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A Visual Approach to Information Systems: Representations of the Force and Momentum of Accounting Wealth Changes

Dissertation Abstract

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It is almost universally accepted that a primary purpose of an accounting information system is to accumulate and communicate a firm's economic data for the use by those making decisions regarding the firm. Over the past several years, due to the proliferation of computers, there has been an explosion of information available to these decision-makers. During this period of time there has also been a shift in organizational culture toward increased employee involvement in decisions. This indicates that there is an increase in non-financial people involved in the organization's decision-making process. Many organizations are moving rapidly toward a condition where more complex information is being interpreted and acted upon by decision-makers without extensive financial experience.

Within the field of accounting, there have been suggestions that to increase "decision usefulness," and expand the double entry system, there needs to be included, a concept of momentum that describes the rate at which an organization is earning income. Furthermore, the rate at which momentum is changing is described as "force" (Ijiri, 1986). Our current accounting framework measures the wealth of a firm as the total assets less total liabilities of the firm. This is also referred to as the equity of the firm's owners. A method of accomplishing the introduction of force into accounting has been proposed by defining momentum equal to the first derivative of wealth and force equal to the second derivative of wealth ($M = dW/dt$ and

$F = d^2W/dt^2$ where $M =$ momentum, $W =$ wealth and

$F =$ force) (Ijiri, 1986). This unique representation of accounting information, in terms of physics, has provoked some criticism. One critique of this model questions the increased information complexity and the unknown benefits to decision-makers (Fraser, 1993). The same author also indicates it may be difficult to empirically test the model.

Information Visualization

One method of information presentation that has been used extensively in the fields of engineering and the physical sciences is information visualization. Information visualization, refers to using abstract pictures that can communicate the information contained within numbers to allow a better understanding of the numbers, and therefore better decisions (Tuft, 1983). Within the realm of business, on a limited basis, researchers have investigated the usefulness of graphical representations (a small subset of information visualization) and their effect on improved decisions. The results from this research have been mixed. Inconclusive results may be indicative of the limited techniques that have been available to researchers to create meaningful visualizations.

Recently, there have been advances in the field of information visualization that have provided researchers with better tools to model multi-dimensional events within the domain of the physical sciences. The intent of this paper is to apply these tools to the concept of force within accounting, yielding an information system that not only represents this concept, but also allows decision makers, not trained in the details of accumulating accounting data, to make more effective decisions.

Previous Research

For this study to be beneficial, the proper (or most useful) representation of the data must be selected. Visual representations have been classified into eleven general categories: structure charts, cartograms, maps, graphic tables, process diagrams, icons, time charts, network charts, pictures, tables and graphs (Lohse et al. 1994). Each category has positive and negative characteristics when representing different types of data. Even after the selection of the representation category, there are a large number of decisions related to the actual information representation. To optimize the effect of a visualization, one must look at the details of a representation, and ensure that the data is revealed rather than obscured (Tufte, 1983). For example, these details may incorporate motion, color, or three dimensional effects into the visualization. The studies in the area of accounting information systems have typically modeled information from the traditional problem spaces and used graphs as the tool for visualization (DeSanctis & Jarvenpaa, 1989; Kaplan 1988). The conclusions from this research have been mixed, possibly because most of these studies have focused on issues other than the actual representation of the information provided by the data set. Other authors have studied the suitability of visual displays of data relative to the type and complexity of the decision being approached (Vessey, 1991). This study should extend the work of many of these authors by focusing on a component, the actual visual representation, that was not as developed at the time of their research.

Methodology

Using information visualization tools, I intend to develop a visual representation of the financial concept "force" of wealth change. After the development of the representation, I plan a study of individuals that do not have significant training in accounting. The purpose of the study will be to test their decision making ability using this visual representation versus a control group that will be given traditional accounting representations of the same data. Non-accountants will be used because of the trends within organizations to use non-financial employees in decision-making functions. I expect to find the new method to be superior to the traditional presentation methods, when viewed relative to the quality and timelines of the decision.

Contribution

The major contribution to information systems and accounting will be the adaptation of tools previously used in engineering and the physical sciences to an accounting environment. By this application, information systems will be used to implement an accounting concept previously theorized, but not tested with regard to practical applicability. The test should also confirm the usefulness of visualizations in business decision-making settings.

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