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Using Business Intelligence to Leverage Operational Data in Support of Membership and Asset Growth in Credit Unions

CAPSTONE REPORT

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Abstract

Deregulation in the credit union industry allows new opportunities to expand services and increase competition with other financial institutions by creating membership diversity beyond the traditional common bond. Operational data stored in data warehouses can be mined and leveraged to analyze and predict membership behavior to increase membership and asset growth. This study examines credit union performance indicators, business intelligence solution options, and four case studies to provide an implementation framework for credit union managers.

Keywords: credit union, common bond, membership growth, asset growth, business intelligence, data warehousing, data mining

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Introduction to the Literature Review

Research Problem

At the core of any credit union's financial operations is the information system that executes and stores all member financial transactions (Gamble, 2010). The data for these transactions are usually specific to checking or savings accounts but can encompass transactions related to credit cards, personal loans and mortgages (Ono & Stango, 2005). Additionally, the technologies that support these transactions vary and include Automated Teller Machines (ATM), phone, and the Internet (Ono & Stango, 2005). The transaction histories along with information specific to the member are typically stored in databases (Dass, 2006). These are operational databases and support the credit union business processes (Jukic, 2006). The size of these operational databases makes it difficult for a human analyst to leverage that data in any way to facilitate making business decisions (Dass, 2006).

Jaffri and Nadeem (2004) state that business intelligence (BI) "refers to the use of technology to collect and effectively use information to improve business effectiveness" (p. 1). BI facilitates business decision making by consolidating, analyzing, and providing access to vast amounts of information (Phan & Vogel, 2010). "In today's rapidly changing business environment, the need for timely and effective business information is recognized as essential for organizations not only to succeed, but survive" (Lonnqvist & Pirrtimaki, 2006, p. 32).

Goddard, McKillopp, and Wilson (2008) explain that in their purest form, credit unions serve a membership that is defined by some kind of a common bond. Pre-dating the technology of credit reporting, this common bond is a way to substitute knowledge of one another's creditworthiness for loan collateral (Walter, 2006). This common bond was also used as a criterion to define and restrict membership to members of a local community, employees of a

particular firm or individuals with some other organizational affiliation (Goddard et al., 2008) Recent regulation reforms permit credit unions to evolve from niche players providing services to a narrowly defined membership into full service retail depository institutions serving a broad customer or membership base (Goddard et al., 2008). The relaxation of the previously restrictive common bond requirements has brought credit unions into closer direct competition with other financial institutions (Handrinis & Nikolopoulos, 2008).

Research related to growth of credit unions in the U. S. has typically attributed this growth to a function of either credit union assets or credit union membership (Goddard, McKillopp, & Wilson, 2002). The common bond may present either an opportunity or constraint on the credit union's ability to achieve further growth (Goddard et al., 2002). It is a constraint as it limits an individual credit union to who they may accept as customers (Walter, 2006). Credit unions “close to exhausting their potential membership, face difficulties in sustaining strong growth performance” (Goddard et al., 2002, p. 2349). It is an opportunity for the industry, as even though potential membership is growing, only 15% of the potential membership has been captured (Freeman, 2008). While the recent common bond requirements have allowed credit unions to serve potentially larger groups of members, Goddard et al. (2002) report a stronger relationship for potential membership tied to credit union assets. This growth advantage appears to derive more from a superior capability to increase business with existing members, than from superior capability to attract new members (Goddard et al., 2002).

Purpose

The purpose of this study is to identify factors to increase credit union membership growth and asset growth as a way to support competitiveness (Jaffri & Nadeem, 2004). The goal

is to explore the use of business intelligence in U. S. credit unions to facilitate the analysis of available transactional data that is stored in databases (Dass, 2006).

As noted in the literature, BI is both a process and a product. The process is “composed of methods that organizations use to develop useful information, or intelligence, that can help organizations survive and thrive” (Jourdan, Rainer, & Marshall, 2008, p. 121). The product is the information that allows organizations to more accurately understand current and predict future behaviors of “competitors, suppliers, customers, technologies, acquisitions, markets, products and services, and the general business environment” (Vedder, Vanecek, Guynes, & Cappel, 1999, p. 109). Successful organizations improve the value of their customer base by reducing the rate of defections, increasing the longevity of the relationship and enhancing the growth potential of each customer (Kotler & Keller, 2009, p. 136). BI can be used to mine customer relationships (Phan & Vogel, 2010), identify profitable customers and facilitate retaining them by understanding individual behaviors (Jaffri & Nadeem, 2004). Organizations can gain a competitive advantage with successful implementations of BI (Jaffri & Nadeem, 2004), by recognizing “their raw transactional data as a valuable source of unique information” (Gunnarsson, Walker, Walatka, & Swann, 2007, pp. 271-272).

Significance

As a financial cooperative, credit unions should work to establish a competitive position in the financial market while staying true to their cooperative nature, serving members specific to their common bond (O'Hara & Brohman, 2002). The loyalty of credit union members is unique to their competitive position and credit unions can define success by their ability to meet the needs of their membership (O'Hara & Brohman, 2002). Additionally, the business decisions made at the individual credit union level with respect to the offered products and services,

pricing of those products and services, and marketing and promotions are drivers of membership and asset growth (Goddard et al., 2008). Credit unions that ignore servicing the growth of their membership's assets lose market share to local competition (Bauer, 2008).

BI can allow decision-makers to gain insights into trends and relationships related to their operational data, which enables them to better manage customer information and deliver a higher level of customer satisfaction (O'Hara & Brohman, 2002). BI can be used to review the sequences and periodicity of transactional data behavior (Dass, 2006), and provides a way to better understand customer buying patterns, identify marketplace opportunities, and gauge product effectiveness (Ortiz Jr., 2002). When analyzed through BI, this data reflects explicit and implicit customer patterns and trends and the effectiveness of business strategies and resultant practices (Jukic, 2006).

Audience

The intended audience for this literature review is information technology (IT) managers working within a credit union who are tasked with increasing membership and assets, through the use of BI. On top of supporting activities, IT managers can also benefit from using BI in planning activities (Vedder et al., 1999). From an organizational support perspective, the growth of BI has important implications for both the management and operation of IT units, as IT resources are called upon to support BI activities elsewhere within organizations (Vedder et al., 1999). Additionally, this study is relevant to any credit union manager or executive who uses business intelligence to support decision making that could affect a credit union's performance. Competitive business decisions require effective integration of several different types of information, gathered and processed from across the organization and at different organizational levels (Christensen, 2010) and those decision-makers must have quality information pertinent to

the decision at hand (Park, 2006). BI can give senior managers a holistic view of the company and can identify trends and opportunities for growth (Jaffri & Nadeem, 2004).

Outcome

The outcome of this study is a framework for credit unions to build on the operational collection of transactional and member specific information stored in databases to support membership and asset growth. The framework employs both the process and product of BI. The BI process is the means with which a credit union develops useful information (Jourdan et al., 2008). The BI product is the resulting information that allows a credit union to understand current and predict future member behaviors (Vedder et al., 1999).

In order for an organization to achieve competitive advantage, data needs to be managed, analyzed, and fed into the decision-making process (Gorla, 2003). As part of the decision making process, BI can play a pivotal role in helping credit unions improve member retention and market penetration (Dass, 2006). The framework is designed to enable credit union IT and business managers to leverage the transactional data a credit union maintains in databases to increase their member's "value by understanding individual behaviors, identifying and responding to changing needs, and offering better products and services" (Jaffri & Nadeem, 2004, p. 4). The combined result of the BI process and product facilitates competitiveness through focused, quality decision-making related to membership growth and asset growth.

Delimitations of Research

Credit union industry. Credit unions exist around the world in at least 97 different countries ("2009 Statistical report," n.d.). U. S. credit unions operate within a highly competitive financial market place (Glass & McKillopp, 2006). This study focuses on a U. S. credit union industry context. The not-for-profit, cooperative nature of the U. S. credit union, along with

recent U. S. regulation changes that affect the common bond requirement and subsequently affects how a credit union can grow (Goddard & Wilson, 2005), provide a unique back drop to examine issues of competition.

Credit union performance. Handrinios and Nikolopoulos (2008) evaluate credit union performance by examining the number of members, total assets, total shares, total loans and total capital. Profitability performance measures are inappropriate as credit unions are not-for-profit institutions (Goddard et al., 2008).

The NCUA employs a rating system to provide an estimate on a credit union's performance by evaluating capital adequacy, asset quality, management, earnings and asset/liability management ("NCUA letter to credit unions," 2000). This rating system is also known by the CAMEL acronym. The CAMEL ratings vary from a high of one, sound in almost every respect, to a low of five, basically insolvent and unlikely to survive more than 12 months (Fried, Lovell, & Yaisawarng, 1999). The NCUA does not intend the CAMEL rating to be used as a snap shot of relative credit union performance but more as a tool for credit unions to measure risk and allocate resources ("NCUA letter to credit unions," 2000). Even so, literature notes CAMEL ratings as a tool to outwardly measure credit union performance (Bauer, Miles, & Nishikawa, 2009). The econometrics related to CAMEL ratings is beyond the scope of this study.

To simplify the econometric measurements and following information located in literature (Goddard et al., 2008), this study is specific to the performance related to credit union membership and credit union assets.

Business intelligence focus. The concept of business intelligence can touch on many technology trends. Jourdan et al. (2008) refer to BI contexts in the literature that relate to data

warehousing, data mining, customer relationship management, web mining, machine learning, data modeling, decision modeling, enterprise resource planning, and knowledge management systems. Related to the BI process of the development of useful information, this study focuses on data warehousing. Data warehousing makes operational data available in a format that can more easily be consumed by other user applications (O'Hara & Brohman, 2002). Related to the BI product of the information that facilitates understanding, this study focuses on data analysis through the use of data mining and online analytical processing (OLAP). Data mining comprises a computer assisted process of analyzing data from different perspectives and distilling it into actionable information (Gunnarsson et al., 2007). OLAP allows real-time examination of pre-aggregated measures in line with important business dimensions (Hamel, 2005).

Time frame. The first U. S. credit union was formed in 1909 (Walter, 2006) and a preliminary investigation of credit union literature finds sources cited as far back as 1922. To maintain a perspective relative to current credit union industry and business intelligence technology trends, only literature from 1999 through 2010 is collected.

Literature selection and evaluation. Hewitt (1998) states the primary source for literature included in a literature review is articles published in journals. This study prioritizes articles published in peer-reviewed research journals over professional journals. Peer-reviewed articles require critical review by experts in the field prior to publication (Hewitt, 1998). Additionally theses, reports and conference papers are evaluated for inclusion in the review. Sources not meeting a peer-review level of quality are evaluated by the authority and objectivity of the author and the quality of the work (Bell & Smith, 2009).

Data Analysis Plan Preview

This study uses approaches outlined by Obenzinger (2005) and Hewitt (1998) to analyze data present in identified literature sources. Obenzinger (2005) summarizes this research process as collect, scan and read. This is an iterative process that refines associated literature through a collection of sources, scanning and prioritizing those sources for ideas relevant to the study, and finally reading the prioritized sources to determine importance (Obenzinger, 2005).

Hewitt (1998) describes a similar iterative process in two steps. Initially the information is scanned while recording the search patterns and outputs (Hewitt, 1998). The literature “yield from searching is likely to be of variable relevance and quality” therefore the second phase needs to critically assess each source for relevance and quality (Hewitt, 1998, p. 3).

To critically assess literature sources for inclusion into the literature review data set, the texts must be coded into manageable categories (Busch et al., 2005). A content analysis is used to facilitate a more detailed analysis (Creswell, 2009). “Content analysis is a research tool used to determine the presence of certain words or concepts within texts or sets of texts” (Busch et al., 2005, para. 1). The focus is looking for the occurrence of selected terms within a text, although the terms may be implicit as well as explicit (Busch et al., 2005).

Writing Plan Preview

The writing framework is based on a thematic approach. Thematic literature reviews are organized around topics or issues (“Literature Reviews,” n.d.). The outcome of the study, a framework, relates to three preliminary themes: (a) the credit union industry context and issues specific to membership and asset growth and an exploration of information stored in credit union databases; (b) BI general concepts and processes and also the sub-contexts as it relates the process and product of BI; (c) information that provides industry case histories and examples of

the use and implementation of BI processes and products in support of membership and asset growth.

Definitions

To provide readers with a baseline of information that is required to understand this study a definition of terms is provided. Creswell (2009) states some judgment is used relative to the target audience common knowledge base as to whether a term is included in the definition list. Terms are included in the definition list related to a perceived likelihood of misunderstanding or a potential gap in the target audience's knowledge to a terms meaning.

The **association-rule** is specific to data analysis algorithms that efficiently search for correlations among items in transaction data (Apte, Bing, Pednault, & Smyth, 2002).

Business intelligence “refers to the use of technology to collect and effectively use information to improve business effectiveness” (Jaffri & Nadeem, 2004, p. 1).

CAMEL is an acronym for the five performance dimensions the NCUA uses to evaluate credit unions. CAMEL ratings vary from a high of one, sound in almost every respect, to a low of five, basically insolvent and unlikely to survive more than 12 months (Fried et al., 1999). The CAMEL rating system provides an accurate and consistent assessment of a credit union's financial condition and operations in the areas of capital adequacy, asset quality, management, earnings, and asset/liability management (“NCUA letter to credit unions,” 2000).

The **common bond** both defines and restricts a credit union's target membership (Goddard & Wilson, 2005). The common bond is either an occupational or association specific relationship, or a defined local community, neighborhood, or rural district (*Federal Credit Union Act*, 2007, sec. 1758).

A **competitive advantage** is “whatever value a business provides that motivates its customers (or end users) to purchase its products or services rather than those of its competitors

and that poses impediments to imitation by actual or potential direct competitors” (Christensen, 2010, p. 21).

Competitive intelligence is similar to business intelligence except the emphasis is on the external environment and external information sources (Lonnqvist & Pirttimaki, 2006).

A **credit union** is a “cooperative association organized for the purpose of promoting thrift among its members and creating a source of credit for provident or productive purposes” (*Federal Credit Union Act, 2007, sec. 1752*).

Customer relationship management is the process of identifying, acquiring, serving and retaining profitable customers by interacting with them in an integrated way across a range of communication channels (Padmanabhan & Tuzhilin, 2003).

A **data envelopment analysis (DEA)** is sometimes used in credit union empirical research and tests whether the institution’s efficiencies has improved due to an event (Bauer, 2008). DEA is a linear programming technique developed specifically for the purpose of evaluating the performance of public and not-for-profit enterprises (Fried et al., 1999).

Data mining is the computer assisted process of analyzing data from different perspectives and distilling it into actionable information (Gunnarsson et al., 2007).

A **data warehouse** is a repository that consolidates information from disparate operational systems into one data source (O'Hara & Brohman, 2002).

The **extraction, transformation and load (ETL)** process “facilitates the retrieval of data from operational databases into data warehouses” (Jukic, 2006, p. 84). ETL provides the mappings between operations business processes and analytical applications (Castellanos, Dayal, Simitsis, & Wilkinson, 2009).

The **law of proportionate effect (LPE)** says that growth is independent of size or past growth of a firm (Goddard et al., 2002). The LPE empirically shows that “large and small firms have the same probabilities of achieving any particular growth rate in any period” (Goddard et al., 2002, p. 2329).

Online analytical processing (OLAP) at a concept level is the real-time analysis and consolidation of multidimensional data (Gorla, 2003). Typical OLAP data organizational capabilities include multidimensionality, aggregation, views of detail (i.e. drill-down) and aggregated data (i.e. roll-up), and time slicing (Gorla, 2003).

A **predictive profile** “is a model that predicts future purchasing behavior of an individual customer, given historical transaction data for both the individual and for the larger population of all of a particular company’s customers” (Apte et al., 2002, p. 51).

A **select employee group (SEG)** is the allowed expansion of an additional employee group for occupational related common bond credit unions (Glass & McKillopp, 2006). The Credit Union Membership Access Act in 1998 legislatively permitted the addition of SEGs to a credit union’s field of membership (Glass & McKillopp, 2006).

Research Parameters

This study is designed as a literature review, which utilizes published information in areas specific to a study's topic and exhibits an organizational pattern that combines both summary and synthesis ("Literature Reviews," n.d.). Literature is purposefully selected to help understand the problem and research questions (Creswell, 2009, p. 178). The research parameters identify and describe the strategies and information used to focus and locate the literature in this study.

Research Questions

Research questions narrow the study purpose and provide context for readers (Creswell, 2009, p. 141). A broad central question opens the exploration for the concept of a study (Creswell, 2009, p. 129). The central question in this study is:

How can BI be used to increase credit union membership growth and asset growth, as a way to support competitiveness?

Sub-questions are used to narrow further narrow the focus while conveying an emerging design (Creswell, 2009, p. 130). This study's sub-questions are:

How does membership and asset growth create value for a credit union and the membership?

What types of data does a credit union maintain operationally in databases?

How can operational database data be leveraged in a BI solution?

What BI specific information can be extrapolated from various industry case studies and applied within a credit union context?

Search Strategy

This study is designed as a literature review, which according to Hewitt (1998), reflects an author's knowledge of and interpretation of a topic. The output should include a description of methods used to create the work (Hewitt, 1998). Creswell (2009) states a “literature review means locating and summarizing the studies about a topic” (p. 29).

Major universities have access to public domain literature databases as well as purchased commercial databases which provide quick access to thousands of journals and conference papers (Creswell, 2009). Literature for this study is located primarily using the University of Oregon's Onesearch website which provides students and staff access to search across several document databases and indexes. Additionally, Onesearch provides category descriptions grouping the available databases and indexes into common content areas. The content categories are used to facilitate locating potentially relevant literature sources; the Onesearch categories of business, economics and computer science are used. Further, within each category specific databases are selected to facilitate tracking research results. Within the business category, the Academic Search Premier and Business Source Premier databases are searched. Within the economics category, the EconLit database is searched exclusively and within the computer science category AxXiv.org, Web of Science and Computer Source databases are searched. To provide a way for the researcher to access information from a different interface, Google Scholar is also used to search for literature sources.

Literature collection. A literature review does not include every piece of research done on the topic, only the most significant texts (Obenzinger, 2005). As part of the collection process, search results are scanned in the following order to determine relevance and potential significance; article title, article abstract, article source and whether that source is peer-reviewed

and finally by the ability to locate the full text of the article from an Internet source. The general areas of focus for the literature search are related to credit unions and BI. Searching employs the two high level topics to survey the results and attempt to determine additional controlled vocabulary terms and jumping off points to narrow focus of the search around the topic.

Only one reference is identified that directly relates to BI used within a credit union industry context (O'Hara & Brohman, 2002). Additionally, only two references are located that relate to BI in a banking or general financial institution context (Dass, 2006; Jaffri & Nadeem, 2004). Alternatively, the literature relating to credit unions and BI independent of each other is easily located. The limited nature of literature that directly addresses the topic requires this study to construct a “context based on inference using similar or related research” (Obenzinger, 2005, p. 5). That context is established by the following associations:

- *Credit unions are similar to all retail financial institutions* – Credit unions differ from most financial institutions in that they are mutually owned, are limited by the common bond as to who they can accept as customers, and are tax exempt (Walter, 2006). Even so, credit unions share features common with all depository institutions (Walter, 2006) and some credit union specific literature have used the similarities with the banking industry to draw conclusions (Damar & Hunnicutt, 2010; Emmons & Schmid, 2000). Additionally the bank industries perception relative to the credit union industry as direct competition (Glass & McKillopp, 2006) reinforces those similarities. Evaluating literature that is relevant to business intelligence themes but in the context of a bank or general retail financial institution is possible.

- *Credit unions maintain databases of transactional and member specific information* – Business intelligence sources are located for varying industries types (Gunnarsson et al., 2007; Phan & Vogel, 2010). The literature that relates business intelligence to that of either customer data or the impacts to the customer relationship is collected for preliminary review.

Documentation approach. The Zotero application is used to collect potentially relevant literature sources. Zotero is a free, easy-to-use tool to help collect, organize and cite research sources (“Zotero | Home,” n.d.). Zotero is also used to record new key terms and organize the results of searching and the search strategy. This information is recorded in a document source titled with the name of the database being searched. Information specific to the associated database results, such as the quantity of matching results, descriptions of the result trends and newly identified key terms are recorded as a note to the database specific document.

Information for located literature sources is stored as a Zotero document object. The following attributes of each source are recorded for inclusion as a reference or for the review of literature data set: document title, author(s), publication or website information, issue and volume for documents with the associated information, permanent URL if one exists and the date the literature source is accessed.

Search terms. Key terms for credit union topics are initially located from portions of the Federal Credit Union Act. Additionally terms are mined from the federal credit union regulating authority, the National Credit Union Administration and through credit union industry trade groups of the Credit Union National Association and the World Council of Credit Union web sites.

Credit union industry regulation and trade group web sites

- National Credit Union Administration (NCUA) – <http://www.ncua.gov>
- Credit Union National Association (CUNA) – <http://www.cuna.org>
- World Council of Credit Unions (WOCCU) – <http://www.woccu.org>

Initial searches located several credit union industry trade publications, including the Credit Union Directors Newsletter, Credit Union Journal, Credit Union Magazine, and Credit Union Management. While not a specific credit union trade group publication, credit union information is also obtained from Federal Reserve Bank publications including the Federal Reserve Bank of Chicago and the Federal Reserve Bank of San Francisco. Key terms for BI technology are found in two BI specific literature reviews (Jourdan et al., 2008; Lonnqvist & Pirttimaki, 2006).

Key Terms – credit union context

- credit union
- financial institution
- membership
- technology

Key Terms – BI context

- business intelligence
- data mining
- customer value
- customer relationship management

Search results for two word combinations, such as *credit union* or *data mining*, provide large amounts of literature results with little precision to narrow focus. The addition of a third

term to the search query greatly limited the quantity of results and scanning those results based on the criteria became feasible. A summary of search results and their evaluated quality is located in the appendices.

Data Analysis Plan

This study employs coding as a way to analyze identified literature references specific to the topic. Coding involves taking the data gathered during collection and segmenting it into categories labeled with a term (Creswell, 2009, p. 186). Busch et al. (2005) describe coding as a requirement to critically assess the literature and the focus is looking for selected terms within the text. References specified in the Annotated Bibliography are included in the set of literature selected to be subject to the coding process.

The data analysis is structured around concepts related to credit union performance and assessing the value of their membership along with the technology, concepts and processes related to BI. Busch et al. (2005) describe eight steps that are used as a system of selective reduction to reduce text into appropriate categories.

1. *Level of analysis* – Codes are based on topics the intended audience would expect to find, in past literature and common sense (Creswell, 2009, p. 186). Single words and word combinations relevant to this study such as *credit union, common bond, membership, assets, growth, competition, business intelligence, data mining, data warehouse, and database* are coded.
2. *Coding concepts* – Coding is bound primarily to the pre-determined list of three core concepts, which include (a) credit union performance relative to membership and asset growth, (b) BI technologies of data warehousing and data mining, and (c) BI solutions built around transactional data stored in databases. Focusing on a

specific set of concepts allows the related literature to be examined for very specific concepts (Busch et al., 2005). However, the traditional approach is to allow the codes to emerge during the analysis (Creswell, 2009, p. 187). To allow a limited flexibility to incorporate important material (Busch et al., 2005), related concepts that emerge through the process of this data analysis may be included.

3. *Coding for existence* – When coding for existence, coding concepts such as *credit union*, would only be counted once regardless of the number of times that concept may appear in the text (Busch et al., 2005). Emphasis is placed on the meaning of the identified concepts and not on the number of times a concept is addressed.
4. *Generalization of concepts* – Coding must be applied either exactly as the terms appear or by generalizing the concepts as similar even though they may appear in different forms (Busch et al., 2005). This study evaluates concepts relative to their context to include in the coding. Terms are generalized to better code concepts of a similar meaning.
5. *Translation rules* – Translation rules are documented throughout the analysis to ensure each translation is coded in a similar fashion. This gives the coding process a level of consistency and coherence (Busch et al., 2005). For example, terms related to *data mining, data warehousing, competitive intelligence, customer relationship management* are associated with *business intelligence*. Terms related to *field-of-membership* or *select employee group* are related to the credit union *common bond*.
6. *Irrelevant information* – Coding terms in use by this analysis avoid common phrases and patterns used as normal interaction within the English language.

Texts that appear irrelevant by lack of any identified coding terms are re-evaluated to examine whether the coding scheme as a whole needs to be refined or added to.

7. *Manual coding* – Coding is done manually by reading through the references selected to use in the coding set, and recording occurrences of the words and concepts noted above. The qualified texts are noted utilizing the tagging ability of the Zotero application as well as being compiled in a report detailing each coded passage. The coded references are identified in the Annotated Bibliography as the result data set.
8. *Analyze results* – Once complete, data identified during the coding process is examined in an attempt to draw any conclusions and generalizations that are possible (Busch et al., 2005). Creswell (2009, p. 184) states the coding process is used to generate a description of the themes for further analysis. The Writing Plan of this study discusses how the themes are presented.

Writing Plan

The University of North Carolina's Writing Center (n.d.) describes a thematic review as being organized around a topic or issue. Themes are organized at a high level around credit union and business intelligence categories. Three preliminary themes are designed to build this study's framework and outcome through analysis of literature that examines individual credit union and credit union industry performance. The first theme is related to that performance, and literature is reviewed that presents information of credit union performance specific to membership and asset growth as well as the data that credit union's store in databases as part of their operational business. The second theme is related to BI literature, which is examined at an

introductory level and focuses on the sub-themes of BI related to process and product. The third theme is based on BI case studies and industry examples not necessarily specific to a credit union but where the information of the associated industry is similarly stored in databases and of a transactional nature which can be generalized for application within a credit union context.

This study also employs a *Swiss cheese* rhetorical pattern as described Obenzinger (2005) by presenting a picture of the current knowledge related to these three overarching themes of credit union performance through membership and asset growth along with BI built from information stored in transactional databases. This process is similar to the synthesis of two fields review (Busch et al., 2005) where insights into this study's topic are based on a review of the literature specific to themes of both credit union performance and BI. The following outline describes the preliminary themes and sub-categories of the writing plan.

1. Theme One: Credit union asset and membership performance
 - a. Growth of credit union membership
 - i. The common bond requirement
 - ii. Recent regulation effects with the common bond
 - iii. Limits and opportunities of the common bond
 - b. Growth of credit union assets
 - i. Creating value for the credit union and the members
 - c. Credit union operational data stored in databases
 - i. Credit union information systems
 - ii. Credit union data stores
2. Theme Two: Business intelligence
 - a. Business intelligence concepts

- b. Sub-theme: BI as a process – Data warehousing
 - i. Data warehousing benefits
 - ii. Moving from operational data stores to a data warehouse
 - 1. Extract-transform-load (ETL)
- c. Sub-theme: BI as a product – OLAP and data mining
 - i. OLAP benefits
 - ii. Data mining benefits
 - iii. Data mining techniques to analyze information in a data warehouse
 - 1. Association-rule analysis
 - 2. Predictive profiling
- 3. Theme Three: BI case study exploration
 - a. BI solutions based on transactional operational database information
 - b. BI solutions creating customer value

Annotated Bibliography

The Annotated Bibliography lists 26 selected references that are critically relevant to this study. All references listed in the Annotated Bibliography are included in the coded data set. Each included reference is evaluated following the criteria specified by Bell and Smith (2009), which is specific to a works authority, objectivity, quality, coverage and currency.

Apte, C., Bing, L., Pednault, E. P. D., & Smyth, P. (2002). Business applications of data mining. *Communications of the ACM*, 45(8), 49-53.

Abstract. The article focuses on application of data mining to business processes. The traditional approach to data analysis for decision support has been to couple domain expertise with statistical modeling techniques to develop handcrafted solutions for specific problems. More recently as of August 1, 2002, several trends have emerged to challenge this approach. One is the increasing availability of large volumes of high-dimensional data occupying database tables with millions of rows and thousands of columns. Another is the competitive demand for the rapid construction and deployment of data-driven analytics. A third is the need to give end users analysis results in a form they readily understand and assimilate, helping them gain insights they need to make critical business decisions. Moreover, knowledge discovery in databases techniques emphasizing scalable, reliable, fully automated, explanatory structures have shown that in data analysis, such structures supplement, and sometimes supplant, human-expert-intensive analytical techniques for improving decision quality.

Comment. This article examines data analysis related to both transactional data contained in databases along with associations to competitive demand. The authors

examine four predictive profiling contexts related to the direct mail, retail, automobile insurance, and health care industries. The information concerning the relationship of transactional data and the analysis that can be achieved from data mining are significant to this study, and is used to support the development of the Review of Literature section of this paper and is included in the coded data set. The article is evaluated as credible by the fact that it appears in a peer-reviewed journal and the authors' credentials as research staff for IBM or associate professors at academic institutions.

Bauer, K. J. (2008). Detecting abnormal credit union performance. *Journal of Banking & Finance*, 32(4), 573-586.

Abstract. Credit unions are an important financial intermediary, but little credit union research is done. A primary reason for the lack of research is the cooperative nature of the industry, making traditional methods of detecting abnormal performance inappropriate. This paper proposes two methods of detecting abnormal performance, one parametric, the other non-parametric. Instead of testing the efficiency of the institution, this paper proposes testing the return vector, as indicated in the theoretical objective function of the member. Simulations demonstrate that both methods are correctly specified and powerful.

Comment. This article is relevant for the study as it facilitates framing performance related to the operation of a credit union, as described in the delimitations of research section of this paper. The author discusses data envelopment analysis (DEA) and proposes a new methodology to test for performance anomalies. Additionally the author contributes data on several performance aspects of credit unions and the motivations behind member's lending and saving practices that can influence the performance. The

article is deemed credible by appearing in a peer-reviewed journal and by the fact this author has created additional research literature and is recognized by peers with citations in other sources contained in this study.

Bauer, K. J., Miles, L. L., & Nishikawa, T. (2009). The effect of mergers on credit union performance. *Journal of Banking & Finance*, 33(12), 2267-2274.

Abstract. The motivation for mergers in the credit union industry differs from the commercial bank industry due to the lack of residual claimants to benefit from wealth gains. In the cooperative ownership environment of credit unions, the owners/members gain utility via the rates offered for loans and deposits. Credit union regulators also gain utility when mergers remove risky credit unions from the industry. We measure these utility gains using the event study method of Bauer [Bauer, K., 2008. Detecting abnormal credit union performance. *Journal of Banking and Finance* 32, 573–586] employing quadrant tests based on a multivariate test of equality of centroids. We find gains to the owners/members of the target credit union and to the regulators but not to the acquiring firm. We posit that the acquiring credit unions may encounter regulatory pressure to merge. In addition, the owners/members of the acquiring firm may avoid potential disutility in the cooperative insurance environment were the target firm allowed to fail.

Comment. This article examines credit union performance in the context of recent industry mergers. While the focus is on the relationship with performance and mergers, the article discusses aspects related to credit union performance in general and the industry competition with other financial institutions. It is relevant to the study by providing insights into how the common bond may affect membership growth and data specific to asset growth, as described in the Review of Literature. The article is deemed

credible by appearing in a peer-reviewed journal as well as one author being found in additional research literature related to credit unions and all three authors are associated with either Illinois State University or St. John's University.

Castellanos, M., Dayal, U., Simitsis, A., & Wilkinson, K. (2009). Business processes meet operational business intelligence. *Bulletin of the IEEE Computer Society Technical Committee on Data Engineering*. Retrieved from <http://citeseer.ist.psu.edu/viewdoc/summary?doi=10.1.1.156.5396>

Abstract. As Business Intelligence architectures evolve from off-line strategic decision-making to on-line operational decision-making, the design of the backend Extract-Transform-Load (ETL) processes is becoming even more complex. We describe the challenges in ETL design and implementation, and the approach we are taking to meet these challenges. Our approach is centered on a layered methodology that starts with modeling the business processes of the enterprise, and their information requirements and service level objectives, and proceeds systematically through logical design to physical implementation. A key element of this approach is the explicit specification of a variety of quality objectives (we call these collectively the QoX objectives) at the business level, and the use of these objectives to drive the optimization of the design at the logical and physical levels.

Comment. This article provides information that ties BI with data warehousing and explores process related to moving operational business data into the data warehouse with extract, transform and load (ETL) methods. It discusses concepts related to typical BI architecture and how data warehouses are traditionally incorporated into that architecture. The purpose of the article is to propose a new methodology for ETL processes based

around a hypothetical situation related to an online retail enterprise. The information presented is critical to this study as described in the Definitions and Review of Literature sections and is included in the coded data set. The authors are employed by HP Labs. The article displays objective qualities documenting sources and by conveying the goal to propose a new ETL methodology. The authors' professional experiences along with the quality of objectivity provide evidence to the credibility of this document.

Dass, R. (2006). Data mining in banking and finance: A note for bankers. In *Data Mining & Business Intelligence in Banking and Finance* (Vol. 1). Presented at the Banknet India's CTO Summit, Mumbai, India. Retrieved from <http://www.iimahd.ernet.in/publications/data/Note%20on%20Data%20Mining%20&%20BI%20in%20Banking%20Sector.pdf>

Abstract. Currently, huge electronic data repositories are being maintained by banks and other financial institutions. Valuable bits of information are embedded in these data repositories. The huge size of these data sources make it impossible for a human analyst to come up with interesting information (or patterns) that help in the decision making process. A number of commercial enterprises have been quick to recognize the value of this concept, as a consequence of which the software market itself for data mining is expected to be in excess of 10 billion USD. This note is intended for bankers, who would like to become aware of the possible applications of data mining to enhance the performance of some of their core business processes. In this note, the author discusses broad areas of application, like risk management, portfolio management, trading, customer profiling and customer care, where data mining techniques can be used in banks and other financial institutions to enhance their business performance.

Comment. This article provides framing context for this study by describing the operational data financial institutions stored in databases and their usage with BI and data mining. This article is included in the coded data set. The information presented is critical to framing this study in the Introduction section of this paper as well as the Review of Literature. The article is deemed credible by Mr. Dass' academic affiliation with the Indian Institute of Management, in Amhedabad, India as a tenured professor.

Emmons, W. R., & Schmid, F. A. (2000). Bank competition and concentration: Do credit unions matter? *Review*, 82(3), 29-43.

Abstract. This article addresses the lack of literature related to the interaction of banks and credit unions. It discusses issues related to comparing a not-for-profit financial cooperative, like a credit union, with the for-profit financial institution of a bank. The article also provides some analysis of credit union membership and how that impacts the local competitive structure. This article finds empirical evidence that the local proximity of banks and credit unions directly affect each other's competitive positions.

Comment. This article is relevant to the study by examining competition between credit unions and banks. It discusses issues specific to credit union membership and the common bond which are critical to this study. The performance of credit unions in a financial industry context is explored in the Review of Literature. The article is evaluated as credible based on the professional affiliation of the authors with the Federal Reserve Bank of St. Louis and by appearing in a peer-reviewed journal.

Fried, H. O., Lovell, C. A. K., & Yaisawarng, S. (1999). The impact of mergers on credit union service provision. *Journal of Banking & Finance*, 23(2-4), 367-386. doi:10.1016/S0378-4266(98)00090-9

Abstract. In this paper we conduct an empirical exercise in which we attempt to provide answers to three questions concerning credit union mergers: (i) do members of acquiring credit unions benefit from mergers?; (ii) do members of acquired credit unions benefit from mergers?; and (iii) what are the characteristics of relatively successful, and relatively unsuccessful, mergers? Our empirical exercise is based on annual samples of nearly 6000 credit unions, including nearly 300 merger participants, during the 1988–1995 period. We find member service provision to have improved in acquired credit unions, and to have been unchanged in acquiring credit unions. We also provide three separate analyses, from three different perspectives, of the role of various characteristics of merging credit unions in determining the success of mergers.

Comment. This article examines member impacts and services relative to the credit union industry merging trend. Mergers relate to the inter-industry credit union competitive landscape. Credit union competition and performance is explored in the Review of Literature. Additionally, the article provides insights into credit union performance decisions and decisions specific to interaction with membership. The article is deemed credible by appearing in a peer-review journal. The authors are affiliated with the University of Georgia and Union College and are recognized by their peers through citations of this literature.

Glass, J. C., & McKillopp, D. G. (2006). The impact of differing operating environments on US credit union performance, 1993-2001. *Applied Financial Economics*, 16(17), 1285-1300. doi: 10.1080/09603100500426713

Abstract. Today US credit unions operate within a highly competitive financial market place. Set against this competitive operating environment, the present study employs

stochastic frontier analysis to evaluate the performance of large credit unions (assets greater than \$50 million) over the period 1993 to 2001. Although credit unions may share a common co-operative philosophy, differences between credit unions are also apparent across a range of operational, structural and locational characteristics (environmental conditions). The impact of these different environmental influences is modeled in two ways. One assumes that environmental factors affect the efficiency with which the production process is operated, while the second assumes that the environment affects the production process itself. Net and gross cost efficiency measures are obtained for both models, with the differences between these measures for a specific credit union being viewed as the impact that environmental variables have on the inefficiency of that credit union. In addition, if it is assumed that the main environmental factors are accounted for in the modeling, then a credit union's net efficiency measure may be interpreted as a measure of managerial performance when operating in equivalent environments. The analysis revealed that different environments (the age of the credit union; the potential for expansion within the existing common bond; whether the credit union has the option of expansion through the addition of select employee groups; whether the credit union is state or federally regulated; whether insurance is provided at state or federal level; as well as regional characteristics such as per capita income and the level of unemployment) account for much of the variability in cost efficiency between credit unions and once credit unions are placed in broadly equivalent operating environments only marginal differences are apparent in their managerial performance.

Comment. This article is relevant to the study by providing a current credit union industry competition context. It examines performance of credit unions with larger than

\$50 million in assets based on the idea that these institutions are more likely to have evolved into full service financial providers and as such are now operating in a highly competitive environment. The article is included in the coded data set. The authors use an empirical econometric analysis with data originating from information compiled and made available by the NCUA. The article is deemed credible by the appearance in a peer-reviewed journal along with the author's academic affiliations with the University of Ulster and Queen's University.

Goddard, J., & Wilson, J. O. S. (2005). US credit unions: An empirical investigation of size, age and growth. *Annals of Public and Cooperative Economics*, 76(3), 375-406.
doi:10.1111/j.1370-4788.2005.00283.x

Abstract. An econometric analysis of the growth performance of US credit unions for the period 1992–2001 investigates empirical relationships between size, age and growth. *Ceteris paribus* larger credit unions grew faster than smaller unions. State credit unions grew faster than federal credit unions, and single bond credit unions grew faster than multiple bond credit unions. The size-growth gradients were generally steeper for state than for federal credit unions, and for single bond than for multiple bond credit unions. These patterns are attributed to variations in legislation and regulatory treatment. There is some evidence that younger credit unions tended to outgrow older ones. This seems consistent with a life cycle typology of credit union growth and development. There is also evidence of a positive persistence of growth effect. The cross-sectional variance of growth is inversely related to size, but is largely independent of age.

Comment. This article examines credit union performance relative to dynamics such as size, age, and common bond criteria. The authors use data available from information

collected by the NCUA as well as Callahan and Associates to create an empirical performance analysis. This article is critical to this study by providing analysis of credit union performance specific to membership and assets. Additionally the article discusses how regulatory changes have impacted the growth of both membership and assets. The information is specifically relevant to the Review of Literature and included in the coded data set. Additionally, this article also helps frame the delimitations of research. The article is deemed credible by appearing in a peer-reviewed journal along with the authors' academic affiliation with the University of Wales and University of St. Andrews.

Goddard, J., McKillopp, D. G., & Wilson, J. O. S. (2002). The growth of US credit unions.

Journal of Banking & Finance, 26(12), 2327-2356. doi:10.1016/S0378-4266(01)00203-5

Abstract. The growth of US credit unions during the 1990s is investigated empirically, using univariate and multivariate cross sectional and panel estimation techniques.

Univariate tests of the law of proportionate effect suggest that in general large credit unions grew faster than their smaller counterparts. On average credit unions with above-average growth in one period tended to experience below-average growth in the next. Smaller credit unions tended to have more variable growth than large ones. While credit unions share a common co-operative philosophy, they differ in terms of age profile, scope for membership growth, charter type and financial structure and performance. In estimations of a multivariate growth model, most of these characteristics are found to have a significant influence on the size-growth relationship. While large state chartered credit unions grew faster than their smaller counterparts, the reverse was true for federally chartered credit unions. In general, if larger credit unions grew faster than smaller ones, they tended to do so for specific reasons: because their charters were less

restrictive, because they were more efficient, or because they had a financial structure that was more conducive to growth. Therefore credit union growth was not ‘random’, but highly systematic.

Comment. This article empirically examines the systematic growth of credit unions. The information is critical to help frame this study’s purpose and definitions as well as being included in the Review of Literature coded data set. Central to this article is examining which credit unions make the best use of opportunities for growth. The law of proportionate effect (LPE) is discussed and noted that research specific to the LPE and financial institutions is lacking. The authors describe credit union specific variables related to federal or state charters, common bond requirements, institution age, size of potential membership and financial performance. The outcome describes how these variables empirically affect a credit unions growth. The article is deemed credible by the fact that it is cited in other references, which indicates recognition from peers. Additionally, the article appears in a peer reviewed journal and the authors’ are respectively academically affiliated with the University of Wales, Queen’s University and the University of St. Andrews.

Goddard, J., McKillopp, D. G., & Wilson, J. O. S. (2008). What drives the performance of cooperative financial institutions? Evidence for US credit unions. *Applied Financial Economics*, 18(10-12), 879-93.

Abstract. Nested analysis of variance is used to identify the sources of variation in performance, measured by growth of membership and growth of assets, for a large sample of US credit unions. The analysis reveals that sector effects (geographic, common bond and charter type) account for only relatively small proportions of the variation in

performance. This raises doubts as to whether credit unions are likely to benefit much from competitive repositioning at sector level (by changing their charter type or common bond designation). It may be that the perceived benefit derived from such maneuverings is greater than the actual benefit, or it may be that the large number of credit unions seeking a more permissive operating environment has ended up negating any potential gain in performance across the sector as a whole. In contrast to the limited role identified for sector effects, individual credit union effects explain a large proportion of the variation in performance. This suggests that decisions made by individual credit unions with respect to staffing, governance and product portfolio, as well as philosophy and ethos, play an important role in explaining the heterogeneity in credit union performance.

Comment. This article examines the credit union issues of varying performance specific to an individual credit union context. The article uses data provided by the NCUA to present empirical evidence of credit union asset and membership growth related to credit union's common bond requirements, institution size and charter type. The article is deemed credible by appearing in a peer-reviewed journal. Goddard, McKillop and Wilson are recognized by their peers through citations of their work. Mr. Goddard, Mr. McKillop and Mr. Wilson are respectively affiliated with Bangor University, Queen's University and the University of St. Andrews.

Gorla, N. (2003). Features to consider in a data warehousing system. *Communications of the ACM*, 46(11), 111-115.

Abstract. This article aims to find the effect of online analytical processing (OLAP) features on perceived ease of use (PEU) and the perceived usefulness (PU) of OLAP, and to provide guidelines for better design of data warehouses with OLAP technology. In

order for an organization to achieve competitive advantage, voluminous data needs to be managed, analyzed, and fed into the decision-making process. Data warehouses provide decision support to organizations with the help of analytical databases and OLAP tools. Incorporating OLAP tools into decision models as part of decision support systems improves decision making. However, despite potential benefits of data warehousing and OLAP tools, such projects were difficult to use and failed to realize benefits.

Corporations that invest in data warehouses often do not provide tools to end users that they can use easily, resulting in unused software and unrealized return on investment.

The most important determinants of new technology acceptance are PEU and PU.

Comment. This article examines data warehousing to support competitiveness. The article's purpose is to find the effects of data warehousing features on perceived ease of use and perceived usefulness for end users. The article discusses concepts relevant to this study related to data warehousing, and by describing the information from transactional databases used with data warehouses. The information is used to define terms specific to this study along with framing the outcome and is included in the data set coded in the Review of Literature. The article is deemed credible by appearing in a peer-reviewed journal and the author's affiliation with Wayne State University.

Gunnarsson, C. L., Walker, M. M., Walatka, V., & Swann, K. (2007). Lessons learned: A case study using data mining in the newspaper industry. *Journal of Database Marketing & Customer Strategy Management*, 14(4), 271-280. doi:10.1057/palgrave.dbm.3250058

Abstract. Many organizations across a variety of industries are engaging in the process of data mining as part of an overall strategy for business intelligence, customer relationship management (CRM), including churn prevention. This paper provides an

overview of the data mining process and illustrates a case study in which data mining is utilized as a churn prevention tool for a major Midwest USA newspaper. For this case study, a decision tree, a common modeling technique, was the analytical tool of choice. Lessons learned throughout the data mining process are provided to offer insight and to promote the sharing of information. Strategies for getting started in the data mining process are presented to encourage organizations to embrace a data-driven strategy for business intelligence, CRM and churn prevention.

Comment. This article presents a case study specific to the implementation and use of data mining as a means to retain customers. The industry example uses the transactional data maintained operationally to build a data mining solution. Issues related to data warehouse and data preparation are also discussed as part of the overall data mining solution. This is particularly relevant to this study to frame the purpose, help provide delimitations of research, term definitions and to support the Review of Literature. The article is deemed credible by appearing in a peer-reviewed journal. Additionally, the credibility is validated by author's experience and academic affiliation. Dr. Gunnarsson previously taught at Xavier University and has since established S2 Statistical Solutions, Inc. Ms. Walker is a professor at Xavier University. Mr. Walatka and Mr. Swann both have professional experience related to data analysis.

Hamel, L. (2005). *A brief tutorial on database queries, data mining, and OLAP*. University of Rhode Island. Retrieved from <http://homepage.cs.uri.edu/faculty/hamel/pubs/hamel-197-manuscript-final.pdf>

Abstract. Modern, commercially available relational database systems now routinely include a cadre of data retrieval and analysis tools. Here we shed some light on the

interrelationships between the most common tools and components included in today's database systems: query language engines, data mining components, and on-line analytical processing (OLAP) tools. We do so by pair-wise juxtaposition which will underscore their differences and highlight their complementary value.

Comment. This article examines concepts specific to OLAP, data mining and general database queries. Information about the functions and results of each approach are compared against each other to delineate differences. The information is critical to this study as seen in the Review of the Literature. The article is deemed credible by the author's academic association with the University of Rhode Island.

Handrinos, M. C., & Nikolopoulos, K. (2008). The future of credit unions in the United States: Evidence from quantitative extrapolations. *Applied Financial Economics Letters*, 4(1-3), 177-82.

Abstract. Credit Unions (CUs) are financial co-operatives owned and controlled by their members; in the United States they operate both on state as well as on a national level and are in direct competition with retail high-street banks. In this study we use published data for six key financial figures from ten states in the US and present short to mid-term extrapolations. An Expert Forecasting Support System, selecting via a competition among classic extrapolative techniques, has been employed in order to prepare one-year as well as five-years ahead forecasts. The results surface significant statistical evidence of: (a) merging across CUs, and (b) blooming of all key financial figures.

Comment. This article extrapolates credit union industry performance for the next five years. Information such as the credit union common bond and industry competition is discussed with is relevant to this study by helping to frame the research problem and

delimit the research. The authors examine credit union data from 2001 through 2005 provided by Callahan and Associates, Inc. Of the six key figures determined by the authors for the extrapolation, credit union membership and credit union total assets are included. These figures are of critical importance to this study as referenced in the Review of Literature. The article is deemed credible by appearing in a peer-reviewed journal and the authors' affiliations with the University of Peloponnese and Lancaster University, respectively.

Jaffri, S. A. H., & Nadeem, M. (2004). *Application of business intelligence in banks (Pakistan)*.

SZABIST, Karachi, Pakistan. Retrieved from <http://arxiv.org/abs/cs/0406004v1>.

Abstract. The financial services industry is rapidly changing. Factors such as globalization, deregulation, mergers and acquisitions, competition from non-financial institutions, and technological innovation, have forced companies to re-think their business. Many large companies have been using Business Intelligence (BI) computer software for some years to help them gain competitive advantage. With the introduction of cheaper and more generalized products to the market place BI is now in the reach of smaller and medium sized companies. Business Intelligence is also known as knowledge management, management information systems (MIS), Executive information systems (EIS) and On-line analytical Processing (OLAP).

Comment. This article is critical to the study by directly examining the role of BI in financial institutions. General BI aspects such as, infrastructure, data transformation, data warehouses, implementation and support is discussed. Additionally, the article describes industry BI perspectives for consumer banking and investment banking. A small case study specific to the BI implementation of the State Bank of Pakistan is examined. The

information presented in this article is critical to framing the introduction of this study and with the Review of Literature. The article is deemed credible by authors' affiliations with the Shaheed Zulfikar Ali Bhutto Institute of Science and Technology (SZABIST), respectively. Additionally the article follows a logical structure and the information presented is consistent with other references identified in this study.

Jourdan, Z., Rainer, R. K., & Marshall, T. E. (2008). Business intelligence: An analysis of the literature. *Information Systems Management*, 25(2), 121-131.

doi:10.1080/10580530801941512

Abstract. This research collects, synthesizes, and analyzes 167 articles on a variety of topics closely related to business intelligence (BI) published from 1997 to 2006 in ten leading Information Systems (IS) journals. We found a generally increasing level of activity during the 10-year period and a focus on exploratory research methodologies. We noted that several methodologies were either underrepresented or absent from the pool of BI research. We also identified several subject areas that need further exploration.

Comment. This article is a review of BI related literature. It is critical to this study by presenting a broad view of BI and introduces sub-contexts found in literature that relate to BI. This information is used to frame the introduction and the research questions. The article is deemed credible by appearing in a peer-review journal and the authors' affiliation with Auburn University.

Jukic, N. (2006). Modeling strategies and alternatives for data warehousing projects.

Communications of the ACM, 49(4), 83-88.

Abstract. This article focuses on data warehousing. Data stored in a data warehouse can capture many different aspects of the business process, including manufacturing,

distribution, sales, and marketing. Choosing a suitable data modeling approach is essential for a data warehousing project to succeed. The article provides an impartial and concise view of the competing methodologies and issues that fuel the ongoing debate about data warehousing models.

Comment. Mr. Jukic discusses data warehouse implementations and why they are needed to better analyze operational data. The article offers three modeling techniques, including an analysis of each technique, for the creation of a data warehouse. The information presented in this article is critical to the definitions of this study, frames significance and the research problem and is used in the Review of Literature. The article is deemed credible by appearing in a peer-reviewed journal and by the author's affiliation with Loyola University.

Leggett, K. J., & Strand, R. W. (2002). Membership growth, multiple membership groups and agency control at credit unions. *Review of Financial Economics*, 11(1), 37-46.

doi:10.1016/S1058-3300(01)00032-5

Abstract. Starting in 1982, the federal credit union regulator allowed credit unions to add multiple membership groups. The policy was disallowed by the U.S. Supreme Court in 1998, but revalidated by the U.S. Congress later that year. Allowing credit unions to attach multiple membership groups has contributed significantly to rapid growth in the industry. As credit unions add unrelated groups and expand, the prospects for separation between ownership and control increases, creating potential agency control problems. This potential is compounded by the one member, one vote governance structure of credit unions. This research finds empirical evidence that agency problems grow as credit unions add membership groups and members. If a credit union takes on more than one

membership group, and as membership increases, management is apparently able to channel residual earnings away from members (in the form of higher net interest margins) toward itself (higher salaries and operating expenses).

Comment. This article explores the regulatory changes that have allowed the credit union to redefine their common bond to include multiple select-employee-groups (SEG) and the effect that has on credit union management practices. The information is relevant to this study by providing information about recent credit union performance trends related to membership and membership growth. It provides a negative member specific impact associated with credit union membership growth that is considered in the Review of Literature. The article is deemed credible by the authors' affiliation with the American Bankers Association and that the article appears in a peer-reviewed journal.

Little, R. G. J., & Gibson, M. L. (2003). Perceived influences on implementing data warehousing. *IEEE Transactions on Software Engineering*, 29(4), 290-296.

doi:10.1109/TSE.2003.1191794

Abstract. This study surveyed data warehousing implementation project participants to determine what aspects they perceived should contribute to the implementation process. The respondents included: functional managers/staff, IS managers/staff, and consultants. The study identified eight significant factors that participants perceived should impact data warehouse implementation.

Comment. This article uses exploratory research to provide possible impacts the implementation of a data warehouse as perceived by participants of actual data warehouse implementations. This study analyzed surveys of 241 individuals across 41 companies in the U. S., Canada and Europe, with relevant data warehouse and

professional experience. This article is critical to this study by identifying key areas that require consideration when implementing a data warehouse and is used to frame the search strategy and in the Review of Literature. The article is deemed credible by appearing in a peer-reviewed journal and the authors' affiliations with Auburn University and the University of Houston, respectively.

Lonnqvist, A., & Pirttimaki, V. (2006). The measurement of business intelligence. *Information Systems Management*, 23(1), 32-40.

Abstract. Based on a literature review, this article identifies and assesses measurement approaches for two different purposes: determining the value of BI and managing the BI process within an organization.

Comment. This literature review article provides information relative to the overall concepts of BI and suggests ways that BI can be measured to better determine value and manage. The information presented is critical to frame the research problem, define terms and frame the search strategy of this study. The article is deemed credible by appearing in a peer-reviewed journal and the authors' affiliation with the Tampere University of Technology.

O'Hara, M. T., & Brohman, M. K. (2002). Boeing Employees' Credit Union: Leveraging the data warehousing investment. In *35th Annual Hawaii International Conference on System Sciences (HICSS'02)* (Vol. 8). Big Island, Hawaii. doi:10.1109/HICSS.2002.994284

Abstract. The Boeing Employee Credit Union (BECU) has been providing financial assistance to employees since 1935. By 1938, membership had grown to 850 members. During the 1990s, BECU grew from 150,000 members with 362,000 accounts to 260,000 members with 1,170,174 accounts. BECU is the largest financial cooperative in

Washington State, and the third largest credit union in the country. Without significant investments in information technology, however, it would be impossible for BECU to deliver personalized service to its members. The idea of creating a member-centric information systems capability was first expressed in May 1999. Today, the data warehouse has resulted in many benefits, including plans to leverage the \$2 million investment by providing three distinct types of service. This case study details these three types of service, the impact of each service on BECU's performance, and the future directions and the lessons learned from the project.

Comment. This article presents a case study of the Boeing Employee Credit Union's data warehouse implementation. The article addresses some technical content in relation to data warehouse implementations but more focus is placed on the business. The information presented is critical to this study by providing a case study specific to a credit union context. The article is used to define terms and frame the significance of this study. Additionally, this article is included in the data set to be coded for the Review of Literature. The article is deemed credible by being peer-reviewed along with the authors' academic affiliations with East Carolina University and The University of Georgia, respectively.

Park, Y. (2006). An empirical investigation of the effects of data warehousing on decision performance. *Information & Management*, 43(1), 51-61. doi:10.1016/j.im.2005.03.001

Abstract. Organizations implement data warehouses to overcome the limitations of DSS by adding this database component and thereby improve decision performance. However, no empirical evidence is available to show the effects of a data warehouse (DW) on decision quality and performance. To examine this, a laboratory experiment was

conducted. The data warehouse variables considered were the time horizon of the data and its level of aggregation. It was found that using a full data warehouse resulted in significantly better performance and that using it resulted in better performance than using a partial data warehouse (long-time history with no aggregated data). However, using a partial data warehouse was not significantly better than not using a data warehouse at all.

Comment. This article examines decision making in relation to employing the use of a data warehouse. The author's study is based on an experiment evaluating decision performance against databases of varying characteristics, from transactional databases through data warehouses. The information presented is critical to the study by providing information related to the process of BI and helps describe the intended audience. This article also included in the data set coded in the Review of Literature and is deemed credible by appearing in a peer-reviewed journal. Additionally, credibility is established by the author's academic affiliation with California State University.

Phan, D. D., & Vogel, D. R. (2010). A model of customer relationship management and business intelligence systems for catalogue and online retailers. *Information & Management*, 47(2), 69-77.

Abstract. As more retailers evolve into customer-centric and segment-based business, business intelligence (BI) and customer relationship management (CRM) systems are playing a key role in achieving and maintaining competitive advantage. For the past ten years, the authors have had the rare opportunity of observing and interviewing employees and managers of three different management teams at three separate Fingerhut companies as they experimented with various ITs for their companies. When the first Fingerhut

company peaked in 1998, as many as 200 analysts and 40 statisticians mined the database for insights that helped predict consumer shopping patterns and credit behavior. Data mining and BI helped Fingerhut spot shopping patterns, bring product offerings to the right customers, and nurture customer relationships. By 1998, Fingerhut was the second largest catalogue retailer in the U.S. with revenues nearing \$2 billion. However, after Federated acquired Fingerhut in 1999 and made it a subsidiary, Fingerhut Net, it suffered great losses and was eventually liquidated. Finally, a new company, Fingerhut Direct Marketing, was resurrected in 2002 under a new management team, and it once again became successful. What went right? What went wrong? The paper concludes with CRM and BI systems success factors and a discussion of lessons learned.

Comment. This article presents a case study following a specific company through several organizational changes and how BI and CRM played a role in those changes. Information presented is critical to this study by providing real world examples of a BI implementation. This study uses the information to help frame the research problem and purpose. This article is also included in the Review of Literature and coded following the data analysis plan. Mr. Phan and Mr. Vogel are academically affiliated with St. Cloud University and City University of Hong Kong, respectively. The authors' academic affiliations help lend credibility to this article along with the fact it appears in a peer-reviewed journal.

Vedder, R. G., Vanecek, M. T., Guynes, C. S., & Cappel, J. J. (1999). CEO and CIO

perspectives on competitive intelligence. *Communications of the ACM*, 42(8), 108-116.

Abstract. The article focuses on competitive intelligence (CI), also known as business intelligence, which is both a process and a product. As a process, CI is the set of legal and

ethical methods, a company uses to harness information that helps it achieve success in a global environment. As a product, CI is information about competitors' activities from public and private sources, and its scope is the present and future behavior of competitors, suppliers, customers, technologies, acquisitions, markets, products and services, and the general business environment. There is much more to competitive intelligence than just market research. The word assessment suggests an ongoing process using a variety of information streams and data gathering techniques including psychological profiling and new technology evaluation. The growth of CI has important implications for both the management and operation of IT units. CI supports the information needs of organizations in a variety of ways. Historically, companies have usually applied CI to the information and business planning needs of non-IT business units. Companies have also used CI in their strategic planning process.

Comment. This article presents ideas of BI in a competitive context. The ideas presented are also focused on the impacts to and from an organizations Information Technology infrastructure. The article uses a survey to measure the current state of competitive intelligence activities. The resulting survey data is from 55 CEOs and 82 CIOs. The information is critical to this study to frame the introduction and is include in the Review of Literature data set for coding. The article is deemed credible by recognition from peer citations, the articles appearance in a peer-reviewed journal and the authors' academic affiliations with the University of North Texas and Central Michigan University.

Walter, J. R. (2006). Not your father's credit union. *Federal Reserve Bank of Richmond Economic Quarterly*, 92(4), 353-77.

Abstract. Market forces and regulatory changes have produced an evolution of the credit union industry so that many credit unions now compete more directly with banks than in the past. Because credit unions are tax-exempt, while in general banks are not, observers note that credit unions may have an advantage in the competition. The goal of this article is to provide a history of the evolution without taking a stand on the merits of either side of the tax debate.

Comment. This article is relevant to the study by providing credit union industry analysis from a historical perspective up through recent trends. Ideas specific to the common bond and ways in which credit unions differ from other financial institutions are discussed in depth. Information from this article is used to present the research problem and frame the delimitations of research. This article is deemed critical as it is published in peer-reviewed economic journal and by Mr. Walter's professional experience working as a senior economist to the Federal Reserve Bank of Richmond.

Review of the Literature

Through the process described in the Data Analysis Plan, references selected for coding (see Annotated Bibliography) are sorted into categories associated with the three primary themes identified in the Writing Plan. The larger categories of *credit union performance*, *business intelligence solutions*, and *business intelligence case studies* are identified. Appendix C shows the coded references sorted into their corresponding theme categories. Overall, the *credit union performance* and *business intelligence solution* categories contain the majority of articles identified and coded with 11 references each. Case study articles included in the *business intelligence case study* category are not as prevalent with only four being identified and coded. Only one reference is identified and coded that contains aspects related to both a credit union and business intelligence context (O'Hara & Brohman, 2002). The O'Hara and Brohman (2002) article is also a case study and it is the only article located and coded that is relevant to all three primary themes identified in the Writing Plan.

The review of literature reports on information necessary for development of the framework identified in this study's proposed outcome. The framework (see Conclusions) describes the operational collection of transactional and member specific information stored in databases to support membership and asset growth and employs both the process and product of BI. Understanding credit union growth dynamics, current industry trends and competitive landscape provides direction as to where a credit union can be positioned to achieve further growth. Additionally, understanding how to leverage operational and transactional data in the credit union database to make better business decisions and more effectively interact with membership is one avenue that could create additional growth opportunities.

Credit Union Performance

The U. S. credit union industry began in 1909 and originally served a niche loan market of unsecured, small dollar, consumer loans (Walter, 2006). Credit unions are “financial cooperatives owned and controlled by their members” (Handrinos & Nikolopoulos, 2008, p. 177). Until the 1980s, that ownership and associated membership was limited to a group with some type of single common bond (Leggett & Strand, 2002). Traditionally, people were attracted to the combination of amplified borrowing power along with encouragement to put money aside (Handrinos & Nikolopoulos, 2008). The amplified borrowing power came with the association to the common bond. The unsecured nature of a credit union’s original lending practices relied on the member’s association with the common bond and could be leveraged by the credit union as a substitute for collateral to determine and offset risk (Walter, 2006). Today, credit unions play a significant role in the U. S. economy (Handrinos & Nikolopoulos, 2008). They are important financial institutions in the U. S. despite the relatively small seven percent market share (Bauer, 2008).

As noted by Handrinos and Nikolopoulos (2008), “the CU industry in the U. S., since the 1977 change of legislation of the financial services industry, has been affected by a number of forces such as innovation, technology, deregulation and competition” (p. 178). In 1982, the NCUA began allowing credit unions to add unrelated membership groups to the field of membership (Leggett & Strand, 2002). The U. S. Supreme Court later ruled the NCUA’s policy violated the Federal Credit Union Act (Leggett & Strand, 2002). Subsequently, Congress revisited that decision and passed the Credit Union Membership Act, which legislatively allowed credit unions to add select employee groups (SEGs) to their field of membership (Goddard et al., 2008).

Growth and the common bond. Discussions of credit union growth need to analyze the common bond requirement. The ratio of actual to potential membership available to the credit union given the coverage of its common bond is an important determinant of growth (Goddard et al., 2002). The common bond association defines the credit union's membership base to a group of people that share employment, profession, locality, religion or ethnicity (Handrinos & Nikolopoulos, 2008). Thus the credit union's market penetration and potential customer base is capped by the definition of their common bond.

The credit union industry is experiencing a downward trend in the average rate of credit union membership growth (Goddard et al., 2008). One explanation is that credit unions are beginning to experience difficulties attracting new members given a restrictive scope of their associated common bond (Goddard et al., 2008). Credit unions that are close to the potential membership limit face difficulties sustaining strong growth performance (Goddard et al., 2002). With the changes of the Credit Union Membership Access Act, federal credit unions can add potentially unrelated groups to the field of membership creating multiple common bond credit unions (Leggett & Strand, 2002). By allowing credit unions to add inclusive criteria to the common bond, it has allowed credit unions to grow into a larger potential membership base. This less restrictive interpretation of the common bond creates new opportunities and has been important in permitting credit unions to sustain growth (Goddard et al., 2002). An avenue now available is to alter the common bond status to operate in an environment most favorable to their growth aspirations (Goddard et al., 2008). Not only does it increase the potential membership from a credit union perspective, it also broadens the choices for individuals interested in credit union services (Goddard et al., 2002). From an industry perspective, credit unions with multiple common bonds grow faster than those with a traditional common bond (Goddard & Wilson,

2005). However, comparisons between single and multiple common bond credit unions show there is not a significant difference between their profitability when measured by the return on assets (Leggett & Strand, 2002).

While credit unions that have come close to exhausting their potential membership in relation to their common bond status, other growth opportunities may be available in relation to the products and services being provided. Credit unions that have significantly penetrated their common bond are increasingly likely to provide repeat services to members and will therefore be better placed to identify members that represent sound business opportunities (Glass & McKillopp, 2006). The repeat servicing better allows the credit union to determine high and low risk members resulting in lower loan losses which has a positive impact on cost saving (Glass & McKillopp, 2006).

Deregulation and the changing the competitive landscape. Credit unions are import to the competitive financial institution landscape even with their relatively small seven percent market share (Bauer, 2008). Deregulation allows credit unions to diversify and overall strengthen their competitive position by creating diversity amongst their membership (Glass & McKillopp, 2006). Goddard et al. (2008) believe that the credit unions that successfully adapt to recent regulation changes “can be expected to demonstrate improved performance in terms of membership and asset growth” (p. 891).

Goddard et al. (2008) state recent regulation changes allow credit unions to “evolve from niche players providing services to a narrowly defined membership into full service retail depository institutions” (p. 891) serving a broad membership base. “Credit unions now compete head on with other retail financial institutions and indeed with other credit unions due to common bond dilution” (Glass & McKillopp, 2006, p. 1298). The less restrictive common bond

has allowed an increase for their potential membership base. This, combined with a credit union's tax-exempt status, creates friction with the banking community where they feel credit unions have an unfair advantage (Glass & McKillopp, 2006).

Banks and credit unions directly affect each other's competitive positions (Emmons & Schmid, 2000), but to what level the effect is felt by either financial institution is open to some debate. Emmons and Schmid (2000) find that competitive conditions among banks influence the behavior of credit unions and their potential members, but credit unions are not important determinants of bank deposit rate-setting behavior. This suggests that credit unions react more to banking competitive positioning than vice versa.

Credit union information systems. Credit unions serve as convenient and accessible savings and loans institutions to members (Handrinos & Nikolopoulos, 2008) and share features common to all financial institutions. Credit unions have expanded beyond traditional savings and loan accounts to now include checking accounts, mortgage and home equity loans, and credit and debit cards (O'Hara & Brohman, 2002). Credit unions have also expanded beyond the traditional brick-and-mortar delivery channel to include branch networks, Automated Teller Machines, voice response applications, call center service departments, and websites to provide services to their members (Walter, 2006, p. 360). Additionally, credit unions are now able to incorporate a commercial account portfolio and can offer interest bearing business checking accounts, commercial, agriculture, and venture capital loans (Goddard et al., 2008).

Industry competition has "necessitated that credit unions invest heavily in information technology to improve and enhance the financial products on offer to members" (Glass & McKillopp, 2006, p. 1294). Investments into information technology can enable credit unions to deliver more competitive financial products and increase the level of service provided to their

members (O'Hara & Brohman, 2002). These investments and subsequently each added product and delivery channel increases the need for more complex information technology (Ono & Stango, 2005). Providing these new services and products often requires large databases containing member details along with their records of transactional data (Dass, 2006). As a result, valuable pieces of information are contained within operational databases (Dass, 2006). Credit union developments associated with information technology have led to an increased demand to analyze operationally captured data, stored in large and complex data warehouses (Dass, 2006). Based on the large amount of member specific information already being maintained, business intelligence solutions can be employed to leverage and analyze the existing data to glean insights associated with business objectives (Dass, 2006). Using business intelligence based on their transactional data, credit unions improve member growth and by identifying the correct products to market to each member they improve asset growth (Dass, 2006).

Business Intelligence Solutions

The strategic plans for competing in any market place are no better than the information on which those plans are based (Dass, 2006). Companies are now able to collect vast amounts of transaction data and the abilities to collect that data have outpaced the ability to efficiently analyze it (Apte et al., 2002). Business intelligence (BI) “presents business information in a timely and easily consumed way and provides the ability to reason and understand the meaning behind business information” (Lonnqvist & Pirttimaki, 2006, p. 32). Organizations have a greater chance of being successful by having access to the right information at the right time (Dass, 2006). BI has become an important source of that information (Vedder et al., 1999).

Jourdan et al. (2008) note an increasing trend in BI related literature that suggests the topic is becoming more important to researchers and practitioners. BI is presented in literature as both a process and a product. The process refers to the methods that are used to develop useful information (Jourdan et al., 2008). The product is the resulting information that provides insights to understand current and predict future behaviors of customers and competitors (Vedder et al., 1999).

The data warehouse drives the process of business intelligence. Businesses that require “data-driven analysis for decision making typically construct data warehouses to capture as much information as possible about their customers” (Apte et al., 2002, p. 49). More succinctly, a data warehouse supports the process of BI. Data warehousing is a standard practice for most large companies and the data it stores can capture many different aspects of business processes (Jukic, 2006). Additionally, current literature identifies a data warehouse as a critical piece of a typical BI architecture (Apte et al., 2002; Castellanos et al., 2009).

The data warehouse is created as a separate data store whose primary purpose is to support data analysis (Jukic, 2006). There are at least three reasons why the data warehouse should be separate from the operational database:

1. Operational databases drive the business and customer interaction and adding the overhead of additional data analysis processes negatively impacts the overall performance of the operational database (Little & Gibson, 2003). The performance of the operational database queries “can be severely diminished if they must compete for computing resources with analytical queries” (Jukic, 2006, p. 84).

2. Data retention required by analytical processes to discern behaviors and trends is often not maintained to the same degree in operational databases and only accessible through operational database backups (Little & Gibson, 2003).

3. It is difficult to architect a database that can be interacted with in a way that easily supports both operational and analytical purposes (Jukic, 2006).

“For any data warehouse, the infrastructure that facilitates retrieval of data from operational databases into data warehouses” is known as extract, transform and load (ETL) (Jukic, 2006, p. 84). ETL provides the mappings to move data from the operational business processes into a form that facilitates analytical processing (Castellanos et al., 2009). The data warehouse is populated by extracting “data from distributed and usually heterogeneous operational sources; cleansing, integrating, and transforming the data” (Castellanos et al., 2009, p. 1) to a form compatible with the data warehouse design. A large amount of time and resources could be required to properly design and implement the ETL processes. Up to 70% of the effort to create a data warehouse goes into the ETL design and implementation (Castellanos et al., 2009; Jukic, 2006). Apte et al. (2002) note that “transaction data is notorious for requiring transformation” (p. 51) before it can be used in an analytical context making the ETL process even more important for consideration of credit union data.

Data mining and OLAP deliver actionable information. Once a data warehouse is implemented and populated with data, “various analytically useful extracts are possible” (Jukic, 2006, p. 86). Processes like data warehousing, OLAP and data mining can be combined into powerful BI solutions which “are not only able to retrieve records efficiently but also support sophisticated analyses such as customer classification and market segmentation” (Hamel, 2005, p. 1). Data mining and OLAP are two potential technologies that support creating the BI product

of useful information (Little & Gibson, 2003). According to Hamel (2005), “OLAP allows for real-time access to pre-aggregated measures along important business dimensions” (p. 12), while Dass (2006) notes “data mining can contribute to solving business problems in banking and finance by finding patterns, causalities, and correlations in business information and market prices that are not immediately apparent to managers because the volume data is too large or is generated too quickly” (p. 3). Several dynamics converge to drive the need for more advanced data mining techniques:

One is the increasing availability of large volumes of high-dimensional data occupying database tables with millions of rows and thousands of columns.

Another is the competitive demand for the rapid construction and deployment of data-driven analytics. A third is the need to give end users analysis results in a form they readily understand and assimilate, helping them gain the insights they need to make critical business decisions. (Apte et al., 2002, p. 49)

“Data mining is an iterative process that is employed as part of an overall strategy for business intelligence and problem solving by employing statistical modeling to large amounts of transformed, transactional and historical data” (Gunnarsson et al., 2007, p. 273). By using data mining techniques “users gain insight into trends and relationships among the elements in the database and are better able to manage customer information and deliver a higher level of customer satisfaction” (O'Hara & Brohman, 2002, p. 1).

The objectives best suited for data mining are those involving prediction or attempting to understand a specific behavior (Gunnarsson et al., 2007). In contrast to simple database queries, data mining creates models associated with the data in question (Hamel, 2005). The modeling process attempts to predict or explain individual or segmented population behavior (Gunnarsson

et al., 2007). “The models can be viewed as high level summaries of the underlying data and are in most cases more useful than the raw data, since in a business sense they usually represent understandable and actionable items” (Hamel, 2005, p. 5). For example, a database query could return a data set of members that have an account balance greater than \$100.00, whereas a data mined model could construct something like members that have an account balance greater than \$100.00, are older than 35 years of age, have at least one loan account, and directly deposit their pay check. The query finds raw data matching a certain constraint, and data mining algorithms construct actionable rules that summarize thousands of records (Hamel, 2005). If a credit union determines the resulting model is a desirable cross-section of membership, the associated information allows them to target that market segment (Hamel, 2005).

Modeling transaction data requires dealing with several challenges. Transaction data typically includes large numbers of records potentially generated by millions of transactions on a daily basis (Apte et al., 2002). Additionally, those transactions exhibit a heterogeneous quality as behaviors vary depending on individual tastes and means (Apte et al., 2002). Association-rule algorithms were developed early on to efficiently search for correlations with the transactional data (Apte et al., 2002). These algorithms are good for exploratory analysis but are less suited for predicting individual behavior (Apte et al., 2002).

Predictive profile modeling leverages the data warehouse to predict outcomes of decision alternatives (Apte et al., 2002) and can be used to predict buyer patterns and maintain customer loyalty and satisfaction (Phan & Vogel, 2010). A popular approach to predictive profile modeling is to first create various segments of target populations and then develop separate predictive models for each segment (Apte et al., 2002). Traditionally, good segmentation criteria tended to be found primarily through trial and error (Apte et al., 2002). Apte et al. (2002) state

predictive profile algorithms typically transform “transaction data for each customer into a set of feature values that are then used to make predictions” (p. 51) about future behavior. The model is not designed to capture all aspects of individual behavior but to extract useful higher level characteristics (Apte et al., 2002).

Where data mining models return actionable rules, “OLAP allows users to compare and contrast measures along business dimensions in real time” (Hamel, 2005, p. 11). Incorporating OLAP analysis into decision models can improve the quality of decision making (Gorla, 2003). In order to enable OLAP, the database tables are usually reorganized into a “star schema where the inner-most table is called the fact table and the outer tables are called dimension tables” (Hamel, 2005, p. 8). Jaffri and Nadeem (2004) discuss employing a star schema to address the business intelligence challenges faced by the State Bank of Pakistan’s Credit Information Bureau. By rearranging the database structure and incorporating pre-aggregation of specific dimensions, related query results require less computational power and can enable real time analysis (Hamel, 2005). Additionally, data mining models can be used to improve the accuracy and precision of the OLAP queries. By using the data mined actionable rules based on the historical data, OLAP queries can be more usefully designed (Gorla, 2003).

Business Intelligence Case Studies

Four case studies are identified as pertinent for examination in this study. A consensus among all four case studies is that business intelligence can be used to increase the quality of business and individual decisions as well as increase the quality of customer relationships. The first case study is specific to business intelligence and exhibits a direct relationship to a credit union (O'Hara & Brohman, 2002). The second pertains to other financial institutions (Jaffri & Nadeem, 2004). The third and fourth examine the nature of industry specific transactional data

(Gunnarsson et al., 2007; Phan & Vogel, 2010). Each case study provides insights into the implementation of a business intelligence solution. Business intelligence benefits, implementation best practices, and potential benefits and difficulties are described as they relate to real world practices.

Case study #1: O'Hara, M. T., & Brohman, M. K. (2002). Boeing Employees' Credit Union: Leveraging the data warehousing investment. In *35th Annual Hawaii International Conference on System Sciences (HICSS'02)* (Vol. 8). Big Island, Hawaii. doi:10.1109/HICSS.2002.994284

O'Hara and Brohman (2002) investigate the implementation of a data warehouse for a specific large credit union. The case study is particularly relevant as the subject is a credit union; however it must be noted that although the solutions, philosophy and business decisions of a credit union can be approximated, they are difficult to capture entirely.

The credit union in question received numerous benefits related to increasing membership and asset growth, as a result of their data warehouse implementation and the information they were able to extract from that data. O'Hara and Brohman (2002) identify the benefits as:

- Increased efficiency and quality in marketing campaign development and tracking.
- Identifying new products and services most suitable to member needs.
- Creation of new business opportunities.
- Enhanced credit union performance; both return-to-member and with an increase in the number of services per member.

Additionally, O'Hara and Brohman (2002) identify the following six best practices during the credit union's BI solution implementation:

- Align with the businesses strategic plan. In this case, the business intelligence solution was driven by the organization's strategic plan to better understand their membership.
- Involve users from the beginning and manage their expectations. Users of the solution can have a negative association if they feel left out of the planning.
- Implement the solution quickly. A rapid deployment allowed for an immediate commitment from users.
- Concentrate on internal customer service. IT needs to serve the interests of internal customers to be successful.
- Develop a plan to transfer expertise. Managing the knowledge resources can ease the transition of the project through its life cycle stages.
- Invest in project management. Proper project management can allow the implementation to stay on time and within budget.

Case study #2: Jaffri, S. A. H., & Nadeem, M. (2004). Application of business intelligence in banks (Pakistan). SZABIST, Karachi, Pakistan. Retrieved from <http://arxiv.org/abs/cs/0406004v1>

Jaffri and Nadeem (2004) discuss business intelligence in more general terms associated with the financial industry and how a technical solution was implemented for an organization that provided credit ratings for individuals in Pakistan. That solution was created around a data warehouse and incorporated an OLAP enabled star schema architecture. Discussion addressed the software tools and associated versions that were used during the implementation.

Jaffri and Nadeem (2004) identify three best practices to begin the implementation of a business intelligence solution:

- Do your homework. Consider where business intelligence can be applied, who would possibly benefit and what types of information would be needed.
- Share and collect ideas. Gather subject matter experts to share and brainstorm ideas related to what business processes can benefit most from business intelligence.
- Evaluate alternatives. Categorize and prioritize the ideas collected during brainstorming to the opportunities that offer largest benefits.

The benefits of a business intelligence solution are sometimes not easily quantifiable but none the less can have a large impact. Jaffri and Nadeem (2004) identify the following three intangible benefits of a business intelligence solution:

- Improved operational and strategic decision making.
- Improved employee communication and job satisfaction.
- Improved knowledge sharing.

Case study #3: Gunnarsson, C. L., Walker, M. M., Walatka, V., & Swann, K. (2007). Lessons learned: A case study using data mining in the newspaper industry. *Journal of Database Marketing & Customer Strategy Management*, 14(4), 271-280. doi:10.1057/palgrave.dbm.3250058

Gunnarsson et al. (2007) study how business intelligence can be used to influence and maintain customer relationships. Gunnarsson et al. (2007) examine the process of moving from operational data to eventually leverage that data and implement data mining algorithms. The reference conveys a set of best practices through that implementation process, described as:

- Include business support for the data warehouse infrastructure.
- Identify and align business objectives with the data that is available.
- Limit free form data by standardizing and categorizing input.
- Avoid process-centric data storage, which can result in silos of unrelated data.

- Keep the data preparation and data mining processes iterative.
- Identify the appropriate target variables that meet business objectives.
- Choose the correct data mining model that will meet the business objective.

Gunnarson et al. (2007) identifies data mining benefits both in general and more specifically to the objective of customer satisfaction. Those benefits are noted as:

- The data mining process can create knowledge that ultimately advances the organizational objectives.
- Knowledge acquired through the process can also lead to new understanding and new business objectives.
- An increase in effectiveness of marketing and customer retention programs which leads to increased satisfaction and lower costs.

Case Study #4: Phan, D. D., & Vogel, D. R. (2010). A model of customer relationship management and business intelligence systems for catalogue and online retailers. *Information & Management*, 47(2), 69-77.

Similar to Gunnarson et al. (2007), Phan and Vogel explore the implementation of a business intelligence solution and its effect on customer relationships. Phan and Vogel (2010) follow a catalogue retailer that experiences initial success by targeting and building customer relationships with business intelligence. The success of the organization is followed by a decline and more recently by a resurgence. The authors attribute the decline to outside influences and losing sight of the original business intelligence and organizational goals. The authors identify the organization's business intelligence solution as one of the key success factors that initially lifted the organization to success and is now again playing a role to improve value to the customer and differentiate the business from competition. While Phan and Vogel (2010) view their

organization through a specific strategic context, the following general business intelligence benefits are also described:

- The ability to predict which customers would make purchases and how much they were going to spend.
- Identifying customers that were more likely to pay their bills and ones that were not.
- A reduction in costs through increased marketing efficiency.
- Being able to reach customers with the right offer at the right time.

Conclusion

Credit unions operate in an increasingly competitive environment. For credit unions to continue to remain competitive within their industry and with other retail financial services organizations, they need to determine ways to increase both membership and assets. The purpose of this study is to demonstrate that credit unions can leverage the operational data already being maintained in their information systems. One way to leverage that existing data is to implement a business intelligence solution. The goal to move from the existing operational data to a full blown business intelligence solution involves the implementation of a data warehouse and the use of data mining and OLAP processes to analyze and produce information. The resulting information then feeds back into decision making and strategic planning to drive credit union competitiveness and membership value. The following information describes a framework that credit union IT managers can use to plan for and execute implementing a business intelligence solution to create membership and asset growth.

Phase #1: In the beginning...planning. Planning is critical to achieve success with a business intelligence implementation. Gunnarson et al. (2007) describe that this phase begins with correctly identifying the business objectives. The initial question to ask is what does the business hope to accomplish by implementing a business intelligence solution? Planning is essential in order to avoid a fragmented and isolated implementation effort (O'Hara & Brohman, 2002). The information gathered during planning should address where business intelligence can best be applied in the organization, who will benefit from its use, and what type of operational data sources can be used (Jaffri & Nadeem, 2004). Planning with a focus on the business objectives directly tie into the required informational output and the subsequent design of the

infrastructure. IT professionals need to be aware of the objectives so the resulting architecture can meet the needs of the business (Gorla, 2003).

Because many technical decisions are made while planning the implementation of a business intelligence solution, it is important to gain top level management support. Decisions must be made about the type of hardware platforms on which the data warehouse and analytical applications will reside, the database management system that will be used, the concurrency of data compared with the operational databases (i.e., how often the data warehouse is refreshed). Each decision has an associated financial impact and senior management needs to understand and support the business intelligence solution for it to be successful (Little & Gibson, 2003).

Planning activities should involve a cross section of groups and individuals from the organization (Gunnarsson et al., 2007). One reason for this is to ensure adequate identification of the data required to meet the business objectives. Along with the core credit union transactional database, there could exist any number of ancillary information systems providing support and data for various departments. The goal to meet business objectives could require a more intimate understanding of the departmental databases, their architectures and functions. Including a cross section of groups within the organization can benefit the plan by supporting sharing and brainstorming ideas about the business processes, objectives and how business intelligence will meet those needs (Jaffri & Nadeem, 2004). The planning activities need to address the source data requirements, how that data will be obtained and how it relates to the business objectives (Gunnarsson et al., 2007). Leveraging those disparate information systems plays into one of the strengths of a business intelligence solution, with the ability to combine specific operational databases under one roof of the data warehouse. It is critical that department and application subject matter experts be included in the planning activities so that the resulting

effort put forth is better able to deliver on the defined business objectives (Gunnarsson et al., 2007).

Phase #2: Build and populate the data warehouse. The data warehouse provides data about specific subjects, relative to business analytical objectives, that support the day-to-day operations of the organization (Little & Gibson, 2003). Moving the operational database data into a data warehouse consumes a considerable amount of effort. Estimates from Castellanos et al. (2009) and Jukic (2006) go up to 70% effort during this phase, while Gunnarsson et al. (2007) state that 85% of business intelligence implementation goes into preparing the data and data warehouse. That effort is related to the discovery task of identifying the existing operational database structures and then planning how to best fit that data into the targeted data warehouse architecture. The complexity increases in relation to the various data types supporting activities across the organization, and how these vary with regards to their time intervals (Little & Gibson, 2003).

Data warehouse data should be designed around two primary categories of information: a) the summary or aggregated information to speed and refine OLAP queries, and b) more detailed levels of data to drive data mining analysis (Little & Gibson, 2003). Additionally, the data warehouse performance can be improved by paying attention to physical design techniques related to the architecture of the data warehouse and proper planning around the points of aggregation (Gorla, 2003).

The process of moving data from operational databases into a data warehouse is typically known as extract, transform, load (ETL) (Jukic, 2006). The data first needs to be extracted from the operational database. Transforming that data is required to map the transactional data from various database sources into one format compatible with the chosen architecture of the data

warehouse. Transforming the data typically requires additional infrastructure to handle the transition and mapping as the data moves from the operational database into one designed for analytical purposes (Jukic, 2006). Finally, the transformed data from one or more operational databases are loaded into the data warehouse.

Phase #3: Let there be enlightenment! Once the data warehouse is implemented and finally populated with data, analytical analysis becomes possible (Jukic, 2006). Successfully implementing a data mining and OLAP strategy can increase operational efficiencies, improve profitability, and provide an enhanced quality of service (Apte et al., 2002). Other potential credit union benefits include:

- Predict which existing products and services will be most attractive to current and potential membership.
- Identify new products and services suitable to the needs and demands of members.
- Increase the effectiveness of marketing campaigns to target potential members.
- Improve business operational and strategic decision making.
- Improve organizational knowledge sharing.
- Ultimately enhance credit union performance through attracting new membership and increasing the number of services per member.

The benefits can drive a credit union's membership and asset growth. It can improve the strategic positioning "by delivering improved value to customers which they cannot find from competitors" (Phan & Vogel, 2010, p. 69).

As noted by Apte et al. (2002), credit unions can leverage the data warehouse to predict the outcomes of various business decisions. In order to do this, credit unions should use an

iterative process of analyzing data through both the summarization and model creation that OLAP and data mining allow. The process begins with OLAP queries to identify appropriate places to segment the membership and create decision points. Then by using those decision points a data mined predictive profile can be created to better understand how particular decisions can meet the business objectives and more specifically facilitate the membership and asset growth of the credit union. Additionally, the model creation outcome of the data mining analysis directly feeds back into future refinement of analyzing the aggregated dimensional data through OLAP queries and the process begins anew.

Credit unions can use their existing operational data to create more value for their membership and thus increase both their membership penetration and asset growth. With appropriate planning, credit unions can move their operational database data into a data warehouse and then further exploit that data with OLAP and data mining techniques to create a strong business intelligence solution and increased value for their membership.

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Appendix A

Summary of Search Results

Database / Search Engine	Key terms	Result Qty.	Result notes
Academic Search Premier	credit union	861	Mostly newspaper articles of limited quality.
	credit union AND membership	54	Mostly newspaper articles and specific to changes in legislation related to field-of-membership.
	credit union AND technology	58	Majority of Computerworld articles but none seemed very relevant.
	customer-centric AND technology	40	A good mix of peer reviewed sources and IT articles.
	business intelligence		
	business intelligence AND review	74	Locates two BI literature reviews
	credit union AND business intelligence	0	
	credit union AND outsource	1	Not relevant
ArXiv.org	credit union AND business intelligence	0	
	financial institution AND business intelligence	1	Locates a relevant source
	data mining	355	All relevant to data mining in general but contain highly technical information that is beyond the scope of this study
	data mining AND customer	19	Relevant sources here that could possibly be extrapolated to relate to the topic
	data mining AND customer value	0	
	business intelligence AND review	1	Result does not relate
	business intelligence AND customer relationship	0	
	customer relationship management	2	
Business	credit union	37,138	Too many articles to sort through.

Source Premier	credit union AND membership	1885	
	credit union AND technology	2561	Large number of credit union industry trade publications. The number of results made it difficult examine beyond articles of 2009 or newer
	credit union AND business intelligence	43	Articles specific to the search terms but results were specific to small case studies for individual credit unions.
	credit union AND outsource	44	Articles specific to the key term but only from credit union industry trade publications
	customer-centric AND technology	188	A large number of peer-reviewed academic articles, but difficult to correlate the results with the study topic.
EconLit	credit union	1188	Industry specific information but a large number of results
	credit union AND membership	431	More specific to membership related issues, but was able to locate a few sources browsing results
	credit union AND business intelligence	1	Not related
	financial institution AND business intelligence	4	
	credit union AND outsource	12	
Web of Science	credit union AND business intelligence	0	
	financial institution AND business intelligence	0	
	data mining	10,297	Too many results
	data mining AND customer	338	Potential good sources here, results spread across spectrum of IT
	data mining AND customer value	10	Small number results but the results seem difficult to integrate.
	business intelligence AND review	14	Locates two BI literature reviews previously found through Academic Search Premier.
	business intelligence AND customer relationship	10	Results are specific to data warehousing
Google Scholar	credit union	39,800	Too many results
	credit union AND technology	13,900	Too many results
	credit union AND	19,800	Too many results

membership		
credit union AND	143	Locates a few references already found through other databases
business intelligence		
financial institution AND	674	
business intelligence		

Appendix B

Summary of Search Engine and Database Quality of Results

Database / Search Engine	Quality of Results
Academic Search Premier	A small number of peer-reviewed materials are relevant but that quantity made it easy to browse for sources.
ArXiv.org	Many of the result sources appear to be written in an academic nature, but some information about the result is difficult to ascertain.
Business Source Premier	A good source of current industry trends and potentially to look more into small case studies if needed. This database contains a limited number of peer-reviewed results for these search terms.
EconLit	Good sources related to the credit union industry and current trends. The majority of academic research sources are located here.
Web of Science	Good sources related to the information system aspect of this study. While nothing directly correlates to credit unions or financial institutions there could be some integration points for the study.
Google Scholar	The information returned contains book references which could be mined for further resources if needed; it also located a few sources that were missed from in other databases searches.

Appendix C

Literature references sorted by theme category

Author	Title	Date
<i>Credit union performance</i>		
Bauer, K. J.	Detecting abnormal credit union performance.	2008
Bauer, K. J., Miles, L. L., & Nishikawa, T.	The effect of mergers on credit union performance.	2009
Emmons, W. R., & Schmid, F. A.	Bank competition and concentration: Do credit unions matter?	2000
Fried, H. O., Lovell, C. A. K., & Yaisawarnng, S.	The impact of mergers on credit union service provision.	1999
Glass, J. C., & McKillopp, D. G.	The impact of differing operating environments on US credit union performance.	2006
Goddard, J., & Wilson, J. O. S.	US credit unions: An empirical investigation of size, age and growth.	2005
Goddard, J., McKillopp, D. G., & Wilson, J. O. S.	The growth of US credit unions.	2002
Goddard, J., McKillopp, D. G., & Wilson, J. O. S.	What drives the performance of cooperative financial institutions? Evidence for US credit unions.	2008
Handrinos, M. C., & Nikolopoulos, K.	The future of credit unions in the United States: Evidence from quantitative extrapolations.	2008
Leggett, K. J., & Strand, R. W.	Membership growth, multiple membership groups and agency control at credit unions.	2002
Walter, J. R.	Not your father's credit union.	2006
<i>Business intelligence solutions</i>		
Apte, C., Bing, L., Pednault, E. P. D., & Smyth, P.	Business applications of data mining.	2002
Castellanos, M., Dayal, U., Simitsis, A., & Wilkinson, K.	Business processes meet operational business intelligence.	2009
Dass, R.	Data mining in banking and finance: A note for bankers.	2006
Gorla, N.	Features to consider in a data warehousing system.	2003
Hamel, L.	A brief tutorial on database queries, data mining, and OLAP	2005
Jourdan, Z., Rainer, R. K., & Marshall, T. E.	Business intelligence: An analysis of the literature.	2008
Jukic, N.	Modeling strategies and alternatives for data warehousing projects.	2006
Little, R. G. J., & Gibson, M. L.	Perceived influences on implementing data warehousing.	2003
Lonnqvist, A., & Pirttimaki, V.	The measurement of business intelligence.	2006
Park, Y.	An empirical investigation of the effects of data warehousing on decision performance.	2006

Vedder, R. G., Vanecek, M. T.,
Guynes, C. S., & Cappel, J. J. CEO and CIO perspectives on competitive intelligence. 1999

Business intelligence case studies

Gunnarsson, C. L., Walker, M.
M., Walatka, V., & Swann, K. Lessons learned: A case study using data mining in the newspaper industry. 2007

Jaffri, S. A. H., & Nadeem, M. Application of business intelligence in banks (Pakistan). 2004

O'Hara, M. T., & Brohman, M. Boeing Employees' Credit Union: Leveraging the data warehousing investment. 2002

Phan, D. D., & Vogel, D. R. A model of customer relationship management and business intelligence systems for catalogue and online retailers. 2010