# Preliminary Results-Nature as Metaphor : Innovative Visualization of Accounting Information with Lotus Plants

Voraphan Raungpaka* · Phannaphatr Savetpanuvong** · Uthai Tanlamai***

## Abstract

Learning accounting has always been a challenge for non-accounting students and managers. Understanding accounting information requires more than a numerical description of financial and income statements. Current accounting practice presents accounting reports in the form of tables with values or in two or three dimensional graphs generated by a spread sheet program. The present study proposes an alternative visualization with metaphor from nature as a learning device for novice users and managers. After surveying various kinds of plants, the lotus flower was chosen as an attractive analogy because every part of the plant from leaves to roots is usable and can have economic value. Moreover, lotus flowers, whether man-made or natural, can easily be part of a familiar, natural ecology representing both beauty and serenity.

Results from online survey respondents (n = 220) showed that there was no significant difference on overall usability of the Lotus visualization between expert users and novice users. However, verbally-oriented users differed significantly from visually-oriented users in their usability assessment, perceived usefulness, and intention to use the Lotus visualization.

Keywords : Innovation, Accounting, Learning, Visualization, Analogy

# 1. Introduction

People without a background in accounting often encounter problems in understanding or analyzing financial statements. Therefore, learning accounting principles and practice has been a challenge for non-accounting students and managers. There are many entrepreneurs who have no solid background in accounting but need to understand the financial status of their company. However, understanding accounting information requires more than a numerical description of a business's financial position and income statement. It is common practice to present accounting reports in the form of tables with numbers or two or three dimensional graphs generated by a spread sheet program. Thus, an important question to be addressed is what the best representation of financial data (from balance sheet and P&L statement) for novice and visually-oriented users is.

In this study, an alternative visualization using a metaphor from nature is proposed as a learning device for novice users and managers. A prototype representing financial data with lotus visualization was developed. We expect that the prototype will make financial data more usable to novice users. Through the use of this alternative visual representation, entrepreneurs and managers will be able to increase their learning capability and understand the financial position and operational performance of their company.

# 2. Literature Review

Visualization is "the process of representing data as a visual image" [Latham, 1995, p. 148]. Visualization allows decision-makers to make use of the human visual system to extract information from data and present an overview of complex data sets [Tegarden, 1999].

## 2.1 Visualization in Business

In the business and management domain, graphical visualizations are utilized as a supplement to complex business data for management decision-making and can help managers and entrepreneurs make better decisions under certain circumstances. Visual information can give a clear understanding of a company's financial position and status [Gonzales, 2004; Volmer, 1992]. Prior research reveals the benefits of visualization in business and management [Arunachalam, Pei, and Steinbart, 2002; Blake, 1978; Gonzales, 2004; Ives, 1982; Tegarden, 1999] and investigates the use and value of graphical representations in financial/annual reports [Amer and Ravindran, 2010; Beattie, 1992; Beattie and Jones, 1993; Courtis, 1997; Davis, 1989; Desanctis and Jarvenpaa, 1989; Tanlamai and Soongswang, 2011a; 2011b; Volkov and Laing, 2012; Volmer, 1992; 1993].

## 2.2 Visualization in Financial Reports

According to the International Accounting Standards Board (IASB) framework "the objective of financial statements is to provide information about the financial position, performance and changes in financial position of an entity that is useful to a wide range of users in making economic decisions" [IASB, 2009].

In traditional practice, financial reports are

displayed in numerical form. It is common prac-
tice currently for financial statements to be rep-
resented in a graphical alternative to the conven-
tional tabular presentation. Existing research
has shown that the use of different graphical
formats in financial reports is prevalent, e.g., bar
charts, line graphs, histograms, pie charts, dash-
board, two- or three-dimensional graphical dis-
play, and other typical business diagrams gene-
rated by spreedsheets [Arunachalam et al., 2002;
Beattie, 1992; Beattie and Jones, 1993].

Desanctis and Jarvenpaa's study, assessing
the effectiveness of various reporting formats in
presenting accounting data found that graphical
formats can improve the accuracy of forecast
judgments [Desanctis and Jarvenpaa, 1989]. A
recent study assessed the usefulness of several
modes of information presentation as alterna-
tives to numeric data in financial reports and
found that "tables, bar graphs and line graphs
are appropriate information presentations to use
for the general purpose of financial reports."
[Volkov and Laing, 2012]. Furthermore, it has
become standard practice to use a combination
of graphical and numeric information to display
financial data [Tanlamai and Soongswang, 2011a].

A number of studies have been dedicated to
evaluating the effectiveness of different report-
ing formats in presenting financial data. For ex-
ample, determining whether various reporting
formats improve the accuracy of forecast judge-
ments, whether alternative visuals affect the
level of learning in financial report users, and
how useful alternative types of format for the
presentation of accounting information are have
been studied [Arunachalam et al., 2002; Beattie

and Jones, 1993; Blake, 1978; Courtis, 1997;  Davis,
1989; Desanctis and Jarvenpaa, 1989; Stella and
Malcolm, 2003; Tanlamai and Soongswang, 2011a;
Volkov and Laing, 2012; Volmer, 1992; 1993].
However, besides graphical formats generated
by a spread sheet program, there is a demand
for other visual formats to better communicate
financial data to financial report users [Volkov
and Laing, 2012].

To design a new and effective graphical pre-
sentation format, designers need to decide which
sort of format will be most suitable for repre-
senting financial information (Gillan and Wickens,
1998). In the early stages of the design phase
designers may seek direct interaction between
users and financial information to provide a re-
alistic impression of what the final system will
look like [Gould and Lewis, 1985; Shneiderman,
1998]. "Especially when the product is entirely
new, the development of a set of requirements
may well depend upon testing initial ideas in
some depth" [Mayall, 1979]. "Once early data
collection and preliminary requirements are es-
tablished, more detailed design and early develop-
ment can begin" [Shneiderman, 1998].

To ensure that the Lotus Visualization fol-
lows the design principles stated earlier, the fol-
lowing hypotheses were tested :

Hypothesis 1 : There is no difference in the sub-
                jective rating between novice and
                expert users on usability of the
                lotus visualization.
Hypothesis 2 : There is no difference in the sub-
                jective rating between verbally
                and visually-oriented users on us-

ability of the lotus visualization.

Hypothesis 3 : There is no difference in the subjective rating between novice and expert users on the perceived usefulness (PU) of the lotus visualization.

Hypothesis 4 : There is no difference in the subjective rating between verbally and visually-oriented users on the perceived usefulness (PU) of the lotus visualization.

Hypothesis 5 : There is no difference in the subjective rating between novice and expert users with respect to the behavioural intention to use (BI) the lotus visualization.

Hypothesis 6 : There is no difference in the subjective rating between verbally and visually-oriented users with respect to behavioural intention to use (BI) the lotus visualization.

## 3. Research Method

The objective of this research is to examine whether the proposed visual format of a lotus visualisation is useful as a representation of financial data. A comparison was made between the perceptions of students with accounting and non-accounting majors. The research design entails 5 steps as follows :

1) Brainstorming among researchers in an effort to map accounting items with different parts of a lotus plant.

2) Gathering ideas from experts of different disciplines, including plant pathology, accounting, auditing, and finance.

3) Development of the instrument to study attitudes, experience and adoption intentions.

4) Two pilot studies :

a. The first pilot study was administered two months prior to the main study. Thirteen undergraduate students from an Accounting Information Systems Analysis and Design course at a large public university participated in the first pilot test. Booklets were distributed to participants consisting of : (a) Instructions to participants for the usability test of the first prototype visualisation, and (b) the Satisfaction Questionnaire for the first prototype.

b. The second pilot test was administered one and a half months prior to the main study. Forty-five graduate students from a master's program in Corporate Governance (CG) of a large public university participated in the second pilot test. Booklets were distributed to the participants consisting of : (a) the instructions to participants for the usability test of the second prototype visualisation, and (b) the satisfaction questionnaire for the second prototype.

5) Revision of the instrument and use with 220 users to address the usability of visualizing financial statements with a metaphor based on a lotus flower.

### The Development of a "Lotus Visualization" -Steps 1 and 2

After the first two steps, the image and map-

ping of lotus flower with financial data were devised. The following description explains the thought process behind the proposed visual representation.

### The Attempt to link with Nature

The researchers found that organizations tend to provide "one visual fits all" type reports which tend to be inadequate for novice learners. We believe that learners will be able to comprehend massive amounts of financial data if we come up with a single picture that can represent two sheets, i.e. a statement of financial position (a.k.a. balance sheet) and a statement of comprehensive income (a.k.a., profit and loss statement). To integrate the financial information from two sheets, we mimic the ecology of a lotus flower to explain business ecology.

Why did we choose a lotus flower? We believe that going back to nature can ease the learning process. Having investigated various kinds of plants, it was decided that the lotus is an attractive analogy because every part of the lotus flower,

from leaves to roots, is usable and can derive economic value. In addition, it was recognized that lotus flowers in man-made or natural settings, can easily be part of a familiar, natural ecology symbolizing beauty and serenity.

### The Big Concept : Nature Metaphor

The lotus flower can provide a graphical presentation of accounting information. We believe that the lotus plant visualization will provide users (e.g., Small and Medium Enterprise (SME) owners, entrepreneurs, novice users, non-accountants, and accounting students) with integrated financial data from the statement of financial position to the statement of comprehensive income. By transforming financial data into visualization, the system will provide users with a graphical presentation of financial reports to depict financial status. A holistic visual will provide the user with a "snapshot of a company's financial condition" by comparing two or more sets of financial data in a single screen [Williams, Bettner, and Carcello, 2008]. Without

〈Table 1〉 Mapping of Financial Data with a Lotus Flower

| Financial Report items | Part |
| --- | --- |
| **Statement of Financial Position** | |
| Assets | Stem (a.k.a., Pedicel) |
| Liabilities | Adventitious root |
| Ownership equity | Rhizome (Lotus Root)+Adventitious root |
| Retained Earnings | |
| Beginning Retained Earnings | |
| Ending Retained Earnings | Upper Rhizome (Lotus Root) |
| Stockholders' equity | Lower Rhizome (Lotus Root) |
| **Statement of comprehensive income** | |
| Sales revenue | Fruit |
| Cost of goods sold (COGS)/Cost of sales | Pericarp and Seed coat |
| Gross Profit | Cotyledon+Embryo axis |
| Expenses (including operating expenses) | Lotus seed pod |
| Net income | Aeration |

in-depth knowledge of accounting practices, novice users will be better able to understand the financial status of a company from the proposed visual information. Likewise, accounting major students can also use this visualization system to enhance learning and understanding of financial principles.

### Our Mapping

We have mapped the financial data to various parts of the lotus plant. The itemized mapping is shown in <Table 1>.

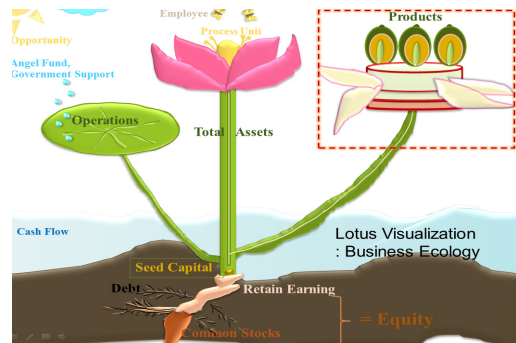### Lotus Visualization

The sample images in <Figure 1>~<Figure 3> show the visualisation mapping. The first image represents the overall business ecology of a lotus plant. Half above and half below water, <Figure 1> depicts the match between salient parts of financial data and component parts of a lotus plant. The visual highlights the lotus flower and its elements as profitability, stem as assets, and different types of roots as liabilities and equity.
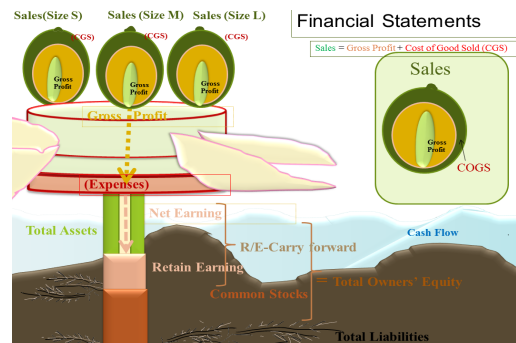
<Figures 2> and <Figures 3> show the detailed elements of the lotus flower in relation to profitability. The former depicts the concept without showing the equivalent financial statements; the latter demonstrates the same information in totality. Mockup data of financial statements were constructed from an introductory accounting textbook.

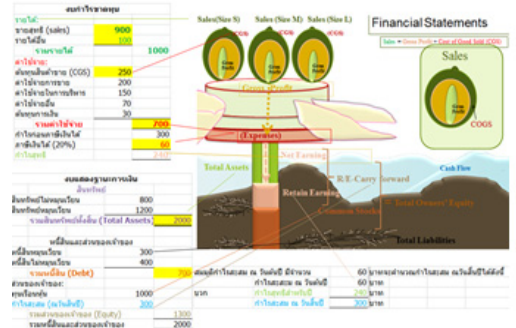### Survey Instrument-Step 3

In order to adequately show the proposed visual, hereafter referred to as Lotus Viz, it is imperative that the image be viewed on a computer



<Figure 1> Lotus Visualization-Business Ecology



<Figure 2> Lotus Visualization-Mapping without Financial Statements



<Figure 3> Lotus Visualization-Mapping Showing two Financial Statements

screen. Thus, a data collection instrument was developed for online responses via survey using Survey Monkey, the world's most popular online survey tool. The online survey was used so that colours and shapes of the lotus plant visuals

could be seen easily. The lotus plant visuals were designed to be static with no data drilled-down capability. This is to mimic the paper-based financial statements that are widely used in a typical business setting in Thailand. Three visuals were included.

The online survey was distributed using the Facebook wall collector viewed by anyone who views the site. In a laboratory environment, the authors encouraged their students to voluntarily respond to the survey. This was done on a voluntary basis, thus, no incentive was offered for participation. The session started by explaining the rationale why Lotus Viz was conceptualized. Then each participant was instructed to complete the following steps : (a) complete the demographic questionnaire; (b) watch a pre-recorded video presentation of the lotus visualization; and (c) complete the online survey with a12 item questionnaire.

*Measurements*

The purpose of the questionnaire was to collect the participants' subjective rating of the usability of Lotus Viz and its perceived usefulness on his/her behavioural intention to use the metaphorical image in the future. The online questionnaire contained questions regarding the experience that the participant had with the prototype Lotus Viz shown on a pre-recorded video. The first ten items were to provide overall assessment of usability and were based on the SUS-System Usability Scale [Brooke, 1996]. Item No. 11 was to address participants' attitude to show their perceptions of usefulness of the proposed Lotus Viz [Davis, 1989]. Item No. 12,

the last question, was used to provide participants' behavioral intention to use the proposed visual [Venkatesh, Morris, Davis, and Davis, 2003]. These items used a 7-point Likert scale, with 1 = Strongly Disagree and 7 = Strongly Agree as anchors. These twelve items were translated into Thai.

1. I think that I would like to use this Lotus Visualization frequently. (U)
2. found the Lotus Visualization unnecessarily complex. (U)
3. I thought the Lotus Visualization was easy to use. (U)
4. I think that I would need the support of a technical person to be able to use this Lotus Visualization. (L)
5. I found the various functions in this Lotus Visualization were well integrated. (U)
6. I thought there was too much inconsistency in this Lotus Visualization. (U)
7. I would imagine that most people would learn to use this Lotus Visualization very quickly. (U)
8. I found the Lotus Visualization very awkward to use. (U)
9. I felt very confident using the Lotus Visualization. (U)
10. I needed to learn a lot of things before I could get going with this Lotus Visualization. (L)
11. I would find the Lotus Visualization useful, e.g. it can help me understand the financial position operation performance of a company. (PU)
12. I intend to use the Lotus Visualization in the future. (BI)

Note that the perceptual values of these items are either positive or negative. Also, the original SUS had classified questions into two groups, usability (U) and learnability (L). The abbreviation for perceived usefulness is PU and that for behavioural intention is BI.

Only one relevant aspect of Felder's learning style was included as a control variable. It is conceivable that individuals with a strongly visually-oriented learning style are more likely to prefer processing visual data than those who are more verbally-oriented [Felder and Silverman, 1988]. As such, visually-oriented users would find the Lotus Viz to be more usable than their verbally oriented counterparts.

The online survey was distributed via the Facebook wall collector to 303 students who were studying in Thailand or abroad. Since the survey was voluntary, some students chose not to participate; only 220 out of 303 students (72.6%) completed the survey. The majority of respondents who completed the survey were accounting majors (146 out of 220) who had taken accounting and/or finance classes and were familiar with the concept and use of financial statements.

However, a minority of respondents who completed the survey were not accounting majors (i.e., science, engineer, IT, and economics majors), students who had not taken accounting and/or finance classes and were not familiar with the concept and use of financial statements. However, some of these students did have work experience. <Table 2> shows the profiles of respondents.

*Statistical Analyses*

According to Brooke, each item contributes to the SUS scale with a range from 0 to 4 [Brooke, 1996]. For positively worded questions (1, 3, 5, 7 and 9), the score contribution is the scale position minus 1. For negatively-worded questions (2, 4, 6, 8 and 10), the score is the scale position minus 5. To get the overall SUS score, the sum of the item score contributions were multiplied by 2.5. Thus, SUS scores range from 0 to 100 in 2.5-point increments.

Regarding usability (U) and learnability (L), we followed the suggestions of Lewis and Sauro [2009], and calculate usability (sum of items 1, 2, 3, 5, 6, 7, 8, and 9) and learnability (sum of items 4 and 10) in addition to the total SUS score. To make the usability and learnability scores comparable with the overall SUS value (ranging from 0 to 100), the summed score was multiplied by 3.125 and 12.5, respectively.

Besides providing the results of the descriptive statistics, an independent sample t-test was applied. A significance level of 0.05 was chosen.

<Table 2> Profile of Respondents

| Respondent's Characteristics | Total Number of Respondents (N = 303) |
|---|---|
| Completed the survey | 220(72.6%) |
| Age(Min, Max, Average) | 18, 60, 24.4 |
| Degree(BA Acct, MA Acct, Non-Accounting major) | 130(42.9%), 16(5.28%), 74(24.4%) |
| With financial statement experience(years) | 2.49 |
| Had taken a basic accounting class(Y, N) | 204(92.7%), 16(7.3%) |
| Had taken a financial accounting course(Y, N) | 199(90.5%), 21(9.5%) |

## Pilot Studies-Step 4

Results from pilot studies are not included in this paper. All in all, the studies were done so as to improve the survey instrument and online survey. The result from **Step 5** of the research design is reported next.

# 4. Results

The following tables summarize the results of the hypothesis tests. As seen in <Table 3>, the independent sample t-test revealed a significant difference in the usability score (item 1, 2, 3, 5, 6, 7, 8, and 9) between the expert group (accounting major students) and the novice group (non-accounting major students), $t (219) = 2.233$ with $p = 0.027$. However, no significant difference

between these two groups has been found for the total SUS score ($t = 1.886, p = 0.062$), learnability (L) ($t = 0.054, p = 0.957$), perceived usefulness (PU) ($t = 0.859, p = 0.391$), and behavioural intention to use (BI) ($t = 1.248, p = 0.213$).

With respect to different types of learners <Table 4>, the independent sample t-test revealed a significant difference in the SUS total score, usability score (U), perceived usefulness (PU), behavioural intention to use (BI) between the verbally-oriented users and visually-oriented users, $t (219) = 4.9$ with $p = 0.000$, $t (219) = 5.42$ with $p = 0.000$, $t (219) = 4.9$ with $p = 0.000$, and $t (219) = 5.25$ with $p = 0.000$, respectively. However, no significant difference between these two groups was found for learnability (L), t $(219) = 0.62$ with $p = 0.533$.

<Table 3> Independent Sample t-test : Results of Participants' Subjective Rating of Lotus Viz- Expert Users (Accounting major) vs. Novice Users (non-accounting major)

| Subjective Rating Scale of Lotus Viz | Mean (N = 220) | Type of User Comparison | | | |
|---|---|---|---|---|---|
| | | Expert Users (N = 146) | Novice Users (N = 74) | t-test | sig |
| SUS total score-(Item 1 to Item 10) | 56.79 | 55.32 | 59.69 | 1.89 | 0.07 |
| Usability score (U)-(Item 1, 2, 3, 5, 6, 7, 8, 9) | 61.88 | 60.05 | 65.47 | 2.23 | 0.027* |
| Learnability score (L)-(Item 4, 10) | 36.46 | 36.40 | 36.59 | 0.06 | 0.957 |
| Perceived Usefulness (PU) (Item 11) | 3.89 | 3.86 | 3.97 | 0.86 | 0.40 |
| Behavioural Intention to Use (BI) (Item 12) | 3.48 | 3.42 | 3.61 | 0.211 | .25 |

Note) *p ≤ 0.05, **p ≤ 0.01.

<Table 4> Independent Sample t-test : Results of Participants' Subjective Rating of Lotus Viz-verbally-oriented Users vs. visually-oriented Users

| Subjective Rating Scale of Lotus Viz | Mean (N = 220) | User Learning Style Comparison | | | |
|---|---|---|---|---|---|
| | | Verbally-oriented Users (N = 110) | Visually-oriented Users (N = 110) | t-test | sig |
| SUS total score-(Item 1 to Item 10) | 56.79 | 51.88 | 61.71 | 4.90 | .000** |
| Usability score (U)-(Item 1, 2, 3, 5, 6, 7, 8, 9) | 61.88 | 55.98 | 67.77 | 5.42 | .000** |
| Learnability score (L)-(Item 4, 10) | 36.46 | 35.46 | 37.47 | 0.62 | 0.533 |
| Perceived Usefulness (PU)-(Item 11) | 3.89 | 3.62 | 4.16 | 4.90 | .000** |
| Behavioural Intention to Use (BI)-(Item 12) | 3.48 | 3.13 | 3.84 | 5.25 | .000** |

Note) *p ≤ 0.05, **p ≤ 0.01.

# 5. Discussion and Conclusion

In this study, we sought to answer the question whether the proposed visual, the Lotus Viz, is a useful representation of financial data for users. We have provided insight into this question by comparing two groups of financial report user (expert users vs. novice users) and two styles of learner (verbally-oriented users vs. visually-oriented users) on usability, learnability, perceived usefulness, and behavioral intention to use the Lotus Viz.

The present study found that there was no significant difference on overall usability assessment of Lotus Viz between expert users and novice users. However, verbally-oriented users differed significantly from visually-oriented users in their usability assessment, perceived usefulness, and behavioural intention to use the Lotus Viz.

Based on a realistic impression of what the final system of innovative visualization of accounting information with a lotus plant will look like, as expected, the novice financial report users judged the usability score of the Lotus Viz system higher than the expert financial report users. The reason why novice users consider the Lotus Viz to be more usable as compared to expert users is because expert users already have knowledge about these fundamental accounting concepts and they require greater detail in accounting information than is possible with the visualization, most preferably represented in number and tabular format. In cognitive science, it has been shown that highly trained experts require less use of visual aids because the understanding of concepts has already been recorded in their long-term memory. However, both expert and novice users found the Lotus Viz to be useful in a way that can easily help them understand the financial position and company operational performance.

Our results offer evidence that visually-oriented users have evaluated the usability score of the proposed system higher than verbally-oriented users. Most notably, the visually-oriented users found the Lotus Viz useful in helping them understand the financial position and company operational performance (PU score 4.16 out of 5.00; see <Table 4>). This result is related to other work in learning styles and strategies [Felder and Soloman, 2012], which has demonstrated that visually-oriented users remember best what they see in pictures, and in visual demonstrations.

From these results, it was found that learnability did not differ between visually-oriented users and verbally-oriented users. However, this conclusion may be premature as yet because the length of the study was inadequate to justify system learnability.

The preliminary results from this initial study indicate that both novice and expert users as well as visually-oriented users embrace the concepts proposed. In addition, informal interviews with some respondents indicated that they accepted the idea of using multiple lotuses in a single picture to compare multiple companies. Our results are in agreement with the study of William et al. [2008] which states that an all-inclusive visual will provide the user with a "snapshot of a company's financial condition"

by comparing two or more sets of financial data in a single screen.

In this paper we have shown that the Lotus Viz, a new graphic presentation of accounting information in a single picture that can represent two data sheets, can also be used to reinforce accounting concepts in a way that provides a tool to help the accounting student retrieve the known information as well as financial principles.

### Limitations

One obvious limitation of this study is that the participants were drawn from a college student population. Thus, "novice users" or non-accounting major students might have taken either basic accounting or finance courses in their bachelor of business administration (BBA), master of business administration (MBA), or master of management (MM) programs. In other words, the novice users in this study are not really naïve to financial statements; therefore, they might not think like a true naïve user.

Another limitation derives from the nature of the research setting itself. Here, the participants were asked to watch a video presentation of the Lotus Viz and to see what the proposed system prototype looks like. However, they did not have a chance to use the system to actually make their financial evaluation. Hence, only perceptual data without usage experience were collected and analysed.

### Further Research

It remains for future work to determine if novice users, such as entrepreneurs and managers, could use the Lotus Viz to help reinforce their decision-making performance. To obtain more realistic data, one clear next step would be to replicate the study and have entrepreneurs or managers evaluate the Lotus Viz. The participants should be asked to actually use the proposed system prototype and work through evaluation exercises such as decision making tasks.

## References

[1] Amer, T. S. and Ravindran, S., "The Effect of Visual Illusions on the Graphical Display of Information," *Journal of Information Systems*, Vol. 24, No. 1, 2010, pp. 23-42.

[2] Arunachalam, V., Pei, B. K. W., and Steinbart, P. J., "Impression management with graphs: Effects on choices", *Journal of Information Systems*, Vol. 16, No. 2, 2002, pp. 183-202.

[3] Beattie, V., "The use and abuse of graphs in annual reports : Theoretical framework and empirical study", *Accounting and business research*, Vol. 22, No. 88, 1992.

[4] Beattie, V. A. and Jones, M. J., "Effect of graphical presentations on insights into a company's financial position-An innovative educational approach to communicating financial information in financial reporting : a comment", *Accounting Education*, Vol. 2, No. 4, 1993, p. 303.

[5] Blake, G. B., "Graphical shorthand as an aid to managers", *Harvard Business Review*, Vol. 56, No. 2, 1978, pp. 6-12.

[6] Brooke, J., SUS-A quick and dirty usability scale : London : Taylor and Francis, 1996.

[7] Courtis, J. K., "Corporate annual report graphical communication in Hong Kong : Effec-

tive or misleading?", *Journal of Business Communication*, Vol. 34, No. 3, 1997, pp. 269-288.

 [8] Davis, F. D., "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly*, Vol. 13, No. 3, 1989, pp. 319-340.

 [9] Davis, L. R., "Report format and the decision maker's task : an experimental investigation", *Accounting, Organizations and Society*, Vol. 14, No. 5/6, 1989, pp. 495-508.

[10] Desanctis, G. and Jarvenpaa, S. L., "Graphical presentation of accounting data for financial forecasting : An experimental investigation", *Accounting, Organizations and Society*, Vol. 14, No. 5/6, 1989, pp. 509-525.

[11] Felder, R. M. and Silverman, L. K., "Learning and teaching styles in Engineering education", *Engr. Education*, Vol. 78, No. 7, 1988, pp. 674-681.

[12] Felder, R. M. and Soloman, B. A., "Learning styles and strategies", Retrieved September 10, 2012, from http://www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSdir/styles.htm

[13] Gillan, D. J. and Wickens, C. D., "Guidelines for presenting quantitative data in HFES publications", *Human Factors*, Vol. 40, No. 1, 1998, p. 28.

[14] Gonzales, M. L., "More than pie charts", *Intelligent Enterprise*, Vol. 7, No. 17, 2004, pp. 12-14.

[15] Gould, J. D. and Lewis, C., "Designing for usability : Key principles and what designers think", *Communications of the ACM*, Vol. 28, No. 3, 1985, pp. 300-311.

[16] IASB., Framework for the preparation and presentation of financial statements. Retrieved September 10, 2012, from http://www.ifrs.org/IFRSs/IFRS-technical-summaries/Documents/Framework.pdf, 2009.

[17] Ives, B., "Graphical user interfaces for business information systems", *MIS Quarterly*, Vol. 6, No. 4, 1982, pp. 15-47.

[18] Latham, R.(Ed.), New York, NY: Springer-Verlag, 1995.

[19] Lewis, J. R. and Sauro, J., *The factor structure of the system usability scale.* Paper presented at the Proceedings of the 1st International Conference on Human Centered Design : Held as Part of HCI International 2009, San Diego, CA.

[20] Mayall, W. H., Principles in design : Design Council, 1979.

[21] Shneiderman, B., *Designing the user interface : Strategies fo reffective human-computer intereaction* (3d ed. ed.). Reading, MA : Addison-Wesley, 1998.

[22] Stella, S. and Malcolm, S., "The impact of presentation format and individual differences on the communication of information for management decision making", *Managerial Auditing Journal*, Vol. 18, No. 1, 2003, pp. 59-67.

[23] Tanlamai, U. and Soongswang, O., "Learning financial reports from mixed symbolic-spatial graphs", *Online Submission*, 2011a.

[24] Tanlamai, U. and Soongswang, O., "Learning from balance sheet visualization", *US-China Education Review*, Vol. A, No. 7, 2011b, pp. 910-625.

[25] Tegarden, D. P., Business information visu-

alization. *Commun. AIS*, Vol. 1, No. 1, 2009, p. 4.

[26] Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D., "User acceptance of information technology : Toward a unified view", *MIS Quarterly*, Vol. 27, No. 3, 2003, pp. 425-478.

[27] Volkov, A. and Laing, G. K., "Assessing the value of graphical presentations in financial reports", *Australasian Accounting Business and Finance Journal*, Vol. 6, No. 3, 2012, pp. 85-107.

[28] Volmer, F. G., "Effect of graphical presentations on insights into a company's financial position : An innovative educational approach to communicating financial information in financial reporting", *Accounting Education*, Vol. 1, No. 2, 1992, p. 151.

[29] Volmer, F. G., "Effect of graphical presentations on insights into a company's financial position-An innovative educational approach to communicating financial information in financial reporting : a reply", *Accounting Education*, Vol. 2, No. 4, 1993, p. 311.

[30] Williams, J. R., Bettner, M. S., and Carcello, J. V., *Financial and managerial accounting* : McGraw-Hill Irwin, 2008.

■ Author Profile

### Voraphan Raungpaka

Voraphan Raungpakais a faculty of the College of Management, Mahidol University, Bangkok, THAILAND. She has previously worked at Kasetsart University, Bangkok, THAILAND. Most of her research interests deal with the behavior aspects of information systems and business applications. Her current research interests include information visualization, visualization of business reports, and web usability. She received Ph.D. in Education (Business Information Systems) from the Utah State University.

### Phannaphatr Savetpanuvong

Phannaphatr Savetpanuvong is a lecturer at Chulalongkorn University in Thailand. He received his Ph.D. in Technopreneurship and Innovation Management. He has more than 15 years of experience in transnational ICT and management consulting firms,including Hewlett-Packard, Ericsson, Microsoft and IBM. His research focuses on applying artificial intelligence and augmented reality visualization techniques to manage innovation and strategic planning. He has published a number of articles in Journal of IT Applications and Management (JITAM) and numerous conference proceedings such as the 4th IEEE International Conference in Management of Innovation and Technology the Strategic Management Society 29th Annual International Conference and the International Conference on e-Commerce, e-Administration, e-Society, e-Education, and e-Technology 2010 and 2011.

### Uthai Tanlamai

Uthai Tanlamai is a professor of information systems at Chulalongkorn University. She received her Ph.D. in Management Information Systems from the University of Illinois at Urbana-Champaign. Prior to joining the Faculty, she was a tenuredfaculty member at California State University at Fresno and taught at Bentley College in Waltham, Massachusetts for a year. Most of her research interests deal with the behavior aspects of information systems implementation. Her current research interests include risk management, ERP implementation, visualization of business reports, and augmented reality of financial data.