction types with data are available. The number of possible attributes for selection is equal with the numbers of dimensions. The selection is made with a slider or a mouse pointer. Analytical data can be selected and all of interaction types with data are available to select – from selecting and brushing to distortion and zooming. Hierarchical parallel coordinate techniques differ in the selection possibilities because only the aggregated data is shown and interaction is limited. The tools available for implementing this kind of data visualization require prior preparation of data and high level of IT knowledge.

Table 5.3b. Analysis of proposed taxonomy for multidimensional and multivariate techniques and their possibilities for selection and direct interaction with data

	Possibility for data selection			Attribute selection		Interaction with data	
Техника	I	II	III	I	II	I	II
PIXELDIS	SELP	SFIL1	S*	SAPn	SAVSP1	ISAND	I*
HPIXELDIS	SELP	SFIL1	S*	SAPn	SAVSP1	ISANG	I*
GLYPHS	SELP	SFIL1	S*	SAPn	SAVISP1	ISAND	I*
HGLYPHS	SELP	SFIL1	S*	SAPn	SAVISP1	ISANG	I*
SCATMAT	SELP	SFIL1	S*	SAPn	SAVISP1	ISAND	I*
HSCATMAT	SELP	SFIL1	S*	SAPn	SAVISP1	ISANG	I*
DIMSTACK	SELP	SFIL1	S*	SAPn	SAVISP1	ISAND	I*
DIMSTACK	SELP	SFIL1	S*	SAPn	SAVISP1	ISANG	I*

3.3. Analysis of other proposed techniques for multidimensional and multivariate data visualization

The techniques offered by the available multidimensional and multivariate visualization tools (as XmdvTool, VizDb etc.) provide multidimensional and multivariate visual displays of some data in order to improve the analyst's exploration possibility. For this purpose, we may take into consideration their capabilities under the proposed taxonomy's frame. These are the techniques for pixel display, glyphs, scatter plot matrices, dimension stacking. All these techniques have their own possibilities for hierarchical displays, which show the statistical averages of analytical data. The advantage is the fact that all data is shown on one screen and the number of data depends on the number of records in the fields in database which are used for visualization. The proposed taxonomy, applied in these techniques for multidimensional and multivariate visualization is shown on the table 5.3a.

It is obvious from the table that the multivariate outputs of the visual display have a different level of visibility, interpretability and insight. They are ranked from techniques which have a high degree of interpretability such as scatter plot matrix to the techniques which aren't interpretable. The scatter plot matrix and its hierarchical version have a high possibility level to detect correlations between dimensions. Most of them have the capability for statistical analysis, but, the cluster, classification and association possibilities have only one scatter plot matrix technique with a high degree of usefulness. The pattern recognition capability is higher only in the glyphs and pixel oriented displays. The next figures (Figures 3 & 4) show some multidimensional and multivariate data displays explained in table 5.3a. The possible improvements are increasing interpretability with the study of glyph possibilities and controlling the arrangement of pixel-oriented displays.

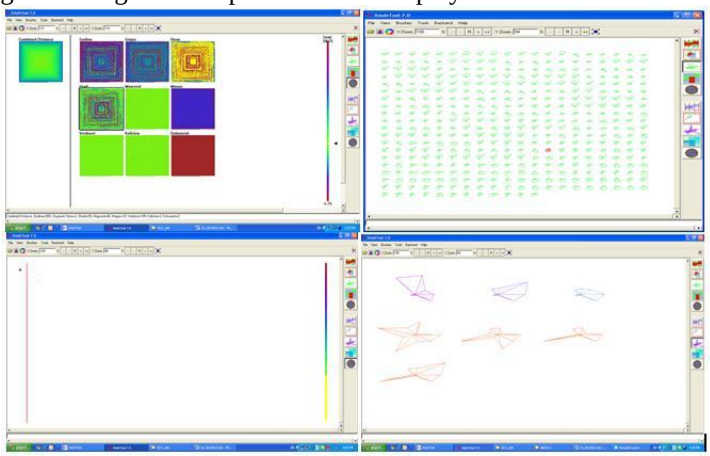

Figure 3: a) Pixel-oriented display of material-finance data b) Glyphs technique for same data c) Hierarchical pixel display d) Hierarchical glyphs

As parallel coordinate technique, these multidimensional and multivariate visualization techniques have the possibilities of data selection, but only in the phase of data visualization preparation. It is possible to set a wide variety of filters for each dimension or for their combination at the same time. All interactions with data possibilities are included. The number of possible selection attributes is equal to the number of analyzed dimensions, and the selections are made by a pointer. The analytical (in the regular displays) as well as the aggregated (in hierarchical displays) data can be selected. It's possible to use all types of data interaction as selection, zooming, linking& brushing or distortion. Using these techniques also requires knowledge of the specific tools for data visualization of multidimensional and multivariate data and advanced data preparation. This also means a high level of IT expertise.

3.4. Analysis of the techniques nodes and links, trees, hyperbolic spaces and Kiviat diagrams

While the mentioned (nodes, links and hyperbolical displays) can be classified into hierarchical structures and relations, the Kiviat display is figure obtained in a polar coordinate system (and its possible transformations in cylindrical or spherical coordinate system). Figures themselves are obtained by connecting points of polar coordinates. This technique can be seen as the axes rotate from parallel coordinates into polar coordinates. Nodes and links are popular for displaying complex relationships in the formation of tree maps, cone tree, hyperbolic trees etc. The size of the hierarchical structure dictates the view and the techniques used to interact with the data. This representation shows all data in the techniques of nodes and links is some kind of clear drawings that can zoom in or distorts, depending on the user requirements. The Kivit figures show shapes obtained in the polar coordinate system giving information about the values of each of the axes. The proposed taxonomy used for this model of visualization is shown on table 5.4a.

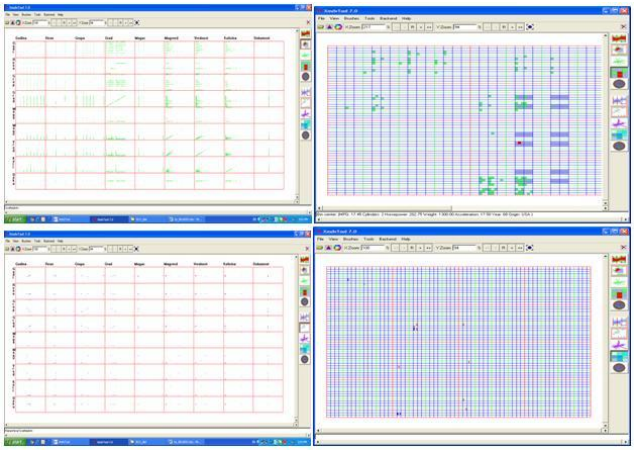

Figure 4 a) Scatter plot matrix b) Dimensional stacking c) Hierarchical scatter plot matrix d) Hierarchical dimensional stacking

The example describes visualization of nodes and relations whose visibility is described only in one display shows the analytical data is from the database without object possibility selection. The arcs show the links between data and they are visible. Their interpretability is depicting as high level of data understandability which gives a high degree of dependency and understandable object classification. There are not many possibilities for statistical and mathematical analysis, but they have a great opportunity for making classifications and clustering. The insight in data possibilities is weak.

Table 5.4a. Analysis under the proposed taxonomy for the properties visibility, interpretability and insight in data

	Overview				Interpretability			Insight in data					
Technique	I	II	III	IV	I	II	III	I	II	III	IV	V	VI
Nodes, links and relations, treemap, conetree	S1	NO	AN	REL V	HL	SC	VCLA	IDAN	ICORR0	ICLU5	ICLS5	IPR 1	IAD 0
Kiviat figures	S1	NO	AN/AG	REL V	ML	WC	VCLA	IDAM	ICORR3	ICLU3	ICLS1	IPR 3	IAD 1

The Kiviat figures are usually shown in the screen without the data selection possibility. They are made from analytical as well as average data (hierarchical kiviats). The level of data understandability for this technique isn't on the highest level and the correlation detection has a low level [2]. The visible level of classification possibility is obvious. The mathematical data analysis are possible with this technique, also it has possibilities for correlation detection, medium level of pattern recognition and clustering capability, but there isn't an ability for discovering clusters and association (Figure 5). The possible improvements are aimed at increasing data filtering with the usage of a slider or a pointer as well as increasing the number of dimensions which are taken into consideration with the visualization.

The data sets selections possibilities for the technique nodes and links are made with the previous data preparation for visualization; there isn't a filter for data selection or attribute selection as well as for interactively movement through the nodes. The number of selected attributes is defined in the previous prepared static data set and there aren't embedded additional possibilities for selection with a slider or a pointer. There isn't an interaction possibility, data changing, navigation capabilities or distortion, zooming or another type of interaction. The tools used for such displays, are mostly for the engineering staff and require high former knowledge of specific software tools which normally allow visualization and simulations. First, data should be adequately prepared for visualization. Kiviat figures are created from the previous prepared data sets, without an interactive data filter or any other possibility for data or attribute selection. These tools do not allow the usage of sliders and pointers nor have opportunities for data interaction. However, the development of visual tools can change this situation. Users need to have knowledge depending on the information that needs to be presented visually and effectively.

Table 5.4b. Analysis under the proposed taxonomy of data and attributes selection and direct interaction with data possibilities

	Possibility for data selection			Attribute selection		Interaction with data	
Technique	I	II	III	I	II	I	II
Nodes, relations, treemap, conetree	SELP	SFIL0	SIF	SAPn	SAVOP0	ISNO	INO
Kiviat figures	SELP	SFIL0	SNO	SAP0	SAVSP0	ISNO	INO

The analysis of these techniques is shown on the table 5.4b in term of data and attributes selection as well as direct interaction with data.

4. The results

Proposed taxonomy, evaluated in this paper, tries to classify the user's purpose and benefits of visual analysis of the financial and accounting data based on several criteria. We estimate that this will provide the classification of data visualization techniques used for financial and accounting data to serve as a basis for automation of the choice of visualization techniques for specific purposes. The implication of such a division would provide a high degree of specification of individual visualization techniques for specific purposes and specific opportunities. In the previous examples, each attribute is encoded by a weight factor. Although is not an easy task and requires complex mathematical calculations or intelligent methods, it is still worth exploring because of the overflow of collected data and the necessity of rapid analysis.

The choice of techniques for visualization according to this taxonomic model as well as the possibilities for selection appropriate visualization techniques can automatically be incorporated in software tools which can produce faster analysts' performance, detection of exceptions etc. Such algorithms can be nested in the creation process of data visualization with HCI intensions for financial and accounting staff.

This visualization can have many goals like: creation of dashboards as system control tools, balanced scorecards etc. Although, the most important prerequisite in this case is the staff's training for usage and tool possibilities, with the purpose of effective and rapid preparation of information from databases or tabular data representation in visual representation [3].

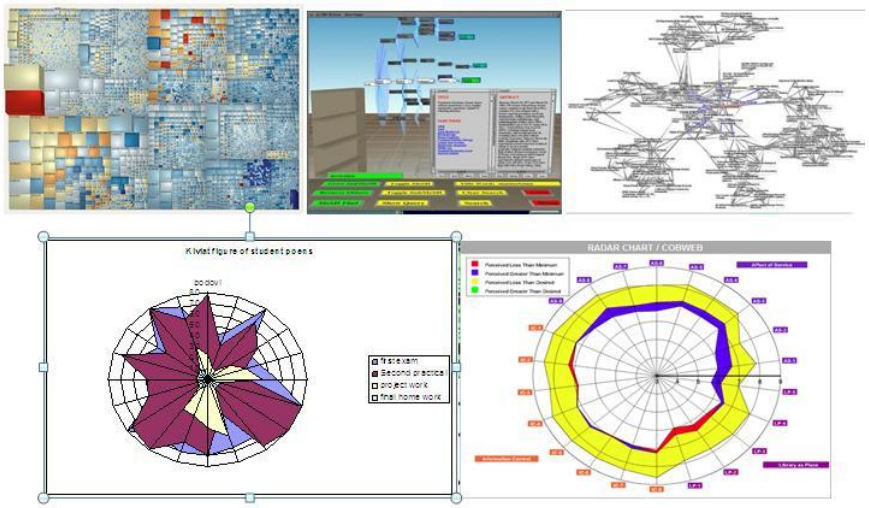

Figure 5 a) Tree maps technique for hierarchical display b) Cone tree c) Semantic network d) and e) Kiviat diagram figure

5 Conclusion

In order to evaluate the proposed taxonomy to support the creation of a coherent and comprehensive conceptual framework that can allow the user classification by users' intention and benefits of visualization for financial and accounting data, we explore the most used techniques for mdmv data analysis according to proposed taxonomy. We evaluate all of these techniques with coding of four dimensions for each technique and their possible values are provided in the given tables. They can be easily understood and used for creation of algorithms for the automation of visual representation on HCI through interactive displays. But, it should be mentioned that there is no final solution for automatic gaining visual representation that would satisfy all end users. In any attempt to automate this process, it is necessary to have the interaction for end users through selection of offered solutions, meaning system that supports decision making process for end users.

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