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Accounting Documentation Software: An Overview of Options and Results from a Lucidchart Software Evaluation

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Accounting Documentation Software: An Overview of Options and Results from a Lucidchart Software Evaluation



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Abstract

Accounting practitioners use documentation diagrams to plan audits, train employees, and consult on accounting information systems development. Accounting educators instruct students in diagram development with various software tools as preparation for industry requirements. This paper presents a review of documentation diagrams identified by practice and major textbooks, a summary of software tool options, and an examination of cloud-based documentation software. We suggest software adoption criteria and propose Lucidchart as a cloud-software solution for developing accounting documentation diagrams. Finally, we present the results from a Lucidchart software evaluation study. The practical contribution is two-fold for educators responsible for teaching accounting documentation topics: (a) a documentation software resource; and (b) an initial usage assessment of Lucidchart software.

Keywords

Accounting Documentation, Lucidchart, Cloud, Documentation Software, Software Evaluation

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INTRODUCTION

Some prior research suggests that accounting documentation, such as flowcharts, is an accepted topic within many accounting curriculum and programs (Neely et al., 2015). Further, most accounting educators and practitioners agree that learning how to create the necessary documentation diagrams when using software is a skill that requires practice and mastery after gaining knowledge about documentation symbols and guidelines (see Borthick, 1996; DeVries and Lee, 2013; Garnsey, 2016). Essentially, learning how to master the documentation software tools is an additional learning objective in courses with accounting documentation topics.

In our experience and in discussion with other accounting instructors (AISEC 2013, 2014, 2015, 2016, 2017; Vician, 2015), we note that instructors face additional challenges when employing documentation software tools, such as: (1) campus resources may not support the licensing costs for Microsoft Visio; (2) student learners would prefer to work on personal computers that are not using Windows operating systems; and/or (3) student learners prefer a click-n-drag approach to building the documentation formalisms (rather than developing or using a locally-developed symbol library with Microsoft Office applications like Excel, Word, or PowerPoint). In these instances, web-based (i.e., cloud) drawing applications may provide useful instructional resources in lieu of existing Windows-environment options. This paper proposes Lucidchart (a cloud-based documentation software application) as an operating-system neutral documentation software alternative to Microsoft Visio, Office drawing tools (PowerPoint, Excel, Word), and SmartDraw.

We begin with a brief literature review and background section addressing documentation diagrams and software usage, an analysis of textbook coverage of documentation topic and highlighted diagrams, and a discussion of existing desktop (Windows and Mac operating systems) and cloud-based software applications capable of producing the accounting documentation diagrams. Next, we present our rationale for proposing Lucidchart and results from a software evaluation study of using Lucidchart. We conclude with suggestions for instructors seeking to use software to support teaching of the documentation topic.

LITERATURE REVIEW AND BACKGROUND

The American Accounting Association 1987 Committee on Contemporary Approaches to Teaching Accounting Information Systems report shows that instructors should include "system documentation techniques" in accounting instruction at a Bloom's taxonomy level of "application" (AAA, 1987). Borthick (1996) identifies "documentation" as a key learning goal for accounting information systems (AIS) courses, with sub-goals of (a) understanding symbolic representations, and (b) modifying and creating symbolic representations. According to Garnsey's (2016) recent survey of AIS educators, the documentation topic and techniques are important for accounting degree. Badua et al. (2011, 2014), Bain et al. (2002), Herron and Premuroso (2012), Neely et al. (2015), Tam (2013), and Welch and Welch (2010) also indicate the need for system documentation topics in the accounting document formalisms for audit firms to demonstrate proper auditing of financial transactions of public company auditees (Whitehouse 2013).

Further, according to DeFelice (2010), the 2011 changes to the Uniform CPA exam included a switch from long simulations to short simulations including: "creating a flowchart

from a description" and "repairing a flawed flowchart." A review of CPA review books from Becker (Brunner et al., 2015, 59) and Gleim (Gleim and Hillison, 2015, 182-184), shows examples of multiple choice questions and simulations that concentrate on flowcharting in the Audit section. The AICPA released blueprints of the new 2017 Uniform CPA exam in 2016. In the audit section blueprint, the section on "Understanding an entity's internal controls" describes the need for candidates to understand the flow of transactions and design of internal controls by documenting flows of transactions and controls within the flow (AICPA, 2016).

Some accounting educators emphasize using Windows operating system software solutions such as Microsoft Visio and/or Office drawing features to create the digital diagrams (AISEC 2013, 2014, 2015, 2016, 2017). DeVries and Lee (2013) provide a step-by-step process of flowcharting instruction that utilizes a Microsoft Excel workbook with embedded narratives, symbols, and flowchart solutions. Borthick et al. (2010) provide a teaching case as one exercise to help students learn proficiency in documentation and highlight the use of Microsoft Excel and Visio as software options. Research suggests that industry practitioners favor the use of Microsoft Visio to produce required accounting documentation (Bagranoff and Simkin, 2000; Eddolls, 2009), though this can vary in importance depending on the size, resources, and personal software preferences of the financial services firm (Joshua Bouchard, Partner – Grant Thornton, personal communication to the author, December 4, 2017).

Textbook Coverage

When prior research examines topical coverage in accounting curriculum, most researchers also identify particular textbooks as part of the analysis. Badua et al. (2014) reports that publisher salespeople believe about 70% of the AIS textbook market is captured by Pearson's authors Romney and Steinbart (~34%), and Cengage Learning's authors Gelinas, Dull, and Wheeler (~20%) and Hall (~15%). Wiley's authors Bagranoff, Simkin, and Norman (7%) and Turner and Weickgennant (6%), as well as McGraw-Hill's Hurt (5%), and another 12% unidentified represent the remaining market share according to Badua et al. (2014). Neely et al. (2015) report AIS textbooks that included these top authors as well as two additional Pearson authors (Bodnar and Hopwood; Kay and Ovlia). We have selected ten AIS textbooks highlighted in Badua et al.'s (2014) market share data and Neely et al.'s (2015) reported textbooks to analyze the amount of accounting documentation coverage and treatment of documentation software. Table 1 lists the textbooks we use in the analysis presented in Table 2.

We have analyzed the textbooks listed in Table 1 to determine the kind of coverage each textbook provided on the system documentation topic. We gather the total number of pages (from Chapter 1 to Chapter N), the total number of pages where system documentation topics are addressed (including database-related diagrams, business process diagrams, and system design documentation), the types of documentation diagrams covered, and what software options for drawing the diagrams are mentioned in each textbook. We also calculate a percentage for amount of topic coverage in the book and compare it to Bain et al.'s (2002) percentage of topic coverage. Table 2 provides a summary of this analysis, using the first author's name to conserve space.

				Badua et al.,
Publisher	Date	Author(s)	Edition	2014 Mkt Share
Pearson	2018	Romney and Steinbart	14 th	34% (2012)
Cengage Learning	2018	Gelinas, Dull, Wheeler, and Hill	11 th	20% (2012)
	2016	Hall	9 th	15% (2011)
Wiley	2015	Simkin, Rose, and Norman	13 th	7% (2009)
	2017	Turner, Weickgennant, and	3 rd	6% (2008)
		Copeland		
McGraw-Hill	2015	Hurt	4 th	5% (2012)
	2014	Richardson, Chang, and Smith	1 st	n/a
Textbook Media	2016	Heagy, Lehmann, and Du	8 th	n/a
Pearson	2013	Bodnar and Hopwood	11 th	n/a
	2014	Kay and Ovlia	2nd	n/a

Table 1: AIS textbooks included in analysis

As illustrated in Table 2, all of the reviewed AIS textbooks include some coverage of the system documentation topic. However, the textbooks vary in the amount and kind of coverage provided. Most textbooks provide at least a textual description of the need for documentation diagrams and may show an illustration or two of diagrams as examples of what accountants might encounter in the workplace. Our Table 2 analysis shows that textbooks varied from a low of 1% to a high of almost 30% coverage of documentation. Certain textbooks provide more extensive coverage that includes instruction in developing the particular diagram(s) along with a textual description and example diagram(s)¹. Most of the reviewed textbooks identify common software application programs used to produce documentation diagrams. However, none of the reviewed textbooks provide descriptive information on how to use the identified software applications to produce the given documentation diagram(s). We observe that instructors appear to make their own choices about what software to use, if at all, when providing topical instruction for accounting documentation (AISEC 2013, 2014, 2015, 2016, 2017; Neely et al., 2015; Vician, 2015).

Our analysis in Table 2 suggests a textbook preference for Windows-based software for accounting documentation diagrams, though a few mention Macintosh software solutions. Our search of practitioner resources identifies two articles by Bagranoff and Simkin (2000) and Eddolls (2009) that discuss Microsoft Visio, a Windows-based desktop software application. To provide a more complete software review, the next section provides a discussion of desktop software tools for both Windows and Macintosh operating systems that can produce the required accounting documentation diagrams.

¹ For example, Romney and Steinbart (2018) include a comprehensive problem with solution in end-of-chapter material. Gelinas et al. (2018) discuss examples in the chapter.

Textbook		E		Bain et al.		
First Author	Book #Pages	l opic #Pages	Book %	(2002) Book %	Types of Diagrams Discussed	Documentation Software Identified
Romney	707	124	м 17.54%	4.25%	Flowcharts (system, document, program), DFD, Business Process, ERD, REA, SOX	Visio, Office (Word, Excel, PowerPoint) in chapter and problems
Gelinas	685	51	7.45%	6.3%	Document flowchart, DFD, displays ERD	Visio in problems.
Hall	743	75	10.09%	1.27%	Flowcharts (system, document, program), ERD, REA, SOX Organization Charts	None
Simkin	486	114	23.46%	7.36%	Flowcharts (system, document, program), DFD, Business Process, REA, Decision Table, SOX	Visio, SmartDraw, Office (Word, Excel, PowerPoint), iGrafx, Allclear
Turner	533	7	1.31%	n/a	Flowcharts (system, document), DFD, Business Process, ERD	SmartDraw
Hurt	334	58	17.37%	n/a	Flowcharts (system, document, program), DFD, REA	Visio, SmartDraw, Office (Word, Excel)
Heagy (8 th)	490	28	5.71%	4.74%	Flowchart (System, document), DFD, Business Process, REA, Block diagram	Visio, CASE tools
Bodnar	511	44	8.61%	12%	Flowcharts (system, document, program), DFD, Business Process, ERD, object-	Visio, Office (Word, Excel), CASE tools (e.g., ER Studio-now RAD
					oriented modeling techniques, IPO, HIPO, UML, Narratives, Resource Utilization, Work Measurement, Work Distribution	Studio); UML software; BPMN software
Kay	470	139	29.57%	n/a	Process Flowchart, DFD, Business Process, ERD, REA	Visio, OmniGraffle (Mac); CASE tool: Altova UModel-BPMN; Tech exercises mention Visio, Excel
Richardson	310	38	12.16%	n/a	Flowcharts (System, Document), DFD, Businese Drocese TIMI Class FRD	None

Table 2: AIS textbook coverage of Documentation topic

DESKTOP SOFTWARE OPTIONS: WINDOWS AND MACINTOSH

There are several desktop software applications for Windows users that produce the required diagrams for accounting documentation. Our textbook analysis above, a Google search for Windows solutions, and our own experience has identified professional diagramming software (Microsoft Visio, SmartDraw, Allclear², iGrafx), drawing tools features of Microsoft Office applications (Excel, PowerPoint, Word), general-graphic/image design software (Adobe Illustrator and Photoshop), and specific computer-assisted software engineering (CASE) tools with diagramming features (Altova UModel; Embarcadero RAD Studio). The MacHow2 website (2018a) indicates Macintosh desktop software applications capable of producing accounting documentation diagrams include graphical application programs OmniGraffle Pro and ConceptDrawPro (both include Microsoft Visio import/export; MacHow2, 2018a) and the drawing tools features of Microsoft Office applications (Excel, PowerPoint, Word). The MacHow2 website (2018a) provides information on other Macintosh solution alternatives to Microsoft Visio, as well as information on how to run Microsoft Visio on a Macintosh with Parallels emulation software (2018b).

Although it is possible to use Macintosh desktop software to draw accounting documentation diagrams, neither practitioners (Bagranoff and Simkin, 2000; Eddolls, 2009) nor the accounting textbook authors analyzed in Table 2 favor these programs. For this reason, we focus our more detailed discussion of desktop software options for accounting documentation diagrams to those that are Windows-based. The next section addresses the commonly used professional diagramming software (Microsoft Visio, SmartDraw) and the drawing tools features of Microsoft Office applications (Excel, Word, PowerPoint) to produce accounting documentation. At the end of this detailed discussion, Table 3 presents a summary of the Windows-based desktop software options discussed in this section.

Professional Diagramming Software

According to Wikipedia (2018b), Visio originated in 1992 as a standalone software application created by Shapeware Corporation (renamed Visio Corporation in 1995) and Microsoft acquired it in 2000 when Microsoft made Visio part of Office software bundling. Visio, a full-featured diagramming and vector shapes software program, features professional-grade shapes organized into industry-recognized templates and stencils (Microsoft, 2018b). Visio includes database code generation, making it a useful tool for information systems developers needing CASE features for database design (Poolet, 2001; Callan, 2005). According to SmartDraw's marketing information (SmartDraw, 2018b) a Visio Professional 2016 installation includes approximately 4800+ built-in symbols and 100+ pre-installed templates.³ We observe that accounting professionals and educators commonly use the following Visio templates and stencils to meet accounting documentation needs: Organization Chart, Flowchart, Audit Diagram, Cross-Functional Flowchart, Business Process Modeling Notation, Data Flow Diagram, and Entity-Relationship Diagram (AISEC, 2013, 2014, 2015, 2016, 2017).

² Ideagen, PLC in the UK produces this flowcharting software and lists it with various spellings of its name on the company website (http://www.allclearsoftware.com) from "Allclear", "AllClear", and "allclear". We use "Allclear".

³ The SmartDraw webpage comparing SmartDraw to Visio capabilities (https://www.smartdraw.com/software/visioalternative.htm) reports this information. Microsoft's website, sales staff, and free technical support staff did not provide this information to the authors despite several communications.

As described on the Microsoft website (2018a), purchase of Microsoft Visio, an allpurpose diagram drawing and vector graphics software application, may be standalone (Visio Standard or Professional versions) or part of an online subscription with Microsoft Office365 (Visio Pro for Office 365). On some campuses, Visio is an additional application licensing agreement with the traditional Office applications (OneNote, Word, Excel, PowerPoint, Access, Outlook, and Skype for Business) typically available through Microsoft academic licensing contracts (Tom Oscanyan, University Software License Manager, personal communication to the author, July 10, 2016). One author's university installs Visio Professional in selected computer labs and on approved faculty/staff Windows computers. At this same university, selected departments partner with Microsoft's Imagine DreamSpark program that permits student access and downloading of Microsoft software (including Visio) during the academic term where the software is used as part of classroom instruction (Andrew Hafferman and Lisa Burke, University Faculty Support Staff, personal communication to the author, September 9, 2014).

SmartDraw emerged as a visual communication software competitor to Microsoft Visio around 1994, according to the company's website (SmartDraw, 2018a). SmartDraw software runs on Microsoft Windows platforms and their recent release of a SmartDraw Cloud works on any platform via web browsers (SmartDraw, 2018b). SmartDraw software, marketed as an easier diagramming solution than Visio, provides 34,000+ built-in symbols and 4,500+ pre-installed templates (SmartDraw, 2018b). As of late 2017, educators must request sales quotes for educational site licensing. SmartDraw software is "designed for ordinary computer users" (SmartDraw, 2018b) and focuses on providing professional charts, graphs, diagrams, and other visual communication solutions. Starting in 2017, SmartDraw provides both import and export of Visio files (SmartDraw, 2018b). SmartDraw has templates/shapes for Organization Charts, Flowcharts (Swimlanes, Document/System/Program Flowcharts, and BPMN) and Software Design (UML, data flow, and entity-relationship diagrams) that will meet the needs of most accounting documentation topics (SmartDraw, 2018b; see topic discussions in Borthick et al., 2010, DeVries and Lee, 2013, and Neely et al., 2015).

Microsoft Office Application Drawing Tools

Educators may find some of the actual shapes used in accounting documentation diagrams in the Shapes Drawing Tools within the Microsoft Office applications of Excel, Word, and PowerPoint (Simkin et al., 2015). This software solution may lend itself to leveraging existing university-installed software to support diagramming needs of accounting documentation topics. Based on our experiences, the manual drawing, sizing, and shaping of each shape can make it difficult for a documentation diagram to have uniform shapes and alignment.

Some accounting educators provide an instructor-developed set of shapes as a template for student use on assignments to address the concern of shape uniformity (for example, see the Borthick et al. (2010) or DeVries and Lee (2013) instructor solutions files). In our experience, the Office Drawing Tools also lack automated connecting lines between shapes, linked grouping of shapes, and quick alignment/spacing within diagrams; these are fundamental features of general purpose professional diagramming software like Visio (Microsoft, 2018b) or SmartDraw (2018b). Yet, some accounting faculty prefer to leverage the Office Drawing Tools to support dynamic PowerPoint animations of processes and to extend student expertise with the Excel application to avoid introducing another software tool into the instructional setting (Ronald Daigle, personal communication to author, June 22, 2016; DeVries and Lee, 2013). Table 3 summarizes the estimated costs of these Windows-based desktop software solutions for diagramming. Although some accounting educators may be able to use Windows-based desktop software such as Microsoft Office and Visio in campus computer classrooms and labs, other educators may not have such resources available or might wish to use other operating system-neutral drawing software. Additionally, these Microsoft solutions do not address both of our observed challenges of student preferences for simple point-and-click workflow and non-Windows personal computers for out-of-class work. As noted in an ITHAKA S+R report, "Today's students have largely grown up in a digital world. They know nothing else" (Bacow et al., 2012, p. 27), and we have found that this student population is interested in simpler software usage for many accounting tasks. For these reasons, we also examine the newly emerging cloud-based software options for developing accounting documentation diagrams in the next section of the paper.

Software Option	Estimated Cost	Key Features
Microsoft Visio 2016 ⁴	 -Individual \$300-590 or \$13-16 per month subscription -Academic Site License – get a quote -Microsoft Imagine DreamSpark annual subscription (free for student download of Visio to own computer, but only during specific class' academic term)⁵ 	-4800+ built-in symbols ⁶ -100+ pre-installed templates ⁷ -Collaboration with Sharepoint; OneDrive Visio Online Public Preview (not editing)
SmartDraw ⁸	 Upgrade from prior desktop version approximately \$99 Cloud \$10 per month Academic site license – get a quote 	-34,000+ built-in symbols -4,500+ pre-installed templates -Used by more than half Fortune 500 and over 250,000 public and private organizations worldwide -Imports and exports Visio diagrams
Microsoft Office Drawing Tools (Excel, Word, PowerPoint)	-No additional cost beyond site license or subscription to Office application(s)	-Can animate shapes in PowerPoint shows ⁹ -Can leverage student familiarity with Excel application and menus ¹⁰

Table 3: Summary of Windows Desktop Software Options for Diagrams

⁴ Material summarized from Microsoft webpages on Visio product (2018a, b).

⁵ Andrew Hafferman and Lisa Burke, University Faculty Support Staff, personal communication to the author, September 9, 2014.

⁶ Material provided by SmartDraw webpage (2018b).

⁷ Ibid.

⁸ Material summarized from SmartDraw webpages (2018a-f).

⁹ Ronald Daigle, personal communication to the author, June 22, 2016

¹⁰ DeVries and Lee (2013)

CLOUD-BASED SOFTWARE OPTIONS

Mobility of business activities, people, and computing devices has steadily increased with the growth of networking capabilities and increased consumer access to multiple computing devices such as smartphones, tablets, and laptops (Denning and Lewis, 2017; Meeker, 2017; Tysiac, 2014; Wallin, 2017). Software options for cross-platform use have expanded as well with the advent of web browser application solutions (Wikipedia, 2018a; Wallen, 2010). At the time of our investigation, educators might choose from three diagramming software options available through web browser access capable of producing accounting documentation diagrams: Gliffy Diagram, Lucidchart, and SmartDraw Cloud. This section briefly highlights these options and their features. Table 4 presents a summary of the cloud-based software options discussed in this section.

Gliffy Diagram

According to the company website, the company began in 2005 in California and "is the world's first net-native business graphics application" (Gliffy, Inc. 2018a). The company offers two products (Gliffy Diagram, Gliffy Project) and three paid and one free account plan options for Gliffy Diagram product (Gliffy, Inc. 2018d, e). Gliffy's customers include technology, software, banking and finance, Internet, Government, Open Source/Non-profit, academic, and other business organizations (Gliffy, Inc. 2018d). Gliffy Diagram relies upon HTML5 editor and a paid "business team" account plan (2+ users) is integrated with Google Drive (Gliffy, Inc. 2018e). Accounting professionals and educators can use Gliffy Diagram to produce flowcharts, network diagrams, floor plans, organization charts, SWOT analysis, Wireframe diagrams, Site Maps, UML diagrams, business process models, and Venn diagrams (Gliffy, Inc. 2018d). Certain UML 2.0 software design and Website/User Interface shapes are restricted to paid Business/Business Team account plans (Gliffy, Inc. 2018b).

All plan versions permit Visio importing and printing (Gliffy, Inc. 2018b). The free plan limits users to 5 public diagrams (no ability to make private after 14-day Free Trial to Business Edition expires), 2MB total size, and can only export Gliffy format files. The paid options permit graphics file exporting (PNG, JPG, and SVG in addition to Gliffy format). Accounting educators can obtain academic pricing by making an online request to the support division of Gliffy and receive a 50% discount for groups of 5+ users (Gliffy, Inc. 2018c). Table 4 provides other differences in capabilities and features by account plan.

Lucidchart

According to its main website, Lucid Software Inc. (2018a) provides two web-based software products: Lucidchart (for diagrams and flowcharts) and LucidPress (for print and digital materials). Further company information indicates the Lucidchart product originated in 2010 as a "flowchart maker", and reports that "over 10,000,000 users trust Lucidchart to keep them on the same page" (Lucid Software Inc., 2018a). Lucidchart relies on HTML5 (Lucid Software Inc., 2018c) making it compatible with all major web browsers (Chrome, Firefox, Safari, Opera, Internet Explorer) and capable of working on multiple operating systems (Windows, Macintosh, iOS, Android). Lucidchart supports multiple application integrations including Microsoft, Google, Atlassian, #slack, and cloud storage providers Box and Dropbox (Lucid Software Inc., 2018b). A *Linux Journal* article reports the software is "easy to use" (Powers, 2014).

As of August 2017, Lucidchart shape libraries (Lucid Software Inc., 2018c) include **Standard** (default: text, box, arrows, note; flowchart; geometric), **Software** (UML, Entity Relationship, User interface mockups, Android mockups, iOS mockups, site maps), **Business** (Data Flow, BPMN 2.0, Organization Charts, Value Stream, Tables), **Networking** (Tech Clipart, Cisco Network icons, AWS Architecture, Google Cloud Platform, Network Infrastructure, Server Rack Diagrams, Azure), **Visual Content** (User images, video), and **Other** (Venn Diagrams, Mind Mapping, Process Engineering, Circuit Diagrams, Floor Plans, Enterprise Integration, Equations). The free account plan (Lucid Software Inc., 2018d) permits the importing of Visio, Gliffy, OmniGraffle and Amazon Web Services (AWS) Architecture format documents for viewing only (no editing, exporting, or printing), allows diagrams with no more than 60 objects per diagram, and can download diagrams to common file formats (e.g., Adobe PDF, and graphics: PNG, JPEG, SVG, and PNG/SVG with transparent background).

Lucidchart premium (paid) accounts allow access to additional shape libraries; import, edit, and export Visio documents; enjoy unlimited shapes and documents; and have more dedicated online storage space (Lucid Software Inc., 2018d). Accounting educators may request a premium account from the Lucidchart Education Initiative group (Lucid Software Inc., 2018e). These free premium accounts provide full access to the same features available to paid Team accounts and include the Visio import/export capabilities. Table 4 provides a brief summary of feature differences by account plan.

SmartDraw Cloud

In 2016, SmartDraw began offering a version of its professional diagramming software with a monthly subscription rate billed annually (SmartDraw, 2018c). Current Windows SmartDraw owners can upgrade their desktop software to the current version and receive access for one year at no additional cost (SmartDraw, 2018e). A free trial version of SmartDraw Cloud is available for 7-days (SmartDraw, 2018c). The company is positioning this version of its software as compatible with all major web browsers (Chrome, Firefox, Opera, Safari, Internet Explorer); capable of working across any operating system platform (Windows, Mac, Android); integrates with Google Drive, Dropbox, and OneDrive; having "one-click export to Microsoft Office products, Pages for the Mac, and PDF" (SmartDraw, 2018c); and as a better online diagramming tool than Lucidchart and Visio (SmartDraw, 2018b, 2018d). Accounting educators may obtain an academic site license for the SmartDraw Cloud software by contacting the Sales staff for a quote (SmartDraw, 2018f). Table 4 summarizes the estimated costs for SmartDraw, Lucidchart, and Gliffy Diagram.

LUCIDCHART: AN ALTERNATIVE?

As highlighted earlier, accounting educators have various software tool options other than Microsoft Visio or Office Drawing Tools to support the accounting documentation topic. These options vary in cost as well as functionality. In Table 5, we summarize the Windows Desktop and Cloud-based software solutions according to our suggested criteria for educators to consider when choosing among different software tool solutions for teaching the accounting documentation topic. We additionally add some potential qualitative concerns for each software option with respect to using the software for accounting documentation tasks, based on the recruiting environments at our respective universities.

Software	Estimated Cost	Key Software Features
Option		
Gliffy	-Free Account (5 public-0 private	- Online support manual and
Diagram ¹¹	documents)	community
	-Standard (\$3.99/month-pay every	- All plans import Visio, Gliffy,
	3mos.; 200 private diagrams)	.gon, .gxml
	-Business (\$7.99/month- pay every 3	-Paid plans: Private diagrams, image
	mos.; Standard, +Unlimited diagrams,	export (SVG, JPG, PNG, Gliffy),
	UML/Wireframe shapes)	Revision history, custom shape
	-Business Team (\$4.99/month per 2+	libraries
	users; Business, +Google Drive,	
	private sharing, commenting tool)	
	-Academic Pricing – 50% discount	
	for groups (Standard \$12.38/month	
	for 5 users; ~\$120/yr)	
Lucidchart ¹²	-Free 7-day trial (Pro/Team features)	- Online help, videos, forums
	-Free (3 documents; 60 objects; 25	-All plans import Visio, Gliffy,
	MB)	OmniGraffle, AWS Architecture for
	- Free Higher Education Upgrade	viewing; paid plans can edit, print
	with Educational email address	-Download diagrams to PDF, PNG,
	(unlimited documents; unlimited	JPEG, SVG
	shapes; 1GB; Visio import/export;	-Collaboration (through chat,
	layers; backup & restore)	comments)
	-Basic/Personal (\$5.95/month;	-Integrated with Google Apps,
	Unlimited shapes, documents;	Google Drive, Confluence, JIRA,
	100MB; basic shapes)	Jive
	-Pro (\$9.95/month; Basic, +1GB,	-Paid/Team plans: Visio export;
	Visio export, All shape libraries,	Revision history, more shapes &
	presentation mode)	storage
	-Team (\$20/month; Pro +team	-Mobile/Tablet app for iOS
	management, 5GB, Confluence)	
	-Academic Free Team accounts;	
	contact sales	
SmartDraw	-Free 7-day trial (all features)	-Professional Industry Diagrams;
Online ¹³	-Cloud ~ \$10 per month	includes SmartDraw desktop shapes
	-Academic site license – quote	and templates
		-Visio diagram import and export
		-Collaboration possible
1	1	- integrated with UneDrive. Dropbox.

Table 4: Summary of Cloud-based Software Options for Diagrams

¹¹ Material summarized from Gliffy webpages (2018a-c). ¹² Material summarized from Lucidchart webpages (2018a-e).

¹³ Material summarized from SmartDraw webpages (2018a-f).

We observe that some institutions, colleges/schools, and accounting programs may be able to afford to license, install, and maintain Microsoft Visio or SmartDraw software on campus Windows computers or pay for subscriptions to SmartDraw Cloud for student and instructor usage. We also observe that some students may also be able to cover the costs of individual software license or subscriptions to these professional diagramming software tools for their own Windows computers. We also recognize that when educators wish to illustrate the creation of simple documentation diagrams, then the drawing tools embedded in Microsoft Office applications (e.g., Excel, Word, PowerPoint) or Gliffy Diagram might be adequate software solutions for teaching the accounting documentation topic.

However, there are situations when educators require additional diagramming functionality for more complex diagrams but find themselves working within institutional and student budget constraints as well as student workflow and non-Windows computing preferences. One of our institutions does not provide campus computer installations of Microsoft Visio, citing cost and support reasons. In our experience, we observe that students now have a broader array of computing devices available for completing accounting documentation assignments (e.g., Macintosh or Android computers and tablets) that may or may not have immediate access to Windows-based desktop diagramming software. We also observe that students may be unable (or unwilling) to use campus Windows computers to complete accounting documentation assignments on their own time outside of the classroom setting. We believe that in those instances, the cloud-based option of Lucidchart software merits serious consideration due to the following reasons:

- <u>Cost</u>: Free to Faculty and Students with educational email address (.edu)
- <u>Shape Functionality</u>: Breadth of shape library supports accounting documentation diagramming needs
- Platform functionality: Windows, Mac, Linux, Chromebook, tablets
- Visio functionality: Can import and export Visio format diagrams

We investigate the viability of Lucidchart software as an alternative software choice for accounting educators. In our industry recruiting environments, one concern is how professional does the diagram look when completed. For a visual comparison, Figures 1 and 2 show the same document flowchart prepared in Microsoft Visio and Lucidchart. We believe these diagrams show an equivalent representation of one author's University Course Registration process with an acceptable quality level of diagramming standards for document flowcharts that would meet our accounting recruiting environment requirements.

We further designed and executed a software evaluation study in our AIS classes to gather student and instructor assessment of the Lucidchart software experience. The remainder of this section reports student and instructor software evaluation results and concludes with our perspective of the pros and cons of using Lucidchart for the accounting documentation topic.

	ons		Lucidchart	Free – Academic	use			Free	(Higher Ed-	Unlimited;	Individual=5	documents)	Х	Х	Х	Х	Х	Х						
7 1 8 1 - 1 6 - 1	loud-based Soluti		Gliffy	50% discount	Academic	Group pricing	(quote)	Free	(5 documents)				most	Х	Х	Х	Х							
		SmartDraw	Cloud	Academic site	license available	(quote)		\$10 per month	subscription				Х	Х	Х	Х	Х	Х						Professional
	ktop Solutions		SmartDraw	Academic site	license available	(quote)			n/a				Х	Х			Х	Х						Professional
	WINDOWS Des	Microsoft	Visio	Academic site	license	available	(quote)	\$300 - \$590 or	\$13-16 per	month	subscription		Х	Х			n/a	n/a		Х				Professional
		Adoption Criteria to consider		Cost - University				Cost - Student					Documentation Diagram Shapes	Platform - Windows	Platform - Mac	Platform – Linux, Chromebook	Import Visio	Export Visio	Qualitative Concerns	Same as used by industry practice?	(company concern of workplace	readiness; see Bagranoff and	Simkin, 2000 and Eddolls, 2009)	Professional quality of diagrams ¹⁴

Table 5: Suggested Adoption Criteria for Accounting Documentation Software Options

Blank = indicates criteria is not met by the software $\frac{\text{Legend}}{\text{X} = \text{indicates criteria is met by the software}$

¹⁴ Based on a review of company websites (Microsoft, 2018b; SmartDraw, 2018a-f).





Figure 2: Sample document flowchart in Lucidchart





We administered a software evaluation study of Lucidchart in undergraduate AIS courses during summer 2016, fall 2016, and spring 2017 at two Midwestern universities, one public and one private. We identified four sections of the AIS course that use the same textbook by Simkin et al. (2015) as the target participant population for the software evaluation study. The Institutional Review Board (IRB) at each university reviewed and approved the consent form, data collection procedures and survey instrument for the inclusion of student subjects in the study. The expedited review approval required a non-coercive, voluntary study participation protocol as the principal investigators were also the instructors of the invited student subjects.

Protocol: Students first received instruction in documentation topics during one week of the course. Students also received instruction for using documentation software during one to two weeks of the course. Students then completed skills-based exercises using documentation software to create document flowcharts. University A students first used Visio, then used Lucidchart. University B students used Lucidchart.

Each principal investigator prepared a four-minute video inviting students (at the other institution) to participate in the research study. According to the IRB-approved protocol, each instructor started the invitation video for the class and left the room while the video was playing. Each instructor created a link to the combined online consent statement and anonymous survey instrument within the course's learning management system. The survey instrument collected demographic and computing background, participant self-assessment of accounting documentation knowledge and accounting documentation software skills, and participant evaluation of the Lucidchart software experience. The Qualtrics-delivered survey instrument took less than ten minutes to complete.

Data Collection: We invited ninety-six students to participate in the study. In order to comply fully with University IRB requirements to minimize coercive pressure for participation in the study, we did not offer extra credit or other incentives for participating in the survey. Thirty-eight students consented to participate but only thirty-four students both consented to participate and fully-completed the anonymous survey instrument, resulting in a 35% response rate that is within the norm for online surveys (dataSpring Editors, 2017).

Results - Participants: We statistically tested the collected data for section effects and did not find any. We present results for the full dataset. Participants were predominantly female (65%), senior-level class standing (88%), and were between 20-23 years (85%) which is representative of course enrollment during the study time period. All participants designated "Accounting" as their educational specialization area and indicated ownership of a computer. Participants rated prior computing experiences as positive (97%) with only one respondent choosing neutral. A majority of participants indicated using a Windows computer to complete coursework (65%).

As a manipulation check for the software evaluation study protocol, the survey asked participants to provide a self-assessment of accounting documentation knowledge and accounting documentation software skills. Participants indicated knowledge of <u>how to draw</u> <u>documentation diagrams</u> (88%=yes) and knowledge of <u>how to use software to draw</u> <u>documentation diagrams</u> (91%=yes). Table 6 presents descriptive statistics for the participant self-assessment of accounting documentation knowledge and accounting documentation software skills.

I know how to	University A	University B	Total
draw documentation diagrams, like flowcharts, data			
models, process models			
Yes	13 (93%)	17 (85%)	30 (88%)
No	1 (7%)	3 (15%)	4 (12%)
use software to draw documentation diagrams, like			
flowcharts, data models, process models			
Yes	14 (100%)	17 (85%)	31 (91%)
No	0 (0%)	3 (15%)	3 (9%)

Table 6 Descriptive Statistics - Participant Self-Assessment of Knowledge and Skills

Results – Software evaluation: The student assessment of the Lucidchart software experience consisted of five questions related to student experiences with the software. A five-point Likert scale was used with 1 = Strongly Agree, 2 = Somewhat Agree, 3 = Neither Agree nor Disagree, 4 = Somewhat Disagree, and 5 = Strongly Disagree. Responses were reverse-coded for analysis purposes so that higher numbers reflected agreement rather than disagreement with the statements. A one-sample t-test of mean differences from neutral (value = 3) was performed on the recoded data.¹⁴

The significant p-values reported in Table 7 suggest that students enjoyed using the software (91% agree), found it effective in learning accounting documentation skills (88% agree), thought it helped apply accounting documentation knowledge and skills (85% agree), and believe the software should continue to be used in the AIS course (88% agree). Additionally, students reported disagreement that the Lucidchart software experience was frustrating (59% disagreement). The assessment survey also asked students to provide qualitative comments to two questions: (1) what was the best part of your experience using Lucidchart? and (2) what was the worst part of your experience using Lucidchart? Table 8 lists representative experience comments from twenty-eight students.

Test of mean differences from neutral (value = 3)		
	(n=34)	
Statement	Mean / (SD)	p-value
1. I enjoyed using Lucidchart to complete my	4.18	<.001
documentation assignment.	(.58)	
2. I was frustrated using Lucidchart to complete my	2.47	<.01
documentation assignment.	(1.05)	
3. I found Lucidchart software to be an effective tool to	4.29	<.001
learn accounting documentation skills.	(.68)	
4. Using Lucidchart software helped me apply my	4.12	<.001
accounting documentation knowledge and skills.	(.73)	
5. Lucidchart software should continue to be used in	4.38	<.001
this course.	(.78)	

Table 7 Results of student assessment survey

¹⁴ The use of non-parametric tests does not produce qualitatively different results.

What was the best part of your experience	What was the worst part of your
using Lucidchart?	experience using Lucidchart?
"The ease of login with the cloud from any	"It was sometimes difficult to make the
computer."	program do what you wanted."
"It was available on Mac."	"Funky line movement and trouble perfecting
"It was easily accessible outside of the	where lines originated from."
classroom unlike Visio."	"Touchy."
	"Sometimes the program would be glitchy,
	freeze up, since it was through the online
	server."
"It had the labels for all of the shapes that	"The program was slow"
were used."	
"Not having to plead with buttons to go where	"It is much more difficult to use on a
they needed to."	computer without a mouse – harder to place
"It was user friendly"	things and draw lines"
"easiness and user friendliness."	
"Easiness and very intuitive (drag and drop) –	
design friendly interface."	
" Lot of directions on how to use it to help	
outside of class."	
"saved as you went along, so you didn't	"Lucidchart is user-friendly, it just takes time
lose anything."	like any program to get used to it."
"The program made the charts clean and	"Adding in swim lanes or doing advanced
organized."	things that can seem easier in Visio."
"It was easier than Visio."	"Some of my text would disappear because of
"It was simple and faster than with Visio."	my browser."
"Some tasks were easier to do in Lucidchart	
rather than Visio."	
"Additionally, I liked that it was an online	"Learning a new system."
software that could be utilized to be converted	
to Visio. Therefore, if I was at a Client and	
didn't have access to Visio, I could just use	
Lucidchart and convert to Visio later on."	

Table 8 Representative Anonymous Student Qualitative Comments

Lucidchart: Instructor assessment

At University A, the introduction and optional usage of Lucidchart as a Visio alternative has eased instructional issues for students who do not have personal access to Visio software to complete their assignments. The availability of the Lucidchart option at University A provides students with the ability to complete AIS course assignments on their own terms outside of the Windows-based, Visio-installed computing classroom. When using Lucidchart during class, students frequently comment on its ease-of-use. At University A, a required flowcharting assignment gave students the option to complete the final diagram with either Visio or Lucidchart. During this study, 24% of the students chose to complete the assignment with Lucidchart instead of Visio, despite the fact that students completed the initial draft assignment with Visio. From an instructor's perspective, the Lucidchart option for accounting documentation exercises allows a change to the use of in-class sessions.

Previously, University A dedicated approximately ten instructional hours (over three chronological weeks) to in-class Visio exercises for accounting documentation topics. This time accommodation was necessary as this University's students are reluctant to use University computer labs outside of class to complete required documentation assignments. By using the cloud-based Lucidchart option, University A reduced in-class documentation exercise time to approximately three and one-third hours (one week) and uses the regained in-class session time to explore emerging AIS topics (e.g., cybersecurity, blockchain, analytics, and machine learning).

Since implementing this project in University B's AIS course, students have demonstrated a clear improvement in not only the understanding of accounting documentation, but also the ability to create clear, professional accounting documentation with documentation software. An informal analysis of grades from flowcharting assignments before and after implementation of Lucidchart shows an increase in average grade from around 78-80% before Lucidchart to 86-96% after implementation. Additional observed effects include student voluntary usage of Lucidchart in other courses (such as Audit) and student leveraging of Lucidchart software skills for internship placement. For example, one student has used Lucidchart to create accounting documentation for all the audit processes in training manuals for the State of Michigan banking audit division.

LUCIDCHART: OUR SUMMARY OF THE PROS AND CONS OF ITS USAGE

We have shared the results of a formal software evaluation of Lucidchart as a potential alternative software tool for accounting educator usage when teaching the accounting documentation topic. Additionally, we have four years of teaching experience using Lucidchart software in support of the accounting documentation topic. One of the authors has over thirty-five years of experience using professional diagramming software for systems design, development, and documentation tasks.¹⁵ We regularly live the experience of teaching <u>with</u> technology and desire to share what we have learned on this journey with other accounting educators.

We recognize that each accounting educator faces different requirements for student software skills that are unique to his/her institution, accounting employment environment, and student population, among other factors noted by prior research (Badua et al., 2011; Bain et al., 2002; Borthick, 1996). We also recognize that some accounting educators do not need to consider software alternatives to Microsoft Visio or Office drawing tools. However, in those circumstances when accounting educators need to look beyond Microsoft Visio or Office drawing tools, we believe Lucidchart software merits consideration as a software tool choice. The remainder of this section summarizes our sense of the pros and cons of choosing to use Lucidchart software for accounting documentation diagrams, based on our formal and informal evaluation of the software.

On the Pro side:

- 1. **Price**: The Lucidchart Company provides a free academic version available to students while they are still using their.edu emails.
- 2. Academic Availability: The Lucidchart Company responds quickly to the request for academic accounts and renews that availability on an annual basis.

¹⁵ The thirty-five years includes twenty-four years of university teaching experience integrating technology use in classroom instruction.

- 3. **Microsoft Visio Compatibility**: The Lucidchart software can import Microsoft Visio documents, as well as export Microsoft Visio documents. This feature could allow a staff member of a larger public accounting firm an ability to prepare accounting documentation when firm software or computing resources are not readily available.
- 4. **Platform and Operating System Neutral**: Since Lucidchart is a cloud application available via web browser, students can access the program from their desktop or laptop computers, tablets, or even smartphones. A Windows computer device is not required to use the software.
- 5. **Long-term Accessibility**: The cloud application available via web browser allows students the ability to access the software (and diagrams) when outside of a computer classroom or lab setting. Further, students can continue accessing the software after graduation from college/university as a personal and professional resource.

On the Con side:

- 1. **Sporadic slow performance**: Since Lucidchart software is located in the cloud, it is subject to network connection issues, such as sporadic outages or speed fluctuations. This can be frustrating for students who must wait for the cloud diagramming service in order to finish diagramming tasks.
- 2. **Interface changes**: Due to the cloud-nature of the software product, the Lucidchart interface can change quickly as the company rolls out enhancements to the product. As with any software product that makes changes to the interface, it can cause students and instructors additional time to relearn where functions are located.
- 3. Workplace readiness: Lucidchart is not Microsoft Visio. If employers require specific Microsoft Visio skills, then students with Lucidchart expertise (although producing similar diagrams) may be at a disadvantage for employment (Bagranoff and Simkin, 2000; Eddolls, 2009).

Based on our experience, and our formal and informal evaluation of Lucidchart use, we recommend that accounting educators consider Lucidchart as a viable alternative software tool in support of the accounting documentation topic.

LIMITATIONS

There are two limitations related to our formal evaluation of Lucidchart software for accounting educator usage. First, there is a potential for non-response bias in our sample. As recommended by Grover et al. (1993) we compared response patterns of late and early respondents. We found no differences. Second, as University A students received exposure to Visio, then Lucidchart, there is some possibility of bias present in their software evaluation responses to Lucidchart. However, if such bias was present, we would have expected that University and section effects would have manifested in the feedback responses. There were no such differences in the data. Thus, we are confident that our software evaluation response data is a reasonable sample of the target population of typical accounting undergraduate students enrolled in an AIS course covering accounting documentation topics and software skills.

CONCLUSION

Accounting educators face challenges when using any software in support of accounting topics (Badua et al., 2011; Neely et al., 2015). This paper provides a resource for accounting documentation software, as well as an initial assessment of Lucidchart as a potential cross-platform alternative software tool solution for accounting documentation diagrams. We hope that accounting educators find our analysis useful in making choices about software use to support the development of accounting documentation diagrams.

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