

Original Research Paper

The Development of Digital Accounting System on Cloud Computing

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Abstract: It is crucial for business organizations to be competitive in this rapid change and intense market. Therefore, technology is an inevitable factor for business operations to maintain their competitiveness, especially when information plays a very important role in management decision. Accounting software is an important tool for management to efficiently gather information in time of making decisions, determine business strategy and response quickly to the market. However, accounting software available in the market is costly which means small businesses will most likely not be able to afford it. Therefore, the purpose of this research is to develop a digital accounting system that processes and stores accounting database on a cloud system. This development is an alternative option for all kinds of businesses--SMEs to big firms--to be able to access and use an online digital accounting system on a cloud-computing service (hereafter, "DAC"). The authors used the Waterfall development model through the requirements, analysis, design, implementation, testing and maintenance as the method of developing this accounting application. This research has gathered information from users (SMEs), professors, lecturers, teachers and accounting instructors as a focus group. PHP language was used to develop the system and MySQL was used to store the database. The analytical and system design instruments are Use Case Diagram, Algorithm, Flowchart and ER-Diagram. After SMEs and other businesses had free access and used the developed DAC, they experienced time savings and achieved greater accuracy of accounting entries when compared with manual accounting systems. It was also found that when compared with other accounting software's available in the market as of now, DAC costs less while offering the benefits of financial planning to its users. Therefore, DAC may become a new route of all kinds of businesses to achieve their goal or at least maintain their competitiveness in the market.

Keywords: Digital Accounting, Algorithm, Cloud Computing, Software Development

Introduction

In the past, accountants recorded accounting transactions manually (manual accounting systems) which resulted in frequently found errors and delayed information. Therefore, manually recorded accounting information may not be relevant for managers' effective decision-making. To increase market competitiveness and efficiency of business, managers have to rely on information technology by implementing their own accounting systems or obtaining accounting software to

replace a manual accounting system. By using a computer system and accounting software, managers will have information technology as a tool to get timely, accurate and reliable accounting information to efficiently make economic decisions (Hongchai, 2011).

Accounting software is an important part of accounting information system processes by computer. Accounting software is used to process the accounting transactions received and generate financial reports which will be used by managers and related parties. Accounting software is beneficial to managers because it offers timely

accounting information such as the company's financial position and its performance. Moreover, it is convenient since the managers are able to access the accounting information when it is needed, along with having greater accuracy in the accounting process.

During Thailand's 4.0 period, digital technology has been one of the most important accounting tools. Accountants must improve themselves in response to changes in technology. Accountants are forced to develop and integrate all skills, knowledge and attitude. As innovation and new technology are so important, accountants should be able to use new technology to apply to accounting (Maneewong, 2020).

One cannot deny the importance of the use of computers in accounting. In order for businesses to be successful, it is necessary to have computer software that is efficient and meets the need required by the business. Aphiwatpisan (2012), suggested three ways to obtain accounting software for the organization which includes: (1) The business develops its own accounting software. (2) The business purchases accounting software readily available in the market. (3) The business outsources its accounting needs. However, Malaiwong (2004, p.14) pointed out that many businesses which had developed their accounting software internally often had problems due to the rapid change in technology and the staff being unable to keep up with these multitude of changes. Malaiwong also found that businesses eventually replaced manual accounting systems with accounting software because companies providing the accounting software had strong, dedicated and up-to- standard teams; and were willing to spend time and resources to work with the rapid changes in technology.

Bishop (2018) had a study about the problems of developing accounting software for SME and unsuccessful implementation of accounting packages. He found that the inappropriate and improper management of the package installation and configuration process will result in accounting software does not work properly which leads to the failure of meeting the business strategic goal. Although he proposed model PRINCE2 (Projects in Controlled Environments as a project-management framework for application by SMEs during the implementation of new accounting software) for developing the accounting software in his research, the program has not been developed.

As we can see from the evidence in researches that the business world has changed toward technology like cloud computing. More and more organization adopted the cloud technology such as in healthcare sector using cloud service with e-device, government sector using cloud service with taxation application, Marketing sector using cloud service with customer related data and analysis and education sector using cloud service in classroom (Holtzblatt and Tschakert., (2011), Galla and Gnanavardhan, (2014), Gavrilović and Maksimović., (2019) and Suprianto *et al.* (2021). As also mentioned

above, acquiring an accounting system for the business costs money and other resources. Since small businesses have limited resources and knowledge of information technology, the benefit of information management and accessibility offered by digital accounting using cloud computing, has made it possible for business to work more efficiently and effectively. Therefore, the authors have the following research objectives:

1. To design algorithm in digital accounting on cloud computing services
2. To design database relationship in digital accounting on cloud computing services
3. To develop digital accounting as a software package on cloud computing services, as an alternative option for business

The result from this research is DAC which was tested and used by SMEs. The DAC helps SMEs in term of timely information and little costs associate with it. The users can also work simultaneously throughout the accounting process. The process of developing DAC and how it easily implements in the organization with friendly interface for the users will be elaborate throughout the paper.

Literature Review and Relative Work

Digital Accounting System

The development of a digital accounting system on cloud computing is the development of a new platform of accounting software without having the software installed on a local computer (Shumeyko *et al.*, 2019; Genete and Tugui, 2008). An authorized person can access accounting information on a cloud system through any web browser and without any special software development skills. The accounting information is stored on a secure server with 24/7, readily available information, online.

Accounting Literature

Accounting records can be traced back to the Sumerians in Mesopotamia. In the beginning, the information included records of agricultural products and their value. Not until Pacioli described double-entry bookkeeping in his "Summa de Arithmetica, Geometria, Proportioni et Proportionalita" back in 1494, was double-entry bookkeeping introduced in Italy. Since then, double-entry-bookkeeping, which was based on an algebraic concept, has been accepted as generally accepted accounting principles. Double-entry-bookkeeping is the concept that algebraic manipulations on the left-hand (or so-called "Debit or Dr.") and right-hand ("Credit or Cr.") sides of an equal sign had to "balance." The accounting equation, known as "Assets = Liabilities + Equity" is an error detection tool. If, at any point, the sum of debits for

all accounts does not equal the corresponding sum of credits for all accounts, an error has occurred (Parker, 1989). In addition, revenue and expenses are sub-categories of equity (Elmaleh and Willis, 2005). The account analysis according to double entry bookkeeping shows in Table 1.

The evolution of accounting has continued with the development of technology, economics and society. There are accounting theories and concepts introduced to the business world, such as those of time period, going concern and monetary unit. Therefore, preparing the accounting report has recently become more complicated. The accounting cycle is a process designed to make the financial accounting of business activities easier for business owners. There are ten steps in accounting cycle (Wild *et al.*, 2009) however, after combined some steps using work sheet, only eight steps are shown in Fig. 1.

As mentioned above, all businesses start with step 1 and work through the accounting process. The final results show as financial statements which report the accounting information used in making economic decisions.

The accounting system design using cloud computing is complicated because the system is designed to support all kinds of businesses and at the same time, it has to efficiently work for each organization. The researchers started with designing a MySQL database and eventually put it on a cloud system.

Cloud Computing Service

A cloud computing service works in the same way that

a service provider will render services (sharing resources) with users through the internet. Cloud computing is the development of a concept which is upscale from virtualization and web services. It does not require the users to necessarily have technical knowledge of the work process. There are varieties of applications and services on cloud computing as shown in Fig. 2.

Types of cloud computing services are as follows:

1. Software as a Service (SaaS) renders processing services of applications on the service provider's host computer and other software services. This research's objective is to develop the provision of SaaS accounting software for free through a cloud computing service
2. Platform as a Service (PaaS) renders the processor that integrates with an operating system and application- support services
3. Infrastructure as a Service (IaaS) renders specifically the infrastructure services which are useful in case of complicated processing data

Table 1: Double-entry-bookkeeping, source: (Elmaleh and Willis, 2005)

Account categories	Increase	Decrease
Assets	Debit	Credit
Liabilities	Credit	Debit
Owner's equity	Credit	Debit
Revenue	Credit	Debit
Expenses	Debit	Credit

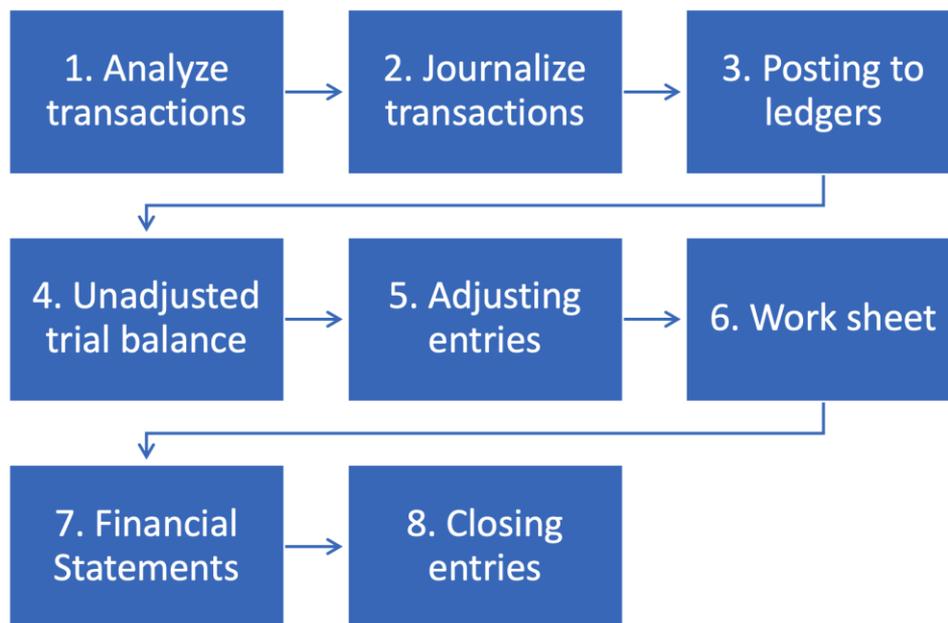


Fig. 1: The accounting cycle, (Source: Wild *et al.*, 2009)

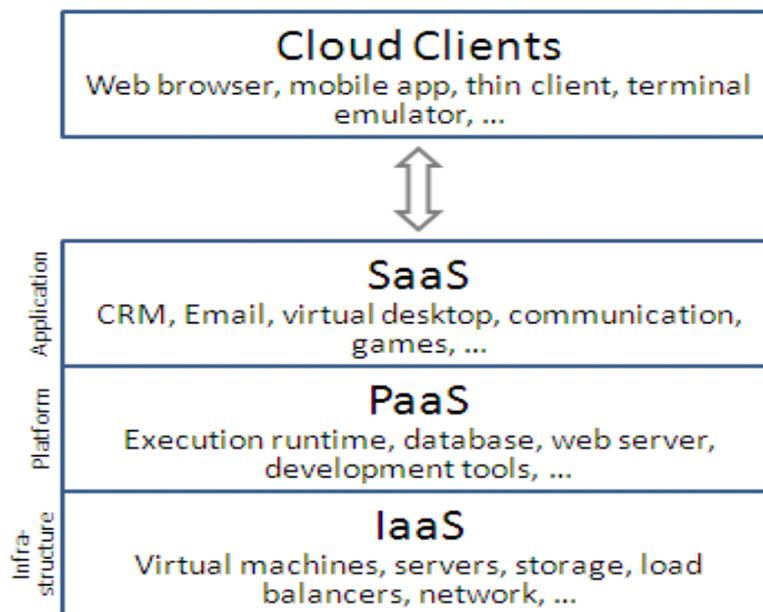


Fig. 2: Service-type Cloud computing, Source: Jim (2016)

Relative Works

Mahanam and Ari (2015) had categorized eight main factors against the cost effectiveness of using the program in the research topic “Problems of Using the Accounting Software Packages for Small and Medium Enterprises (SMEs).” The eight main factors categorized against the cost effectiveness of using the program, including posting methods, audit trials, ledgers and journals, data flow among modules, internal control, reporting capabilities, user documentation and support and ease of use and flexibility. They used a questionnaire to collect the data of 400 cases as sample. The data collected were processed using statistical software for an analysis of average and percentage. The study found that most used accounting software packages were Express, BC Account and Easy Account, for accounting entries and financial reports. It was also found that most SMEs had no problems with posting methods, audit trials, ledgers and journals, data flow among modules, internal control, reporting capabilities, user documentation and support and ease of use and flexibility. These are concerning the eight categorized factors of problems in using an accounting software package. However, there are other problems, including personnel problems, because some employees have no knowledge skills about the program, hardware or computer. Sometimes, hardware or computer problems and related equipment may be outdated, unqualified, or insufficient for the accounting tasks. Sometimes there are problems with information that is often changed without permission from the authorities. There are several suggestions from the study as follows: Suppliers of accounting software packages should advise their customers

about having computer applications that will be compatible with the specific account software package. The suppliers should provide accounting software training to the users and provide assistance in a timely manner. In turn, the buyers should update their computers and related equipment to the required levels so that they always work smoothly with the software and generate reporting as per the expected quality.

Moreover, the research purpose of that study was to enhance accounting efficiency and effectiveness by using software packages for tracking village and urban community funds of municipal areas in Chiang Khong District, Chiang Rai Province. Rattanaprayoon (2017) was to examine the accounting efficiency and effectiveness by using a software package for the village fund. After the sampling group, consisting of 16 village funds, used an accounting software package, questionnaires and interview techniques were used to compare between manual and software-bases preparations of accounting reports. Rattanaprayoon (2017) used a t-test to test hypotheses in regard to four domains of use: System capacity, system reliability, efficiency and effectiveness of the fund’s accounting software package and efficiency in achieving objectives. The result was that an accounting software package proved more efficient and effective than doing it manually. However, only 10 village and urban community funds actually implemented the accounting software, so the researcher had additional questionnaires on the satisfaction of the services from the fund and quality of the program. The hypothesis was supported that the village funds committee had greater satisfaction with automated accounting software packages than manual

accounting. This was a consequence of the ease of the system, the automation accounting process working adequately and the satisfaction of users' needs. The software package could rapidly and automatically calculate loans, debt collection and savings without errors, which resulted in saving time and resources. The results on the quality of the accounting software package indicated that the village funds' committee members had a high level of satisfaction and the members of the village funds also expressed high levels of satisfaction towards the services of village funds management.

Furthermore, Aphiwatpisan (2012) found that accounting software programs helped SMEs to efficiently operate their business. Besides reducing errors and paper usage, it correctly produced timely accounting reports under generally accepted accounting principles. In-house development, purchasing a software package and outsourcing are ways to obtain accounting software programs. Using accounting software programs allows SMEs to obtain reliable and correct accounting information. Accounting software programs also make it easy and quick to keep track of data for tax documents. To select an accounting software package, SMEs should focus on five items, which are: People, system development tools, value on investment, reliable developers and software quality. SMEs should also consider accounting software packages with caution by not over-focusing on prices and not obtaining accounting software that is over-qualified for the company. Currently, since accounting software is moving toward web-based systems, SMEs should obtain accounting software that matches with the company's capabilities. Without carefully considering these factors, such a venture could lead to business failure.

Dongdara (2015) studied 370 SMEs in Nakorn Ratchasima as a sample group in the study of "the key factors affecting the selection accounting software package of business firms in Muang district, Nakorn Ratchasima province", using frequency, percentage, standard deviation and variance (One-Way ANOVA) to test their hypothesis at the significant level of 0.05. The research found that important factors associated with selecting accounting software package for SMEs were quality of the software package, costs, access and portability, after-sales service support, flexibility and reliability of supplier/producer of the software, respectively. A top management executive is the one who makes decisions in selecting the accounting software package. Most firms opt to choose the Express software program. An accounts payable module, accounts receivable module and ledger module were used by the sample group. After their purchases, use problems existed such as in no after-sales service, or the after-sales service that did not match with the firms' needs. At a significant level of 0.05, SMEs at different locations, the lengths of

operational periods and varying sales indicated differences among seven main factors of selecting accounting software. These levels included of the reliability of the software and its producer/seller, how the software works, systems security, after-sales service/support, product price and cost of acquiring the product, the performance limit and other qualifications provided by the software.

This research's results conform to the research study of "factors affecting the intention in using the EXPRESS program of accountants in higher education by Maneewong (2020). The result found that the Express system program is responded well to the needs of users in providing efficient accounting reports following the accepted accounting principles. The issue worth considering is whether the difficulty level of using the program had an impact on the decision to use it. Looking at the level of intention to use Express accounting program, the research found that the overall intention was at the highest level, also it was at the highest level in each aspect. Considering the factors of data quality perception, system quality perception in the users' experiences and perception of the ease in using the program; all positively affected the perception of benefits in the use and the ease of use, of software. All these factors positively affected the users' attitudes toward the program. In addition, the norms of the reference group would have a positive effect on the intention of using the program and toward program usage behavior, respectively.

From all the past literature on this topic, it was found that the advance of information technology enables firms to use information technology, especially in accounting information systems. However, accountants must improve their accounting information system and computer skills since accounting information comes in the form of computer technology information. With skills in computer technology information, organizations can reap the benefits such as saving time and costs while working more efficiently and effectively. Moreover, using digital accounting systems was an effective use of paper, or even when pursuing a paperless function. Industrial companies may efficiently exchange electronic information among related departments (Ghasemi *et al.*, 2011). With that said, there is a gap in the literature in that there is no research study and development of accounting software packages with cloud computing, which are systems that are rapidly accessible and demonstrate high security for information access. As a result, the developing of digital accounting system on cloud computing is necessary and sheds new light on the research conversation.

Research Methods

This is an applied research study which develops an accounting system on cloud system, with its implementation following information development principles (Chanthinok and Jantrarachaturapat, 2020). It uses an accounting digital development framework which

is considered innovation digital accounting (Lehner *et al.*, 2019) as in Fig. 3. The research field of digital accounting is interdisciplinary, as it includes the digital (information) technology and accounting knowledge disciplines.

Digital Accounting Development Process

The waterfall model was used in the Software Development Life Cycle (SDLC). The waterfall model includes requirement phase, analysis phase, design phase, implementation phase, testing phase and system maintenance phase, used in the system development (Supardianto *et al.*, 2021):

1. Requirement Phase

In this phase, users' needs and requirements of accounting software are gathered as a source of information. Since our research has the users from SMEs as focus groups, we specifically use their needs and requirement as the first source of information. However, because accounting process is very specific and has many steps and details, we also went to accounting specialist for help in providing the accurately, reliable and relevant information. As a result, we interview three specialists in accounting systems to ensure that we will have accurate and efficient of analysis and design of the DAC.

2. Analysis Phase

System analysis is actualized by observing and studying literature on accounting theory, accounting book and financial reports. After conducting a literature review, the authors found that there are problems in manual accounting process such as the calculation in each step take long time and may be inaccurate due to human errors. With the development of DAC, the financial reports can be prepared rapidly and more accurately.

3. Design Phase

The process of system design of accounting software on cloud computing includes ER-diagram, flowchart, algorithm for data flow account, database relationship, data dictionary and designing the interface of the program.

4. Implementation Phase

System implement process includes create MySQL database, develop application based on system designs stage. This application program was coded using Adobe Dreamweaver 2020 version 20.2 software with the PHP programming language, FileZilla and Putty File software to upload application on the cloud service.

5. Testing Phase

Functional testing was the first step in software testing of each module. The test was whether it was running

currently follow system design state or not. Testing was using black-box solution focuses on algorithm, functionality and to minimize or zero of errors and make sure the resulting output is accurate.

6. Maintenance Phase

System maintenance under the supervision of an accounting system analyst who is readily available to modify various programs in case any changes occur or even fix the errors of the program that may occur.

The following demonstrates the framework of the research topic and the development of information systems (Specific Function). The development of DAC according to double- entry bookkeeping is as follows:

1. Initial configuration
 - a. User information/SME
 - b. Set a new accounting period
 - c. Assign accounting categories
 - d. Assign chart of accounts
 - e. Record balance carried at the beginning of the period
2. Assets register
3. Journalizing each accounting transaction (adding each account)
 - a. Revenue
 - b. Expenses
 - c. Capital
 - d. Other transactions
4. Records show in general journal (recheck and correct the records)
5. Financial reports
 - a. Statement of financial position
 - b. Income statement

Business owners can register and access DAC 24 h a day (24/7) without inconvenience of developing their own software.



Fig. 3: Perspective on Research in Digital Accounting, Source: (Lehner *et al.*, 2019)

Research Materials

PHP Programming

PHP is the abbreviation of PHP Hypertext Preprocessor. It is script language that works as server-side script. The working process functions as an interpreter program which interprets the language every time a script is called. The benefit of PHP Programming is that there is no compiler when starting a new work, or when a new version of the program is saved over the old when updating the program. The drawback of the program is that any syntax error will only be discovered when the user has found a bug. PHP is web-based programming because all codes or scripts are kept on a web server only (Lerdorf *et al.*, 2006). The clients use the program and have all data on their screen through web browsers such as Internet Explorer, Mozilla Firefox, Google Chrome, Opera and Safari.

Therefore, PHP is an appropriate language to create a website with a database, or a website with data that often changes. PHP helps to create an easily managed system by writing the files management program with the PHP's database.

MySQL Database

MySQL is a Relational Database Management System (RDBMS) that is currently used on the internet. The popularity of MySQL comes from the fact that it is highly efficient free software and therefore a new option for database management products in the oligopoly market. Database developers who have used MySQL have positive views on the ability, speed, ability to support users employing a large bulk of information and the support of many operating systems such as Unix, OS/2, Mac OS and Windows. Moreover, MySQL works with many web development platforms, such as, C, C++, Java, Perl, PHP, Python and ASP. As a result, it is not surprising that MySQL has recently become very popular and will tend to have greater popularity in the future (Williams and Lane, 2004).

MySQL is open-source software and its original source code can be downloaded for free on the internet and it is possible to revise. MySQL holds a GPL (GNU General Public License). MySQL Database works in multi-thread mode, which means that it separately works simultaneously with many users who do not have to wait for others. This benefits the users in working faster operation and works independently. It also works with one or more CPUs such as: (1) It works with programming or script in more than one language; and is especially very good with PHP. (2) Also, it works with big databases up to 60,000 Table. (3) Lastly, it works with many different kinds of data types.

ER-Diagram

ER-diagram is a model used to describe the database structure in the form of a picture. The relationship

between structure and data can be explained as follows:

- 1) "Entity" is the object of interest in the system
- 2) "Attribute" is the feature of the object of interest
- 3) "Relationship" is the relationship between entities

An ER Diagram is important for developing an application's database that wants to systematically and structurally store data. Therefore, an ER Diagram is the document that is used as a universal communication tool, preventing miscommunication between a system designer and developer (Ordóñez *et al.*, 2020).

Flowchart

A flowchart is an image or symbol showing steps, explanations, statements, or words in an algorithm. A flowchart is used as a means to communicate between related parties, so they can better understand without the use of words. A flowchart is a tool to show steps and work procedures by using standardized symbols. A symbol can have a short statement describing needed data, results, or order for processing data in each step; and it connects all the steps together with an arrow line pointing the direction of the workflow from the beginning to the end (Ensmenger, 2016). There are two types of flowcharts as follows:

1. A System Flowchart shows working steps in the system, but not the details in sub-working steps
2. A Program Flowchart shows each working step in the program from receiving the data, calculation and finally the results.

Results and Discussion

After interviewing professionals who prepare accounting reports, the researcher analyzed the basic functions of creating digital accounting software with cloud computing.

Figure 4 shows the overview of digital accounting system on cloud computing service. The user can access the DAC system from any smart devices such as mobile phone, tablet, computer pc, or even computer notebook that has internet connection. Whereas Fig. 5 shows the Use Case Diagram, functional and user environment of the system.

Figure 6 shows that the design of an ER-Diagram must have the information of Company entity (com id key) on every entity to connect an accounting information system to the cloud system and enable it to separate the information of each business owner. After the business owner has registered as a member in order to access DAC, the system will generate a unique com id (Primary Key) and cite the information to every table in the MySQL (Foreign Key). Both data dictionary and complete ER-Diagram are elaborated in Fig. 9 located

in Appendix section.

Algorithm of assets registration and the computation of their depreciation calculated monthly and annually for users' usage

```
1. Input asset_price, start_date, asset_age,
   asset_salvage, cal_type, ComID
2. sal_year = (asset_price - asset_salvage) / asset_age
3. stop_date = start_date + asset_age
4. if (cal_type == "2") { //annual calculation
5.     for (y = start_year; y <= year(stop_date); y++) {
6.         sal_year_value = sal_year
7.         Insert into GL database
8.     } //end for
9. } else if (cal_type == "1") { //monthly calculation
10. stop_date = dateAdd("yyyy", asset_age, start_date)
11. Max_loop_month = (asset_age * 12)
12. for (m = 1; m <= Max_loop_month; m++) {
13.     sal_month =
14.     (sal_year * dofmonth) / fix_day_of_year
15.     Insert Into GL database
16. } //end for
16. } //end if //cal_type=2
```

Algorithm of chart of designated account follows double-entry bookkeeping

```
1. Input TransactionName, GroupName, ComID
2. Input AccID, AccName of Dr.
3. Input AccID, AccName of Cr.
4. Insert Into Item Master Database
```

Algorithm of the beginning balance recorded

```
1. If Not End of set Beginning balance {
2.   For Input Balance Loop {
3.     Input AccID, ComID, Balance of Dr., Balance of Cr.
4.   } //end for
5. } else {
6.   Chk_sum_Dr = Chk_Sum_balance("Dr", ComID)
7.   Chk_sum_Cr = Chk_Sum_balance("Cr", ComID)
8.   If (Chk_sum_Dr != Chk_sum_Cr) {
9.     AlertMessage("Balance is not match")
10.  }
11. }
12.
```

After the whole system was analyzed and designed, the researchers developed a digital accounting system and then provided the service on cloud computing. The system can be accessed and registered through URL: <https://www.mse-exam.net/acc>, which register page is shown in Fig. 7. The register page requires the user to provide information such as business name, contact name, phone number, email address, username and password for accessing the system. Figure 8 demonstrates an example of statement of financial position.

Table 2 demonstrates the advantages of accounting software package usage in comparison with a manual accounting system. In the past, all accounting processes- (journalizing, posting to ledgers, financial

statements) were prepared manually. Errors and delayed accounting information was commonly found with manually prepared accounting. The existence of computer programs has helped business by generating fast, accurate and efficient accounting systems. It is a must for businesses to obtain an appropriate accounting system. Combined together, a computer system and accounting software can create an accounting system that is suitable for a company. That means executives will have accurate, reliable and timely information to make decisions more efficiently. Moreover, the accounting system will provide the ease of inspection and control and prevent mistakes (Rattanaprayoon, 2017).

Table 3 shows two groups of accounting software packages. The first group is the software that works on a Windows operating system (Windows format). The second group is the software that works on a cloud service through a web browser. The benefit of the second group is that it works on all devices which are equipped with a web browser such as Google Chrome, Microsoft Edge, Mozilla Firefox, Safari. Although the Windows format has been in use for many years, from stand-alone to network configurations, it still does not function as well as a cloud service which can be accessed everywhere with low costs. Further, the developer can immediately and continuously correct errors.

The accounting software package that works with a Windows-only format is more expensive than the one that works through a cloud service. The different of price is due to the lump sum, onetime payment when purchasing Windows-format software, as oppose to cloud-based accounting software which charges minimal monthly or annual fees. Another benefit of cloud-based accounting software is that the user can purchase the required functions and then later purchase additional functions (or upgrade and update) when needed and without effecting prior data. The comparison between cloud service platform and Window application is provided in Table 4.

The purpose of this research is to develop a free digital accounting system at a quality level of accounting software packages in the market, which benefits entrepreneurs who have limited financial resources and cannot manage to purchase price-based accounting software packages. It also lowers the trial-time limitations on costly accounting software packages. Zyberi and Rova (2014) stated that many firms which used accounting software packages gained the benefits of saving costs and minimizing paper usage. Consistent with Grande *et al.*, (2011), the empirical study is based on a survey carried out among small and medium-sized firms to ascertain the extent to which development and implementation of Accounting Information Systems (AIS) had taken place and subsequently an analysis was made as to how much this

introduction may impact on improvement in outcome indicators and productivity. As interesting results, they have found that there is a positive relationship among the SMEs that use AIS for fiscal and bank management and better performance measures in SMEs in Spain. Such technology as cloud computing also come in and provide even more benefits to SMEs as we evidence in various industries have been applied in cloud computing to the organizations. For example, in healthcare sector, the company provides self-healthcare treatments where several monitoring equipment using the cyberspace devices have been developed to help patients manage their medical conditions at home. Diabetic patients can test their blood sugar level by using e-device using cloud service. This means physicians will spend more time working with patients with the help of patient healthcare software (Galla and Gnanavardhan, 2014). In marketing, Gavrilović and Maksimović (2019) stated that marketing activity integrated in the cloud is enable the faster and easier collection of customer-related data, their analysis, recognize and predictive analytics on which basis the personalized promotional activities have been performed. In academic, Holtzblatt and Tschakert (2011) found that numerous accounting professors are taking advantage of the capabilities afforded by digital video technologies and accounting educators can reap the benefits of using a digital accounting system on cloud computing as class materials to boost students' performance and make the teaching more productive. Therefore, the production of this research, DAC, can be used as a tool for accounting educators as well. DAC

provides benefits to educators and students that they can easily see the overview of the accounting system without additional costs. Compared with the previous technology when the software is installed in the office, user must deal with potential interruptions such as power outages, software upgrades, hardware failures and human error, cloud is a new technology used in different types of sectors to improve the effectiveness and efficiency of business model as well as solving problems in business world (Galla and Gnanavardhan, 2014).

Besides, the production of this research is consistent with development of Taxation Application for start-up based on cloud computing following MSMEs Tax Regulation that apply in Indonesia (Supardianto *et al.*, 2021). They used PHP language and MySQL database as key material. This application used the Waterfall development model through the requirements, analysis, design, implementation, testing and maintenance. The requirements stage reinforces by applying the User-Centered Design method. Black-box testing on application functionality shows that the application is running well and the output produced in this application successfully displays the final income tax attachment output that can use for Annual Agency Tax Return reporting. This research can help MSMEs/start-ups to manage final income taxation and administration. Also, this application has developed like Software-As-A-Service (SAAS). The application will be put on the cloud side for users, then they can access the application through a browser on an internet.

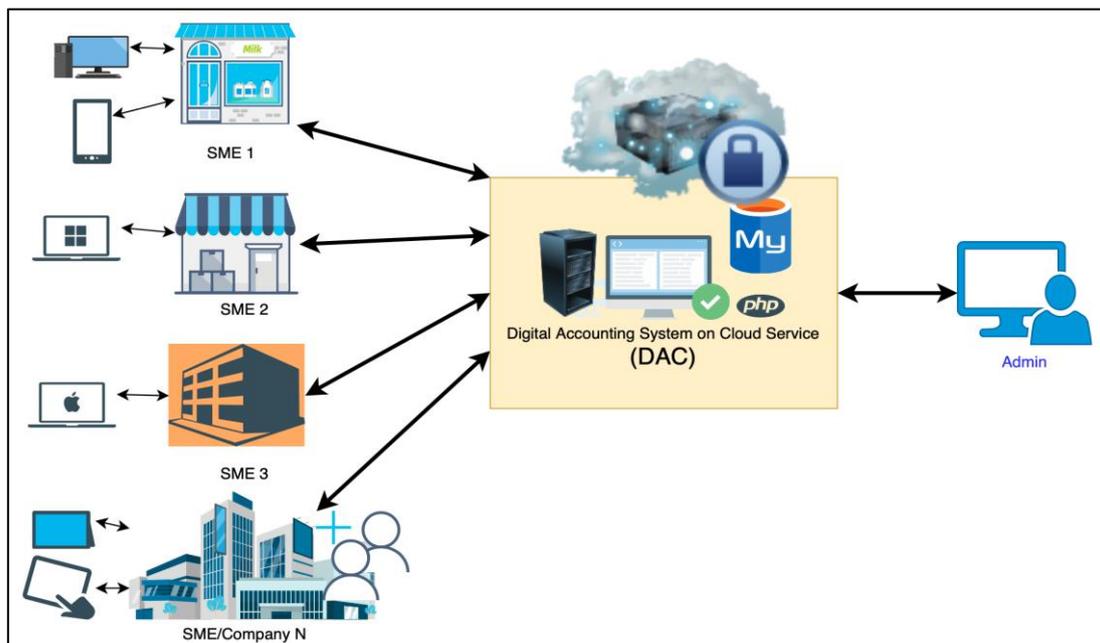


Fig. 4: DAC system overview

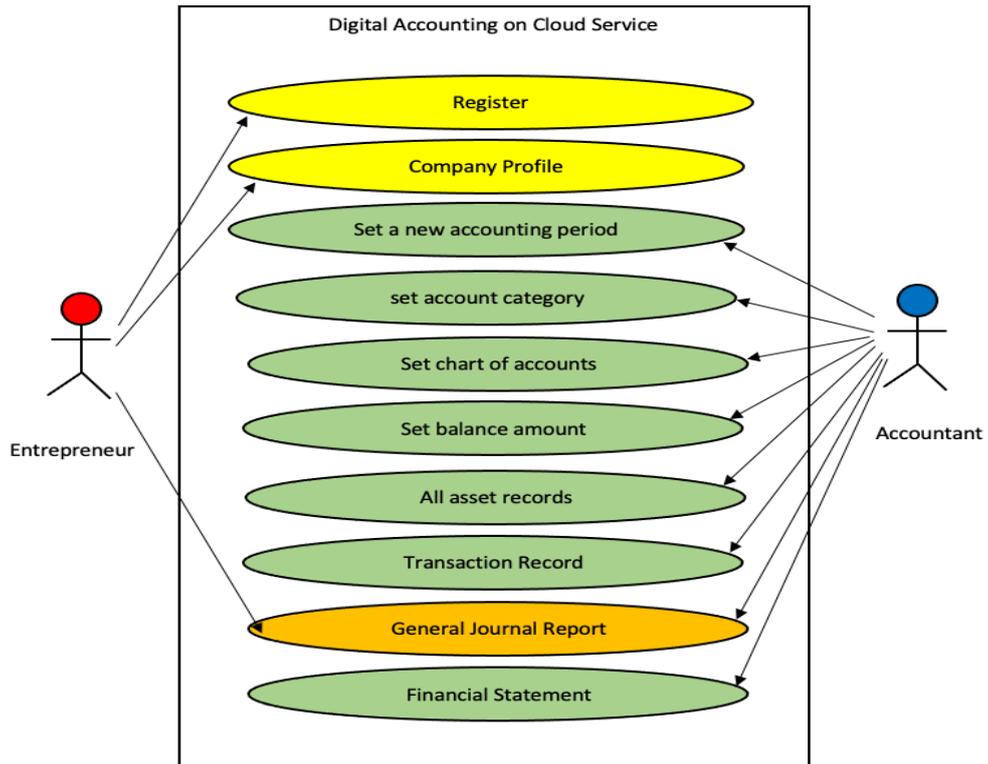


Fig. 5: Function of Digital Accounting on Cloud Service

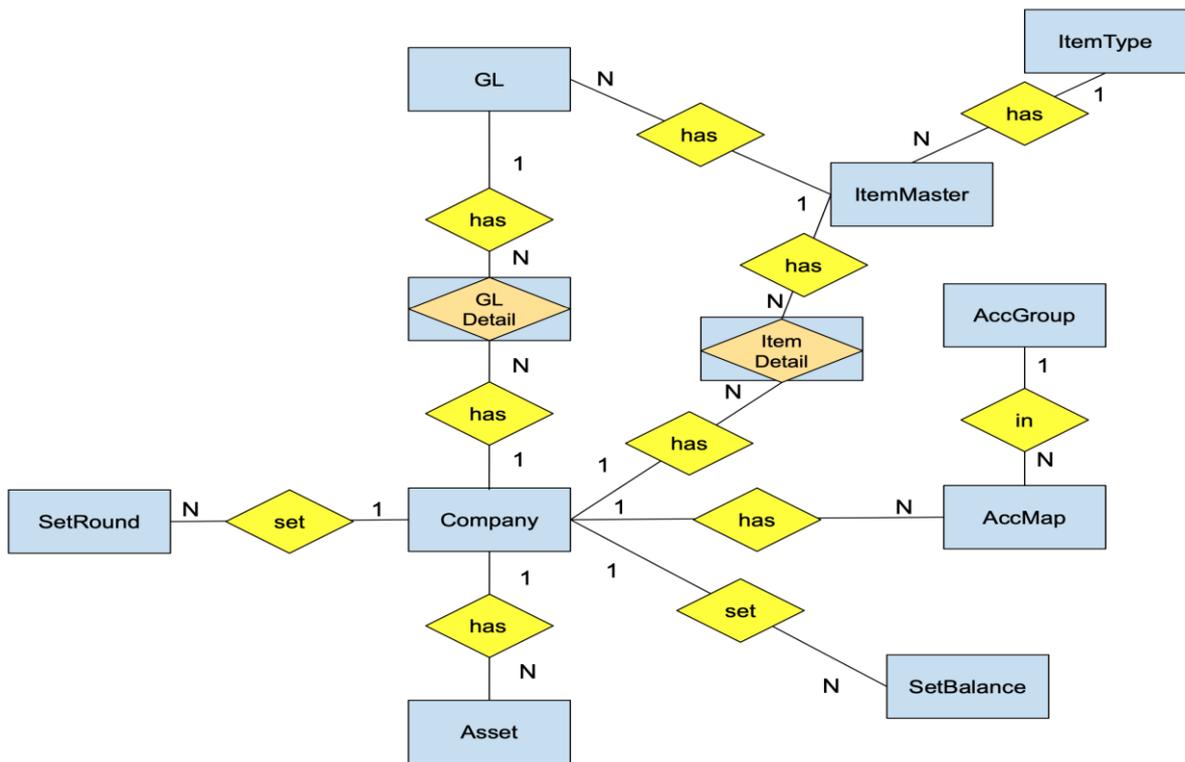


Fig. 6: ER-Diagram for Digital Accounting on Cloud Service

Fig. 7: Register screen in the DAC system

สินทรัพย์		หนี้สินและส่วนของผู้ถือหุ้น	
สินทรัพย์หมุนเวียน		หนี้สินไม่หมุนเวียน	
เงินสด	14,000.00	เจ้าหนี้	200,000.00
ลูกหนี้	20,000.00	เจ้าหนี้	250,000.00
สินค้า	5,000.00	รวมหนี้สินไม่หมุนเวียน	450,000.00
รวมสินทรัพย์หมุนเวียน	39,000.00	รวมหนี้สิน	450,000.00
สินทรัพย์ไม่หมุนเวียน		ส่วนของผู้ถือหุ้น	
ที่ดิน	1,000,000.00	ทุนเดิม	1,185,000.00
โรงเรือน	500,000.00	กำไรสะสม	4,000.00
โฉนด	100,000.00	รวมส่วนของผู้ถือหุ้น	1,189,000.00
รวมสินทรัพย์ไม่หมุนเวียน	1,600,000.00	รวมหนี้สินและส่วนของผู้ถือหุ้น	1,639,000.00
รวมสินทรัพย์	1,639,000.00		

Fig. 8: Statement of financial position

Table 2: The comparison between manual preparation of accounting reports and by a computerized accounting software package

Manual Accounting System	Accounting Software Package
1. Needs many accounting staff members. Human errors due to high workloads.	1. Saves costs due to minimal accounting staff.
2. Non-uniform handwriting resulting in numerical errors. High chance of making an error in each accounting cycle step, resulting in unequal trial balances and causing wasted time and money to correct the mistakes.	The computer does not make numerical errors and does not allow imbalanced transactions. It is easy and has large storage space to store accounting information using the software.
3. Time-consuming processes before reports can be issued. Causing wasted time and money in auditing the transaction errors. No automation used where the kind of transaction appropriate for an automated action function as in accounting software.	2. Able to immediately issue both current and past accounting reports in a timely manner.
4. Time-delayed information for managerial uses.	3. Can record accounting transactions in the general journal without having a beginning account which can be recorded later.
5. Inconvenience of storing accounting documents results in difficulties of searching for past documents when needed. Time consuming in making accounting information/report presentations such as graphs and tables.	4. Manager can see financial reports as soon as the main information and daily transactions are completed which make them relevant to the economic decisions.
	5. The last five years of financial reports and budgets can be compared/available for comparison.
	6. Enables the data in a working paper and trial balance to transfer to the program and create graphs immediately.

Table 3: The comparison of prices for accounting software packages available in Thailand

Software name	Price (THB)	Platform type	Note
Express for windows	28,000	Windows only	
Amanda Bizness ONE	9,900	Windows only	
CD Organizer	29,900	Windows only	
EASY-ACC	26,000	Windows only	
Auto flight express hybrid cloud	70,000	Windows/On cloud service	
Peak account	11,520/year	On Cloud Service	
Acc Cloud	5,900/year	On Cloud Service	Initial setup 9,000 Baht
SME Move	6,990/year	On Cloud Service	
My Account	15,600/year	On Cloud Service	
Flow Account	5,490/year	On Cloud Service	Lazada Connect
DAC	Free	On Cloud Service	Production from outcome of this research

Table 4: The comparison of software development platform types (Mahesh, 2021)

Platform type	Software tools/providers	Compare issues
Window application	Sun's Java	Advantages
	Microsoft's .NET framework	1. The users who have used in this traditional technology in the past will be familiar with the system which mean no uphill learning in new platform. 2. The users who have used and invested in this traditional technology that keeps its legacy system has no switching costs which could be high considered all costs. Disadvantages 1. The software installation and update must be on-site only. 2. Advance IT skill are required for custom development and maintenance. 3. Requires a large IT budget 4. Limitation of Operating System support such as Window OS only. However, no support for different devices to access the application such as mobile web browser.
Cloud service platform	Amazon Web Services (AWS) Microsoft Azure Google Cloud Alibaba Cloud IBM Cloud Oracle Salesforce SAP Rackspace Cloud VMWare	Advantages 1. Cloud computing allows a business to cut their operational and fixed monthly costs of hardware, databases, servers, and software licenses. 2. Services office 24/7 (99.99% uptime). 3. There is no limit to the number of users or resources. It is scalable and reliable. 4. Maintainability and automatic updates of new software, OS, databases and third-party software. It also reduces IT labor cost for a business. Disadvantages 1. Cloud computing must have internet connection for the time of using. 2. They are more likely to be attacked if the security system is not strong.

Conclusion

The result of this research met with all the research objectives. The first objective is to design algorithm in digital accounting on cloud computing. Therefore, we designed the algorithm includes algorithm of assets registration and the computation of their depreciation calculated monthly and annually for users' usage, algorithm of chart of designated account follows double-entry bookkeeping and also algorithm of beginning of balance record. The second objective is to design databases relationship in digital accounting on cloud computing service. With this objective, we designed database relationship and with this only one database under cloud service it is able to support various business applications (See in Appendix). The last objective is to develop digital accounting as software package on cloud computing. After the trial process and testing, we developed

the digital accounting system on a cloud service as the final product of this research. Currently, SMEs can register and gain access to the service free of charge, resulting in saving costs for the company. SMEs can use DAC for financial planning especially for revenue and expenses planning. The main functions of the software are as follows:

- 1) Assigning the beginning data such as information of user/SME, determining the accounting cycle, assigning account category, assigning chart of account and recording a beginning balance
- 2) Prepare the assets registration
- 3) Journalize each accounting transaction such as revenue, expenses, capital and other transactions
- 4) Show all accounting transactions in general journal.
- 5) Issue financial reports

In the future, a document-scanning function can be

added to the system because it will help with automatic recording, prevent documents from being misplaced and documents can be checked at any time. Certainly, in the future the advances in Artificial Intelligence (AI) may be used in predict, cognitive capability and make decision in complex scenarios. After all, a digital accounting system provides a competitive advantage for a company with the ability to have financial planning and always check reports.

Author's Contributions

Kriangsak Chanthinok: Developed the idea, designed both the digital accounting system and the research plan, wrote the manuscript, designed the data dictionary, created the data flow diagram and database design and coded the program.

Krittaya Sangboon: Contributed to the literature review with the related fields, designed the study, developed the methodology, collected the data, performed the data analysis and reviewed the final manuscript.

Ethics

This research study is an original version and has not been previously submitted or published before. The researchers have read and agreed to the submission requirements for this original paper and have abided by the research ethics code.

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Appendix. Tables structure for one database in cloud services

Table 1: Design table name of tbl_acc_group

Field name	Field type (size)	Collection	Key type	Comment
auto_id	int (11)		Primary key	Auto increment
group_id	int (11)			Group account code
group_name	varchar (255)	utf8_general_ci		Group account name

Table 2: Design table name of tbl_acc_map

Field name	Field type (Size)	Collection	Key type	Comment
auto_id	int (11)		Primary key	Auto increment
acc_id	varchar (255)	utf8_general_ci		Account code
acc_name	varchar (255)	utf8_general_ci		Account name
group_id	int (11)		Foreign key	tbl_acc_group.group_id
acc_current_asset	int (11)			1 = current asset
com_id	int (11)		Foreign key	tbl_company.com_id
show_report1	int (11)			1 = show account name in financial report

Table 3: Design table name of tbl_asset

Field name	Field type (size)	Collection	Key type	Comment
asset_id	int (11)		Primary Key	Auto increment
asset_name	varchar (500)	utf8_general_ci		Name of asset
asset_price	decimal (10,2)			Price of asset
asset_usedate	date			Start date of asset used
asset_age	int (11)			Lifetime (year)
asset_salvage	float			The price remains
asset_cal	int (11)			1= Depreciation is calculated
asset_rate	int (11)			Depreciation rate
com_id	int (11)		Foreign key	tbl_company.com_id
item_id	int (11)		Foreign key	tbl_item_master.item_id
acc_id	varchar (255)	utf8_general_ci	Foreign key	tbl_acc_map.acc_id
cal_type	int (11)			1 = Depreciation each month 2 = Depreciation each year

Table 4: Design table name of tbl_company

Field Name	Field Type (Size)	Collection	Key Type	Comment
com_id	int (11)		Primary Key	Auto increment
com_name	varchar (255)	utf8_general_ci		Company name
contact_name	varchar (255)	utf8_general_ci		Contact name
com_mobile	varchar (255)	utf8_general_ci		Mobile number
com_user	varchar (255)	utf8_general_ci		Username for login
com_pwd	varchar (255)	utf8_general_ci		Password for login
com_user_type	int (11)			1 = admin for owner business

Table 5: Design table name of tbl_gl

Field name	Field type (size)	Collection	Key type	Comment
gl_id	int (11)		Primary key	Auto increment
balance	decimal (10,2)			Balance of total for each debit or credit
post_date	date			Transaction date
com_id	int (11)		Foreign key	tbl_company.com_id
gl_note	int (11)			Notes to account records
item_id	int (11)		Foreign key	tbl_item_master.item_id
asset_id	int (11)		Foreign key	tbl_asset.asset_id
acc_is_close	int (11)			1 = Not allow to edit 0 = Allow to edit

Table 6: Design table name of tbl_gl_detail

Field name	Field type (size)	Collection	Key type	Comment
gl_id_detail	int (11)		Primary key	Auto increment
gl_id	int (11)		Foreign key	tbl_gl.gl_id
acc_id	varchar (255)	utf8_general_ci	Foreign key	tbl_acc_map.acc_id
balance_dr	decimal (10,2)			Balance of debit account
balance_cr	decimal (10,2)			Balance of credit account
com_id	int (11)		Foreign key	tbl_company.com_id
asset_id	int (11)		Foreign Key	tbl_asset.asset_id

Table 7: Design table name of tbl_item_master

Field name	Field type (size)	Collection	Key type	Comment
item_id	int (11)		Primary key	Auto increment
item_name	varchar (255)	utf8_general_ci		Set name of transaction
com_id	int (11)		Foreign key	tbl_company.com_id
item_type_id	int (11)		Foreign key	tbl_item_type.type_id

Table 8: Design table name of tbl_item_detail

Field name	Field type (size)	Collection	Key type	Comment
auto_id	int (11)		Primary key	Auto increment
item_id	int (11)		Foreign key	tbl_item_master.item_id
acc_id_dr	varchar (255)	utf8_general_ci		
acc_id_cr	varchar (255)	utf8_general_ci		
com_id	int (11)		Foreign key	tbl_company.com_id

Table 9: Design table name of tbl_item_type

Field name	Field type (size)	Collection	Key type	Comment
type_id	int (11)		Primary key	Auto increment
type_name	varchar (255)	utf8_general_ci		Transaction type name

Table 10: Design table name of tbl_set_balance

Field name	Field type (size)	Collection	Key type	Comment
balance_id	int (11)		Primary key	Auto increment
acc_id	varchar (255)	utf8_general_ci	Foreign key	tbl_acc_map.acc_id
balance_dr	decimal (10,2)			Balance of debit
balance_cr	decimal (10,2)			Balance of credit
round_no	int (11)			0 = default round no for starting balance
com_id	int (11)		Foreign key	tbl_company.com_id
post_date	datetime			Transaction date
acc_is_close	int (11)			1 = Account is closed
year_round	int (11)			Year quoted

Table 11: Design table name of tbl_set_round_acc

Field name	Field type (size)	Collection	Key type	Comment
auto_id	int (11)		Primary key	Auto increment
round_no	int (11)			Round number 0 = default of year quoted
date_end	date			1 = January to 12 = December Date is end of month
com_id	int (11)		Foreign key	tbl_company.com_id
acc_is_close	int (11)			1 = Transaction is not allowed to edit

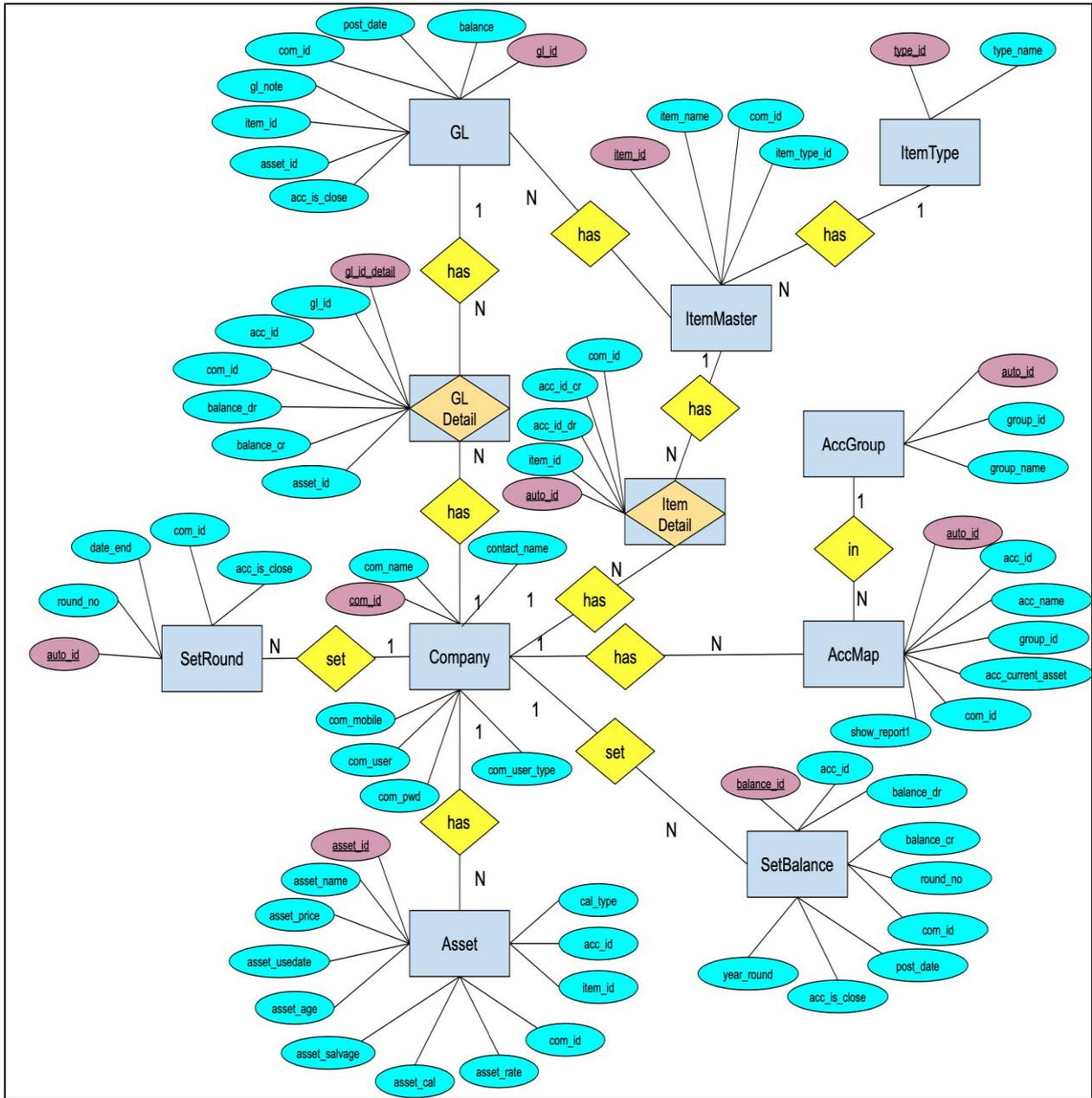


Fig. 9: ER-Diagram with all key attributes