



Lund University
School of Economics and Management
Department of Informatics

Decision Support Systems and Financial Risk Assessment

An evaluative study

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Submitted: 2011-01-13
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Supervisor: Lars Fernebro
Examiners: Björn Johansson, Paul Pierce

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Abstract

Despite the prevalence of FDSS in practice, and despite their significance both to the institutions using them and the financial system in general, few scientific studies address this topic. No past studies have attempted to evaluate FDSS in a financial risk management context. The objective of this research is to provide knowledge into how such FDSS are used to support financial risk assessment at financial institutions, what considerations are important for such systems to be deemed successful and to identify gaps between the FDSS provided and the needs of financial institutions using them. For this purpose, I conduct an evaluative study of two systems used by the Swedish National Debt Office to assess financial risk.

This evaluation is based on my own adaptation of the DeLone & McLean (2003) model of IS success; thereby creating a framework applicable to the assessment of FDSS supporting financial risk assessment. The resulting framework recognizes the importance of system repute and assurance in the evaluation of such systems; with user confidence bolstered by factors such as system transparency and knowledgeable service providers. I find that measurements of net benefit include systems' contribution to loss prevention and the organizations' general risk overview. Additionally, I find that net benefit measurement should consider systems' impact on organizations' operational risk.

While some important factors remain inconclusive, my findings show that the FDSS evaluated at the Swedish National Debt Office are reasonably successful.

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1. INTRODUCTION

1.1 Background

Decision support systems (DSS) have become a significant domain of IS research. Burstein & Holsapple (2008) define the term as systems which represent and process information for the purpose of improving decision making. DSS can range in level of sophistication – from a simple spreadsheet to sophisticated data warehousing and mining applications, knowledge management systems, or modeling systems [Pick (2008)]. Hall (2008) points out that such systems are used by decision makers across a wide range of organizations where complex problems must be identified, structured, and solved in an efficient manner.

Financial problems, in particular, can be of an exceptionally complex and unstructured nature. The sophisticated mathematical financial models in use, the incredibly large, dynamic, rapidly expanding data sets involved, and the potential for catastrophic losses are factors that contribute to the increasingly important role of DSS in the finance. Financial risk is an ubiquitous influence throughout finance; it helps drive the decisions behind everything from investment strategies, loans, and portfolio positions to interest rates, asset pricing, regulatory compliance, and capitalization rates. The prominence of financial risk in financial decision-making combined with the complexity of its assessment contribute to the high relevance of DSS within this domain.

1.2 Problem statement and research questions

While the general topic of DSS has benefited from wide attention in academic literature, a database search will quickly reveal that DSS within the financial risk domain has been largely ignored.

The lack of literature addressing IS within the financial risk domain is both surprising and alarming, as the assessment financial risk is not only of paramount importance to the health of financial institutions, but can have far-reaching consequences to the economy and society in general. The financial crisis of 2007-2010 is a stark reminder of this. Its original name, the “sub-prime crisis”, referred to “sub-prime” loans – or mortgage loans to high-risk borrowers. These loans, were securitized together with others into financial instruments and traded as collateralized debt obligations (CDO) and mortgage-backed securities (MBS)¹. Credit rating agencies gave high ratings to these securities, when, in fact, little was known about the financial risks involved. As a result, risks used to calculate many banks' capital requirements were not accurate, liquidity was lost, and major financial institutions failed or were bailed out by governments. Thus we have witnessed a failure of financial risk assessment and management on multiple levels which resulted in damage throughout the world economy.

Considering the important role that the assessment of financial risk plays – both for the greater economy and the financial institutions themselves – I find it interesting to shed some light on the information systems supporting financial risk-related decision making. I do this through an evaluative study of systems supporting financial risk assessment in practice.

1 See Definition of Terms

On this premise, I propose the following research question:

- *How successful are information systems used to support financial risk assessment?*

1.3 Purpose

Through answering this question, I aim to provide insight into (a) how IS is used to support financial risk assessment at financial institutions, (b) what considerations are important for such systems to be deemed successful, and (c) to identify success gaps between current IS used for risk assessment and the needs of the financial institutions using them.

The study also aims to provide guidance for practitioners – IT departments, consultants, and commercial software developers – to better understand and support the risk assessment needs of financial institutions and targeted end users. Similarly, the resulting evaluative framework may be applied by financial institutions to assess current and potential systems supporting financial risk assessment.

Direct stakeholders include financial institutions, governments, regulatory agencies, corporate finance departments and their IT providers. Indirect stakeholders include investors and a society dependent on a healthy financial sector.

1.5 Delimitations

- The study evaluates two DSS implementations supporting financial risk assessment at a single Nordic financial institution based on the IS success model proposed by DeLone & McLean (2003).
- The study does not attempt to assess the models or processes applied by the institution to assess that risk.
- While I provide support for my choice of evaluation model, I do not seek to evaluate the model itself.

2. LITERATURE REVIEW

This chapter introduces topical definitions and models within IS and finance of relevance to the study. The chapter begins with a general introduction to Decision Support Systems (DSS) and their usage within organizations. Later sections provide a contextual introduction to financial risk and an overview of literature addressing IS within that domain. Finally, I present a summary of IS success factors proposed in literature, with an in-depth discussion of the revised model presented by DeLone & McLean (2003).

2.1 Decision support systems (DSS)

Burstein & Holsapple (2008) define a decision support system (DSS) simply as any system that represents and processes information for the purpose of improving decision making. Holsapple (2008) points out that this improvement in decision making can come in the form of increased productivity (e.g. faster), greater agility (e.g. response time), increased innovation (e.g. creativity), improved repute (e.g. accuracy, trust), or higher stakeholder satisfaction (e.g. decision participants).

Such systems are used by decision makers across a wide range of organizations where complex problems must be identified, structured, and solved in an efficient manner [Hall (2008)]. According to the definition above, many technologies can and have been used to support decision making, and thus constitute DSS: simple spreadsheets, sophisticated business intelligence solutions involving data warehousing and mining, knowledge management systems, groupware, spatial DSS, executive information systems are all examples [Pick (2008), Power (2008)].

A historical review of DSS conducted by Power (2008) reveals that it has been a focus of academic studies for over 40 years. DSS has become an significant domain of IS research, with researchers developing multiple frameworks to better define and understand DSS.

One example is Power (2002)'s "expanded DSS framework", organizing DSS into five categories: communication-, data-, document-, knowledge- and model-driven DSS. He describes communication-driven DSS as those which facilitate collaboration and/or communication. Document-driven DSS provides for document retrieval and analysis. Data-driven DSS emphasize access to time-series, real-time, and/or large quantities of data. Knowledge-driven DSS apply problem-solving expertise to explicitly recommend a course of action to managers. The author defines model-driven DSS as those which emphasize the use of financial, optimization, or simulation models together with limited data and user-defined parameters.

Holsapple (2008) presents Figure 2.1 as the framework most commonly cited in literature to illustrate a typical DSS architecture. To support the decision-making process, a DSS needs to collect data which can originate from a variety of different sources. According to the framework, a DSS would consist of a knowledge system to accommodate knowledge (e.g., a database for information, a model base for reasoning) and a problem processing system to process that knowledge.

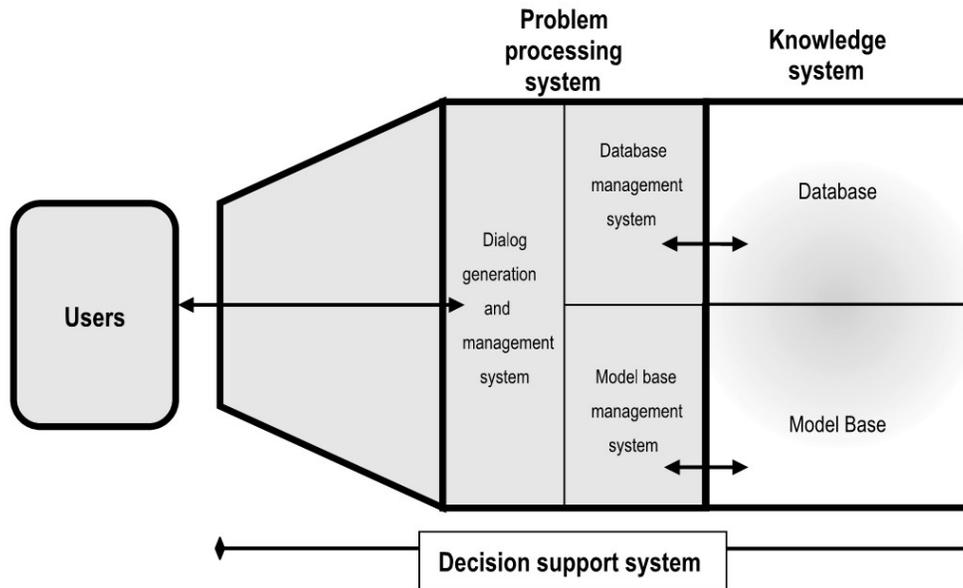


Figure 2.1: Popular DSS architecture framework. Holsapple (2008) p.183

2.1.1 Financial decision support systems (FDSS)

Zhang et. al. (2009) define financial decision support systems (FDSS) as DSS which help decision makers solve problems within the financial management domain; often accomplished through some combination of financial projections, financial planning, financial control, and financial analysis. Weber (2008) asserts that the role of FDSS in the decision process can be *normative* - leading to a clear and unique “best” solution - or *decision-analytic* - providing information and guidance to the decision.

Weber (2008) points to current trends in finance and technology as contributing to the increasingly important role that FDSS play in informing and guiding financial decision making. In the financial world, innovations in financial instruments and trading practices, market volatility, and liquidity shortfalls have contributed to a decision-making environment with greater complexity and risk than ever before. Meanwhile, we have witnessed the growth of reliable, instantly available, and overwhelming quantity of financial market data coupled with the availability of ever more computing power and sophisticated software tools. [Weber (2008)]

While perhaps apparent that financial decision-making is a critical activity in financial institutions, such as investment banks, FDSS are also found supporting a diverse range of vital financial decisions in corporate finance and government. By 1998, Eom et. al. (1998) identified FDSS supporting debt planning, financial asset and cash management, capital structure, financial risk assessment, financial analysis, strategic funding, bank location analysis, merger and acquisition analysis, R&D net present value analysis, lease optimization, portfolio optimization, interest rate determination, real estate valuation, and small business finance.

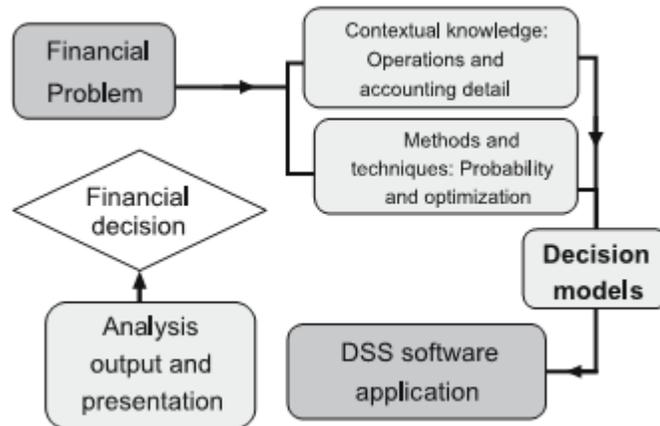


Figure 2.2: FDSS Flow diagram (Weber (2008), p.423)

Weber (2008) presents Figure 2.2 as an extension of the standard components of DSS to the financial domain. Experience, contextual knowledge, and financial methods are combined into the decision model to be implemented by the FDSS. The results are communicated to the decision maker in a format the user can understand and apply to in financial decision-making. The author points out that the core elements of a FDSS are the same as any DSS: a data base, a model base, and a user interface. These core components are also evident in the more comprehensive FDSS framework proposed by Zhang et. al. (2009).

2.2 Understanding financial risk

Risk is ubiquitous. It's a concept has been defined in countless ways, but for the purpose of this study, the term *risk* refers to the probability and/or magnitude of a potential financial loss. Simply speaking, risk *likelihood* refers specifically to the probability of loss, while risk *exposure* is the potential magnitude of such a loss if it occurs.

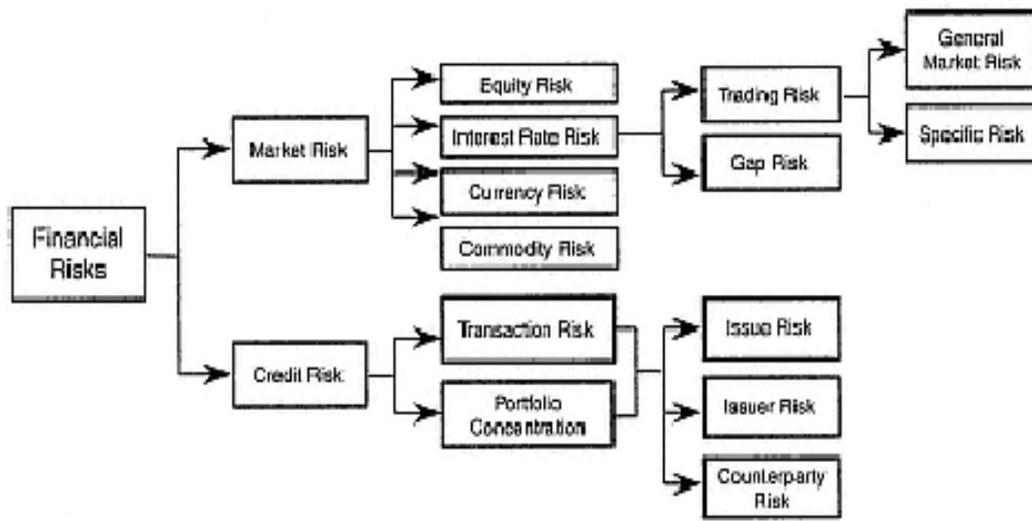


Figure 2.3: Categorical breakdown of financial risk. Crouhy et al. (2000), p.39

The term *financial risk* generally refers to any kind of risk associated with financing. I consider two types of financial risk in this study: market- and credit risk, including the sub-categories identified by Crouhy et al. (2000) (Figure 2.3). *Market risk* is associated with volatile investments and portfolios (including equities, commodities, etc.) and refers primarily to the risk that fluctuations in market prices will reduce the value of positions held. Also included in this definition is *credit risk*. Holley & Mucha (2009) in their thesis describe credit risk as the risk of loss due to a counter-party's non-payment of its obligations. A *counter-party* can be an individual, a company, a collateralized debt obligation (CDO), or even a sovereign government. An *obligation* can be a loan, a line of credit, or derivative thereof. In this paper, market risk and credit risk are collectively referred to as *financial risk*.

A greater part of the focus and energy of financial risk management is directed towards assessing financial risks and the mathematical and computational tools used can be quite sophisticated. In fact, as Crouhy et al. (2000) point out, models of financial risk assessment contain some of the most complex applications of probability, optimization, and estimation theories in practice today.

Of course, risks to financial organizations are not limited to financial risk. Institutions face other important sources of risk; notably operational risk, political risk, and liquidity risk. Some of these are shown in Figure 2.4.

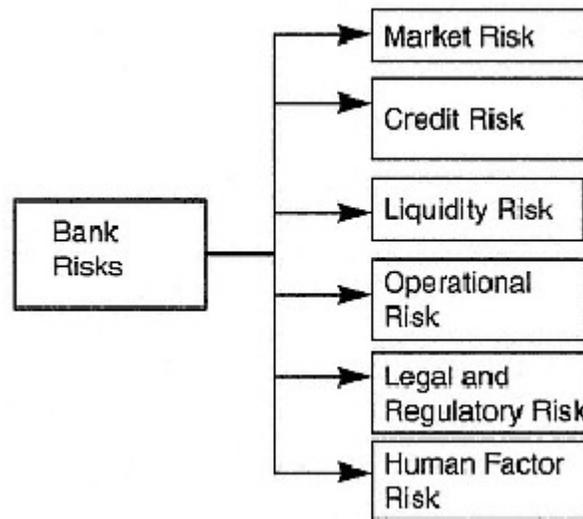


Figure 2.4: Typology of risks faced by financial institutions.
Crouhy et al. (2000), p.35

The financial well-being of financial institutions, businesses, governments, and even households relies on risk management. While risk assessment is just one step in a broader risk management process, it is arguably the most important one, as it provides the basis by which risk-conscious decisions can be made.

While an in-depth review of risk models is out of scope for this study, there is a robust set of tools available to the practitioner and the possible forms and output of such assessments can vary significantly. *Value at Risk (VaR)*, for example, identifies risk in monetary terms as the total amount of loss expected at a given probability and time horizon. A portfolio of commodities with a one-day 10% VaR of \$1 million is expected to lose more than \$1 million in one day out of ten. *Expected shortfall (ES)* identifies risk in terms of expected return in the worst $x\%$ of cases – a portfolio of stocks that has an ES of \$1 million at a 5% level is expected to lose \$1 million in the worst 5% of cases. *Probability of default (PD)* expresses risk in terms of the probability of a borrower defaulting with a given time horizon – a company with a three-year PD of .03 has a 3/100 chance of defaulting on its debt within the next three years. A credit rating is an estimate of corporate or government creditworthiness published by credit rating agencies with a scale typically composed of letter designations and calculated based on a number of (often proprietary) variables. A government with a Standard and Poor's credit rating of AAA is considered very unlikely to default on its bonds.

The list of financial risk measures goes on. We see that financial risk is a multifaceted concept with many potential sources and manifestations and further complicated by the plethora of sophisticated methods which measure risk in terms of probabilities, monetary loss, letter and number-based credit scores, standard deviations, etc.

2.3 An evaluative framework

Rhee & Rao (2008) assert that a meaningful evaluation of decision support support systems requires

both the identification of criteria and the use of an evaluation method. Adelman (1992) finds that the criteria and methods involved will vary according to circumstance and that different criteria will require different methods.

2.3.1 Evaluative criteria

Evaluation criteria are defined by Adelman (1992) as the value-adding objectives to be achieved by the system. He argues that it is these criteria which form the necessary basis for an evaluation. The determination of which measurement criteria to use and how they should be determined to best measure IS success has long been a topic of reflection and debate in IS scholarship. A number of, sometimes conflicting, models have been presented, critiqued, and revised to explain, in a generalized way, what the components of IS success are. This process is far from complete and has been neither neat nor easy. This difficulty may be partially explained by Petter et al. (2008), who speculate that the vagueness of early attempts to define IS success could be attributed to its “complex, interdependent, and multidimensional nature”.

Much early attention was directed towards understanding the qualities that lead us to use IT. Davis (1989) introduced the widely adopted technology acceptance model (TAM) which explains that two beliefs about a system ultimately contribute to our intention to use it – perceived usefulness (PU) and perceived ease of use (PEOU). PU is a measurement of how much a potential user believes the system will help him or her achieve their goals and PEOU is how easy they believe it is to use. This use-centric view of IS success dominated in the early years of personal computing. This view is understandable during a time, as described by Davis et al. (1989), when managers and users were notoriously wary of, and overwhelmed by, new technologies. I recall a particularly entertaining story from that period told by an IS professor at the University of Washington. The architecture firm that the professor worked for was transitioning to computer-based drafting. The architects, however, refused to use the systems for months, until one morning they came to work to find all their drafting desks cut in half.

While we may no longer witness technology aversion to the degree we have in the past, it would certainly seem system usage remains an important prerequisite of successful IS – after all, a system unused is of no use by definition. According to literature, however, acceptance is not synonymous to success. Wixom & Todd (2005), for example, identify *user satisfaction* (e.g. Seddon (1997), Bailey & Pearson (1983)) and *technology acceptance* (e.g., Davis (1989), Hartwick & Barki (1994)) form the “dual streams” of thought explaining IS success. The technology acceptance stream focuses on users' beliefs about systems. The user satisfaction stream focuses on users' attitudes about using systems.

DeLone & McLean (1992) were the first to provide a comprehensive review of IS success measures in literature. It was from this review that they developed their first model defining the constructs of IS success. Their constructs (later updated) went beyond system usage to include *system quality*, *information quality*, *use*, *user satisfaction*, *individual impact*, and *organization impact*. Though famously criticized for being “confusing and misspecified” by Seddon (1997), the author also concedes that the DeLone & McLean (1992) model was important for two reasons: (1) it classified the large number of IS success measures found in literature and, for the first time, (2) defined the dependencies between these categories into a coherent model of IS success.

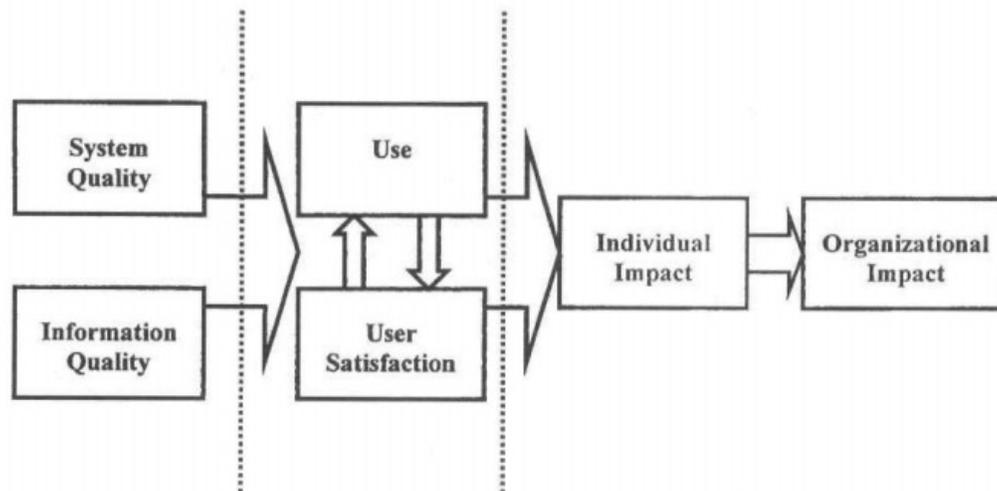


Figure 2.5: Original D&M IS Success Model. [DeLone & McLean (1992)]

The original IS success model developed by DeLone & McLean (1992) is shown in Figure 2.5. The relationships asserted in the model have been tested empirically by a number of studies. Seddon & Kiew (1994), for example, identify significant relationships between both of the quality constructs with user satisfaction and individual impact and between user satisfaction and individual impact.

DeLone & McLean (2003) later refined their much-cited model based on comments offered by academia over the preceding decade. The revised model, displayed in Figure 2.6 and cited by more than 1,300 papers, explains IS success in terms of *system quality*, *system use*, and *system net benefit*; where system quality consists of three dimensions: *information quality*, *systems quality*, and *service quality* and system use consists of *actual use*, *intention to use*, and *user satisfaction*. Read from left to right, one sees three components emerge: the creation (quality) of the system, the use of the system, and the results (benefits) of the system.

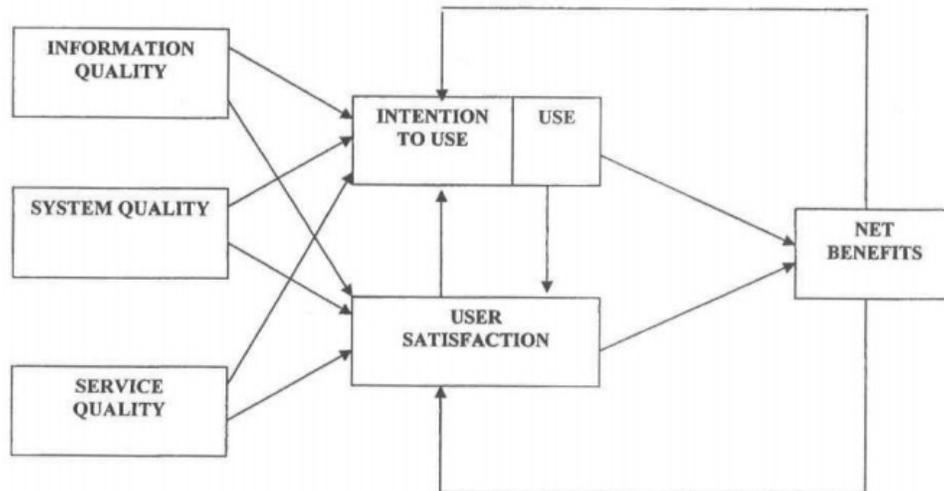


Figure 2.6: Updated D&M IS Success Model. [DeLone & McLean (2003)]
p.24.

Theoretical framework – D&M model constructs and extension to the financial risk domain

A comprehensive list of all criteria applicable to the DeLone & McLean (2003) model's constructs are out of scope for this study. Instead, I draw from literature only those variables I find of particular interest within the context of this study. DeLone & McLean (1992) emphasize the importance of context in applying their model on p. 80, where they state that “*no single variable is intrinsically better than another; so the choice of success variables is often a function of the objective of the study, the organizational context... etc.*”

To illustrate the significance of context in choosing variables of measurement, Seddon et al. (1999) draw examples from literature to create a diverse matrix of variables, with choice influenced by the stakeholders being targeted and level of analysis being done.

In their generalized model for IS evaluation specific to DSS, Rhee & Rao (2008) focus on the decision and decision-maker being supported. This focus is reflected in a trinity of variables measuring the *quality* added to decision outcome, *efficiency* added to the decision-making process and the *satisfaction* of the decision maker. Though the authors do not reference D&M explicitly, the Rhee & Rao (2008) model of DSS evaluation provides a helpful, if not comprehensive, disambiguation of some D&M model constructs as they can be applied to DSS.

Information quality

The *information quality* variable is meant to capture the semantic success of the system. It is one of the few constructs of the DeLone & McLean (1992) model that emerged unchanged in the DeLone & McLean (2003) update. The construct seeks to capture the quality of a system's output, rather than the system itself. The authors identify four empirical tests of this construct within their original model in the literature, each of which find a significant association between information quality and individual impacts (now included under net benefits).

While Seddon (1997) notes that this construct is impossible to use in systems that do not produce information, the variable's relevance is paramount for the quantitative, risk-assessing systems studied in this paper.

DeLone & McLean (1992) draw on the large number of sources within IS literature which tie the quality of information produced by the system to its overall success. They cite nine papers in their summary of information quality measures. In my measurement of this construct, I apply commonly used variables. The following are largely adapted from Bailey & Pearson (1983):

- The authors define *accuracy* as the correctness of the information output by the system. Interestingly, their study finds it the single most important factor in affecting user satisfaction. The authors propose the adjective pairs including “accurate vs inaccurate” and “consistent vs inconsistent”.
- *Currency* is defined as the the age of the information being output by the system.
- *Completeness* is the comprehensiveness of the system's output in terms of information content.; with resulting information content adjectivally described in terms of complete vs incomplete.
- *Format* refers to the layout design and display of the system's informational output. I also add to this definition the desirability of the output in terms of convenience and ease of use.
- The authors identify *relevance* as the fourth most important of 38 factors considered affecting user satisfaction. They define it as “the degree of congruence between what the user wants or requires and what is provided [by the system]”; with system relevance defined in terms of useful vs useless.

System quality

D&M's *system quality* construct is meant to measure the quality of the system itself. DeLone & McLean (2003) identify five empirical tests of their original model finding a significant relationship between *system quality* and *individual impact* (now included in *net benefits*).

Drawing from twelve studies, DeLone & McLean (1992) compile a comprehensive list of system quality measures found in the literature. The authors themselves note the technical nature and engineering focus of many of the studies they draw from for this particular construct.

Since the current study seeks to assess IS as a tool supporting financial risk assessment, rather than the IS as an object itself, I include only a subset of the measures of system quality listed by the authors. Specifically, I have excluded those measures I believe focus too much on the IS as an object (e.g. IS sophistication) to be of much relevance or those which are already represented within other measures (e.g. *stored record error rates* are represented in *information quality*). I draw the following from Bailey & Pearson (1983), Belardo et al. (1982), and Srinivasan (1985):

- I use the term *adaptability* synonymously with flexibility. Bailey & Pearson (1983) define system flexibility as the ability of an information system to adapt to new conditions, demands, or circumstances; i.e. is the system flexible or rigid?
- Bailey & Pearson (1983)'s study concluded that timeliness the 3rd most important factor of the 38 considered in affecting user satisfaction. The authors define timeliness as the availability of

the system's output at a time suitable for its use. For the purpose of this study, I use timeliness and *availability* synonymously.

- Srinivasan (1985) identifies *response time* as one of the key components that affect users' perception of a system's operational stability. Described in terms of responsive vs sluggish, response time is the perceived delay between the request for and the delivery of system output.
- Palmer (2002) defines *usability* is the ease or difficulty that users experience using the system. Usability is closely related to the intuitiveness, efficiency, and intelligibility of the system's user interface.
- Used together with ease of use by Belardo et al. (1982), *ease of learning* refers to the ease of which a new user can begin to use the system.

Service quality

The *service quality* construct is a new addition to the D&M model, introduced by DeLone & McLean (2003) as a response to the number of researchers calling for need of system and end-user support to be counted among the measures of IS success.

Some researchers have applied *SERVQUAL*, a multidimensional measure developed by the marketing area, to measure this element of IS success. *SERVQUAL* includes measuring variables, each of which belong to one of five categories: tangibles, reliability, responsiveness, assurance, and empathy. Pitt et al. (1995) was one such study; the authors test *SERVQUAL* within an IS effectiveness context with encouraging results. The following variables are drawn from this study:

- *Responsiveness*, or turnaround time, is defined by Bailey & Pearson (1983) as the amount of time between when a user initiates a request for service and the reply to that request; described in terms of fast vs. slow.
- *Knowledge*, the degree to which IT employees have adequate knowledge to provide quality service. It is adapted from *SERVQUAL*'s assurance, defined by Kettinger & Lee (1995) as an employees' knowledge and ability to convey trust and confidence.
- Empathy is introduced by DeLone & McLean (2003) as the degree to which service providers have users' best interest at heart; described by Kettinger & Lee (1995) as the degree of caring, individualized attention directed to users.

System use

IS use continues to be an extremely popular measure of IT success in both practice and research. DeLone & McLean (1992) cite 27 studies applying system use as an IS success measure. Such measures generally benefit from simplicity and ease of quantification. The authors list seven empirical tests of the relationship between *system use* and the *individual impacts* construct of their original model. All studies find a significant association between these constructs.

This study places less emphasis on the attitude-based *intention to use* element of the updated model in favor of the behavioral-based *use*. The argument here is that the importance of the *intended use* variable diminishes significantly in the presence of data indicating *actual use* since (1) intended use is primarily

used as a predictor of use, and (2) any additional information content of intended use beyond that of a use predictor is likely to be reflected in the *user satisfaction* construct of the model.

From the list of use metrics presented by DeLone & McLean (1992), I identify three of particular interest to this study.

- *Frequency of use*, or how often users use the system, is perhaps the most common and objective measure of use. Seddon (1997) argues that this measure serves primarily as a proxy for benefits of use, as frequent usage would be expected to reflect user satisfaction and benefits.
- *Planned replacement* - will the system be replaced in the foreseeable future? It is the sole metric I have chosen to measure *intention to use*.
- *Extent of use* - how common is system use across the organization?
- *Degree of use* addresses the importance of a system's output to the decision-making process. It is based on Barti & Huff (1985)'s measure of the percentage of time DSS is used in decision making. I find it a dual measure of utilization and trust.

User satisfaction

In addition to system use, user satisfaction was one of the two main “streams” of research addressing IS success identified by Wixom & Todd (2005). Accordingly, DeLone & McLean (1992) cite 33 papers from the 1980's alone that address this as an important (sometimes only) construct in defining IS success. The authors offer three reasons for the popularity of user satisfaction as a success measure: (1) validity: it's hard to call a system unsuccessful when users like it, (2) comparability: tools have long been available to capture satisfaction in a standardized way, (3) few alternatives: other measures of success tend to be more difficult to capture or weaker in concept.

DeLone & McLean (2003) list eight studies supporting a significant relationship between *user satisfaction* and *individual-* and *organizational impact* (now *net benefits*).

The metric applied in the 33 studies listed by DeLone & McLean (1992) is fairly homogeneously “user-satisfaction”, although also occasionally measured in terms of enjoyment or dissatisfaction. I retain only the most popular metric:

- *User satisfaction* is defined by Bailey & Pearson (1983) as the sum of a user's feelings or attitudes toward a system. It is one of three variables measuring DSS success in Rhee & Rao (2008)'s evaluation model.

Net benefits

Net benefits is a construct new to the updated DeLone & McLean (2003) model. The construct includes and replaces two variables previously found in the DeLone & McLean (1992) model: *individual impact* and *organizational impact*. These are defined as the impact the system has on an individual (user) and organizational performance, respectively. Critics of the model point out the restrictiveness of these two variables, arguing that the impacts of a system can span a wide range of stakeholders – consumers, work groups (e.g. Ishman (1998)), industries (e.g. Clemons et al. (1993)), even society (e.g. Seddon (1997)). In response, DeLone & McLean (2003) replace the two “impact constructs” with the more generic construct *net benefits*.

DeLone & McLean (2003) Recognize that, in practice, the benefits and benefactors considered should be determined by the purpose, nature, and context of the IS being evaluated. The majority of the following measurements were identified in literature by DeLone & McLean (1992) and associated with their *individual impact* and *organizational impact* constructs.

- *Loss prevented* - Have losses to the organization been prevented by using the system? As risk management is essentially an effort to prevent or mitigate loss, this measurement of my own construction is especially relevant to FDSS supporting risk assessment.
- *User productivity* – What is the system's impact on users' job performance. It is adapted from Bailey & Pearson (1983)'s “job effects” factor and can be determined as significant or insignificant.
- *Cost savings* - Has use of the system saved the organization or stakeholders money? (e.g. Rivard & Huff (1984))
- *Decision quality* - Has the system improved the the quality of decisions and their outcomes? I use *decision quality* synonymously with *decision confidence*. One of the three key measurement variables included in Rhee & Rao (2008)'s model for DSS evaluation, *decision quality* is commonly considered in literature evaluating DSS (e.g. Gosler et. al. (1986)).
- *Time to decision* - Has use of the system reduced the amount of time it takes to make decisions? This is a fairly common benefit measure for DSS, used by Belardo et al. (1982) and Gosler et. al. (1986), among others. *Time to decision* is associated with the *efficiency* variable of the Rhee & Rao (2008) DSS evaluation model.

2.3.2 Evaluative methods

Per Rhee & Rao (2008), *evaluative methods* define how we measure the degree to which a system fits established criteria. The situation dictates the evaluative methods applied; as Maynard et. al. (2001) point out, different needs and contexts require different evaluation methods.

Adelman (1992) asserts that evaluative methods can be divided into three types: technical, empirical, and subjective.

Technical evaluation focuses on system logic, processing, and algorithms. In the case of financial risk DSS, such an evaluation would likely entail verification that the system logic properly implements financial models applied. While this method of evaluation is out of scope for this study because of time

and resource constraints, it would in fact be of particular interest in financial risk DSS, where complex, domain-specific financial models are often encoded by software developers who may have little financial background. The criteria used in technical evaluation tends to be objective in nature.

Empirical evaluation is concerned with understanding the improvements made by the DSS to the decision making process itself. Rhee & Rao (2008) point out that this is traditionally accomplished through experimental methods, surveying techniques, case studies, and time-series analysis, or a combination thereof. Depending on the object of focus, the evaluative criteria of an empirical evaluation can be objective (e.g. a monetary cost/benefit analysis) or subjective in nature (e.g. a decision maker's confidence).

Adelman (1992) defines *subjective evaluation* of DSS as an evaluation method focusing on the effectiveness of DSS in terms of its relationship with users, the organization, and environment. Collecting the system's perceived ease of use is an example of this method.

3. METHODOLOGY

3.1 Approach

The updated DeLone & McLean (2003) (D&M) model of IS success was chosen as the theoretical framework on which to construct a research methodology. A thorough review of available literature identified the model as the most appropriate in addressing the study's research question:

How successful are information systems used to support financial risk assessment?

The expressed purpose of the D&M model is to define the elements of IS success, thus providing a well-established framework with which this question can be directly addressed. I anticipated that the following insights would materialize naturally through the process of answering the research question:

- (a) How is IS used to support financial risk assessment at financial institutions?
- (b) What considerations are important for such systems to be deemed successful?
- (c) To identify gaps between current IS used for risk assessment and the needs of the financial institutions using them.

The constructs identified within the model provide a pragmatic basis for defining the sub-questions to be answered by research participants. The constructs also provide a coding system by which system success (RQ) and other insight (a)-(c) can be identified, categorized, and explained.

For the purpose of this study, I choose to apply the updated DeLone & McLean (2003) model over the original DeLone & McLean (1992) model. The newer model is preferred for a number of reasons. The newer DeLone & McLean (2003) model benefits from the considerable amount of review directed toward the original DeLone & McLean (1992) model over the preceding decade, incorporating this feedback. Specifically, I prefer the use of the newer, generalized *net benefit* construct to the more restricted *user-* and *organizational impact* constructs. The newer construct provides valuable flexibility and a simplified coding process in situations where the two may not always be clearly distinguishable or when benefits to other stakeholders beyond the individual and organization should be considered.

To illustrate this last point as it relates to FDSS supporting financial risk assessment, consider a simplified scenario at a large bank. The bank is party to the Basel II accords, which stipulates that capital requirements be based on a ratio of capital to risk-weighted assets. The bank is also considered “too big to fail”, meaning that the government will likely supply monetary aid if the bank faces the liquidity crises that capital requirements are meant to avert. An individual employee at the bank uses FDSS to assess the financial risk on which the bank's capital requirements are based. If the FDSS systematically under-assesses risk, then the banks capital requirements are set lower than they would be otherwise. The bank might be happy with this situation, as it has more capital free with which it can pursue profits and essentially receives free insurance from the government. The individual bank employee will be satisfied as he or she receives a bigger bonus. Taxpayers and society, however, lose in this scenario.

The study's qualitative analysis will follow a survey method, discussed by Creswell (2007) in his exploration of the five approaches to qualitative inquiry. In line with this approach, inquiry will focus

on multiple people's experience with FDSS supporting financial risk assessment. The method of inquiry utilizes a combination of semi-structured interviews and survey questionnaires to capture these experiences within the six dimensions of the D&M model.

Quantitative analysis is to a small degree to complement and strengthen the qualitative analysis with focus on answers provided by participants on standardized survey questionnaires.

3.2 Data Collection

Interview and survey questions are both classified according to the six IS success constructs of the DeLone & McLean (2003) model. Questions are created for each construct based on the measuring variables identified in the LITERATURE REVIEW.

3.2.1 Object and Participant selection

The target population of the study are information systems supporting financial risk assessment at financial institutions, such as banks and financial regulators.

The target group for my object of investigation originally included Scandinavian financial institutions. I formulated a list of potential organizations by identifying the financial institutions in a brochure for an upcoming career fair to be held at Lund University's School of Economics and Management.

I further refined this list after speaking with representatives for a number of these institutions at their respective career fair booths; eliminating those institutions that (a) do not perform financial risk assessment, or, (b) expressed discomfort in being contacted for the purpose of this study.

A stream of emails and phone calls with contacts at remaining financial organizations led to the choice of Riksgälden, known in English as the Swedish National Debt Office, an ideal partner for the study. Riksgälden, described in more detail in Section 4.1 Object of study, was chosen based on the following attributes:

- The organization uses IT to assess a range of financial risks
- I found its representatives friendly, willing to participate, knowledgeable, and responsive

My initial contact at Riksgälden connected me with an analyst at the organization's risk department. The analyst, in turn, introduced me to risk analysts responsible for market and credit risk assessment as well as FDSS administration.

As study participants, risk analysts contribute in a number of important ways:

- **USER** - As system end users they have firsthand experience using the systems. Analysts depend on the output of the systems to weight risk in decision making, reporting, and/or recommendations to management. Through this experience, they can provide the most insight into the *quality* constructs - *information*, *system*, and *service* – as well as *user satisfaction*, *system use*, and individual components of *net benefits*.
- **MGMT** - In their role as financial analysts, they provide insight into business context in which systems are used. Their experiences are important in understanding *system use* and the *net benefit* of systems to the organization.

- **IT** - Some risk analysts are involved as system administrators for, or even development of, the studied FDSS. Through these experiences, they contribute technical context to the study and *system use*.

Table 3.1 lists the study's measuring variables as identified in the LITERATURE REVIEW, under their respective D&M model constructs. Each variable mapped to one or more participant roles. The method by which these variables are captured are discussed in the following section.

Table 3.1: Study constructs, measures, and participant roles

	User	Mgmt	IT		User	Mgmt	IT
Information Quality				System Use			
Accuracy	x	x	x	Frequency of use	x		
Currency	x		x	Planned replacement		x	
Completeness	x			Extent of use	x	x	
Format	x			Degree of use in decisions	x	x	
Relevance	x	x		User Satisfaction			
System Quality				User Satisfaction			
Adaptability	x			Net Benefits			
Availability	x			Loss prevented		x	
Response time	x		x	User productivity	x	x	
Usability	x			Cost savings		x	
Ease of learning	x			Decision quality	x	x	
Service Quality				Time to decision			
Responsiveness	x	x	x		x	x	
Knowledge	x						
Empathy	x						

3.2.2 Collection techniques

Data collection techniques include semi-structured interviews and questionnaire surveys.

Interviews

Kvale & Brinkmann (2008) define an interview as simply a conversation meant to understand someone's view, opinion, or experience. The primary purpose of the interviews conducted in this study is to establish study scope and gain contextual understanding to help focus analysis and enrich narrative description. The interview plan is outlined in Appendix A: Interview Guide. Interviews were semi-structured to provide some degree of flexibility in line with the study's exploratory nature. Interview questions were primarily formulated to capture the measuring variables associated with the *MGMT* and *IT* participant roles as identified in Table 3.1.

The interview process began with initial phone calls to identify FDSS scope and participant roles. Resulting interviews consisted of phone, and email communications with participants. Face-to-face interviews were not considered for logistical reasons relating to travel distance.

Kvale & Brinkmann (2008) point out that the first step of interview inquiry is *themizing*, or determining what will be studied and why. Initial interviews were designed to identify the systems supporting financial risk assessment, end-users, and appropriate contacts for each.

Kvale & Brinkmann (2008) assert that good qualitative interview questions should be focused on a central theme, related to the subject's everyday experience, be specific in their target (though the authors concede that some ambiguity can be useful to illicit information that the subjects themselves find important), and sensitive in formulation. Interview questions were developed with this in mind and assume a half-hour discussion time.

It is anticipated that asking questions personally will provide richer information, as interesting points brought up during conversation can be further explored and non-explicit communication such as voice inflection, subject hesitation, etc. can be noted by the researcher. Interviewers in general face the difficult and time-consuming process of interpreting and transcribing answers and must mitigate the risk that mishearing, misinterpreting, or other researcher errors pose to the study. I address these and other risks to the study in Section 3.4 Methodological reflections.

Questionnaires

Questionnaires are used to gather data regarding risk analysts' experiences in the *USER* role. Each question on the questionnaire was designed to measure one of the six constructs of the D&M model via the measuring variables associated with the *USER* participant role as identified in Table 3.1. The transformation of these success measures into questions is outlined in the Appendix B: Questionnaire questions with coding.

The information content of survey answers are considered less rich, in general, than interview results. Questionnaires increase the quantity of data available to the study and often benefit from more straightforward interpretation, lessened risk of inaccurate transcription, better question standardization, and are more conducive to quantitative analysis than interview results.

After a brief pilot study, in which two users reviewed the questions, links to the final questionnaire surveys were distributed via email to system end-users. Questions were answerable on a simple five-point Likert scale and users' answers were collected on a specialized survey website. The survey questionnaire used can be found in Appendix C: Online Questionnaire.

3.3 Analysis

The goal of the analysis portion of the study is to produce meaningful information that will answer the research question (RQ) and address purpose (a)-(c) of the study.

I apply a modified form of the four-step process presented by Foss & Waters (2003): data coding, theme development, conceptual schema development, and analysis writing / organization.

In practice, the processes of data collection and analysis often ran in parallel, in line with Yin (2008)'s suggestion to start the process of data manipulation immediately after collection.

3.3.1 Prepare data and identify units of analysis

Recorded interview results were transcribed into written form and reviewed together with my own

notes taken during the interview process. Standardized (Likert-scale) answers were also consolidated and values entered into a spreadsheet for later analysis.

Regardless of format (interview vs survey) or analytic approach (qualitative vs quantitative), the units of analysis applied are the six factors of the DeLone & McLean (2003) model and the previously identified sub-variables used to measure them.

3.3.2 Coding

The units of analysis were relatively straight-forward to identify in the case of the questionnaires, as questions are pre-mapped to specific variables (see Appendix B: Questionnaire questions with coding). Thus, questionnaire answers were coded automatically along these lines.

A similar approach was taken in labeling data from interviews, as the questions were also derived from the IS success variables. This process, however, took considerably more time and effort, as the interview format purposefully allows room for deviation for participants to identify important themes of their own. Finally, interview results were scanned for data relating to the analysis units and coded accordingly.

Interesting data which didn't fall into existing categories were noted and set aside for consideration in theme development, where I determined whether some labels should be combined, removed, or added.

3.3.3 Schema development

My next step was to identify significant patterns from the results to tie the data together. I then organized, compared, and contrasted the themes identified to generalize and support a coherent answer to the research question.

I organize and present my empirical findings in the EMPIRICAL RESULTS and my analysis of those findings are presented in the ANALYSIS.

3.4 Methodological reflections

3.4.1 Research quality and validation

Threats to research validity - fabrication, falsification, plagiarism, false authorship, redundant publication, conflicts of interest of various forms, etc. - is often subtle and unintentional in reality. Norris (1997) asserts that error and bias are unavoidable but an attempt should be made to control and understand them. Skepticism, commitment, and detachment are all important factors to assist in this. This entails open-mindedness, alertness to errors, and a willingness to look at oneself in an objective manner.

Hammersley & Gomm (1997) list *bias*, in particular, as a common source of systematic error in research. Bias, which stems from the researcher's own inclinations and experiences, can be especially prevalent if the researcher has other goals apart from knowledge creation. The findings of Ehrlinger et al. (2005) imply that this may be one of the most difficult threats to catch, as people tend to see personal connection to an issue as a source of biasness in others, but enlightenment in themselves.

Relevance is another important trait of quality research. Creswell (2007) suggests rich description as a strategy to facilitate generalization, as a more detailed account will assist in determining similarity of conditions in other contexts. In line with this, context-building is one of the key objectives of my interviews. Seale (1999) ties generalization with representative sampling. In this study, representative sampling is aided by the fact that financial institutions face similar risks, follow similar processes, and are highly integrated with the greater international financial environment.

Table 3.2 summarizes some of the efforts made in this study to achieve quality in terms of data validity and some generally accepted conditions of quality identified by Yin (2008):

Table 3.2: Applied quality conditions

Quality condition	Application within study
<u>Construct validity</u> . <i>Are the measures used appropriate for the studied concept?</i>	<ul style="list-style-type: none"> - Motivate application of the D&M model - Conduct pilot study
<u>External validity</u> . <i>What is the relevant domain to which results can be generalized?</i>	<ul style="list-style-type: none"> - Collect and describe rich contextual info - Choose representative object of study
<u>Reliability & Traceability</u> . <i>Is the study scientifically repeatable? Is every step verifiable?</i>	<ul style="list-style-type: none"> - Record interviews, retain questionnaires - Use low-inference descriptors [Seale (1999)] - Document chain of evidence - Invite external review (peer and adviser)
<u>Data validity</u> .	<ul style="list-style-type: none"> - Check members (verify interview results) - Record interviews for transcription

3.4.2 Ethical considerations

It is the goal of this study to achieve a high ethical standard. Israel & Hay (2006) defines ethical research as research that increases good and reduces harm, that helps assure the trust and future cooperation of participants, that upholds the integrity of the field, and complies with institutional rules and requirements.

Table 3.3 summarizes some of the efforts made in this study to achieve ethical research against some ethical topics given considerable attention by Kvale & Brinkmann (2008):

Table 3.3: Applied ethical conditions

Ethical condition	Application within study
<u>Informed consent</u> . <i>Are participants made aware of the study goals and how their data will be used? Have they given consent without undue pressure?</i>	<ul style="list-style-type: none"> - Describe study purpose clearly to all participants - Describe participation as voluntary - Get consent before recording conversations
<u>Confidentiality</u> . <i>Are contributions not traceable back to participating individuals / institutions?</i>	<ul style="list-style-type: none"> - Maintain anonymity of interviewees and survey participants, masking data when necessary
<u>Consequences</u> . <i>Are participants protected from harm? Is the overall impact of the study positive?</i>	<ul style="list-style-type: none"> - Respect participant time and comfort-levels - Keep interviews within promised time limits

4. EMPIRICAL RESULTS

Coded transcripts of interviews with participants are located in Appendix D: Interview 1, Appendix E: Interview 2, and Appendix F: Interview 3. Interview content is referenced in the following sections as [Appendix {#} {NAME}]{LINE REFERENCE #}].

4.1 Object of study

4.1.1 Riksgälden

Sweden's Riksgälden (National Debt Office) is the agency responsible for the national government's financial management, reporting directly to the Ministry of Finance. The agency was established in 1789 to help finance King Gustav III's war with Russia (Riksgälden a. (Undated)). Its scope of responsibilities have grown considerably since the 1700's and the agency's 170 employees now play an important part in Sweden's economy and financial markets. Riksgälden is charged with the state's cash management, debt management, loans and loan guarantees, and with providing support for the country's banking system and investors. These responsibilities, outlined in detail in Riksgälden b. (Undated), are explained below.

The agency serves as the government's internal bank. This role entails the handling of payments for governmental agencies and ensuring the state's liquidity through cash management and lending to other government agencies.

Riksgälden also manages the country's sovereign debt and related costs and risks; issuing debt in the form of government bonds and treasury bills.

The agency provides guarantees and loans to certain entities as designated by Swedish parliament, charging interest rates based on counter-parties' credit risk. Traditionally, these guarantees and loans have primarily been directed towards infrastructure projects, such as the Öresund bridge to Denmark, but the current financial crisis has recently widened this focus to include other recipients of national interest, such as the automotive and export industries.

Riksgälden contributes to the stability of Sweden's financial system through its support of the country's banks. This support comes in the form of emergency support for critical banks in crisis or capital infusions to encourage lending to Swedish borrowers. The agency also oversees the country's deposit insurance scheme, whereby deposits in Swedish bank accounts are insured up to a certain amount in case of bank insolvency.

4.1.2 Riksgälden's Risk Department and risk management process

Riksgälden's risk department, headed by Mats Filipsson, employs risk analysts to identify, assess, monitor, and report Riksgälden's financial (Figure 4.1) and operational risks. Per the organization's Financial and Risk Policy (Riksgälden d. (2009)), the objectives of risk management are to (1) improve internal control, (2) improve risk awareness within the organization, (3) ensure a correct basis for determination of risk levels, and (4) ensure compliance with those levels and limits set.

The document also outlines the high-level process used to manage the organization's risks (Figure 4.2). Summarized, the process begins as risks to the organization are identified (e.g. financial risks). These risks are then assessed. In the case of financial risk, this is often done by applying various quantitative methods. This risk assessment serves as an important input into the decision-making process to determine which measures (if any) to take against the risk and their urgency. Finally, measures are implemented and their results monitored and reported.

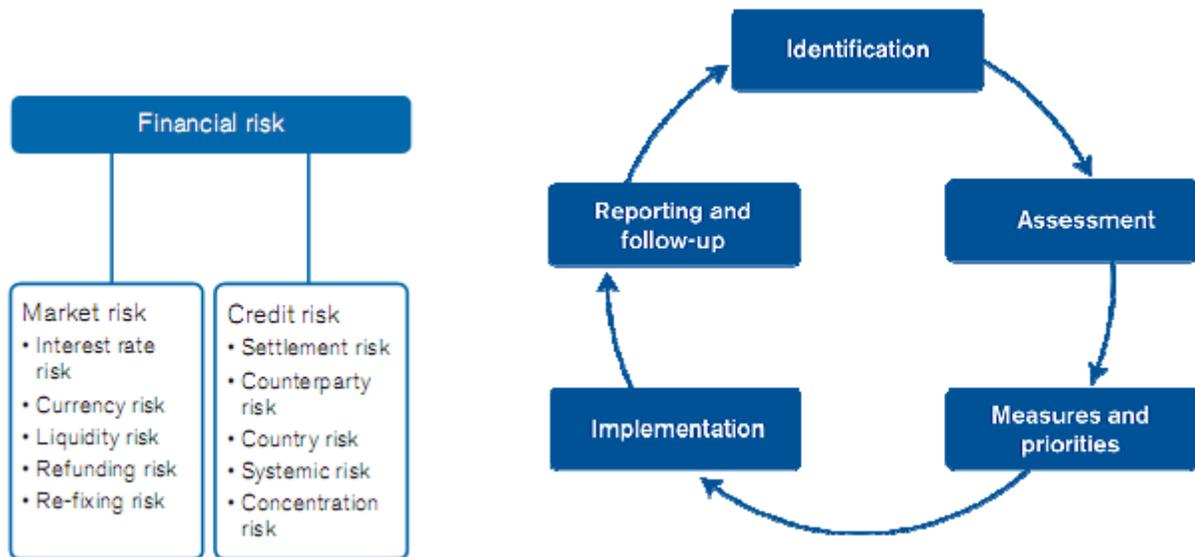


Figure 4.1: Financial risks from Risk Map, Riksgälden c. (2009)

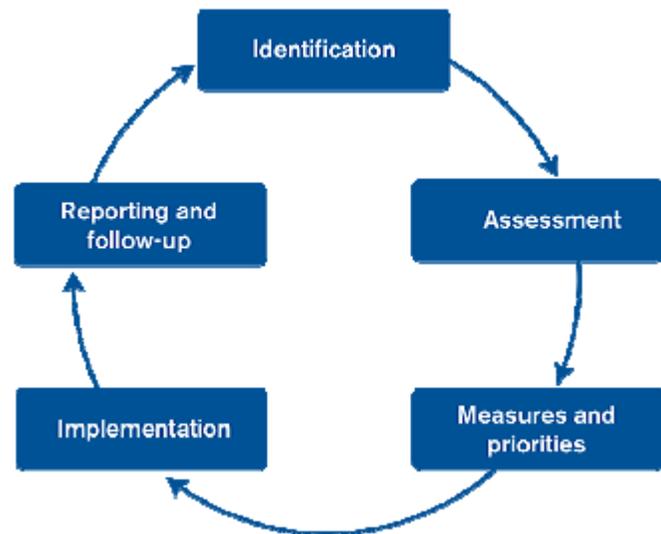


Figure 4.2: Risk management process from 2010 Risk Policy, Riksgälden d. (2009)

The systems evaluated in this study, and described in the next section, support or drive the assessment phase of the risk management process outlined in Figure 4.2 for one or more of the financial risks listed in Figure 4.1.

4.1.3 Evaluated FDSS

Two systems at Riksgälden are evaluated in this study. Both systems are used in financial risk assessment to inform decision-making at the organization. The systems provide information and guidance to decision-making and thus conform to Weber (2008)'s definition of *decision-analytic* DSS. Financial models are applied by the systems and both emphasize access to real-time data to provide current, forward-looking risk assessment. In this regard, the systems could be defined within Power (2002)'s expanded DSS framework as both *model-driven* and *data-driven* DSS.

SimCorp Dimension

SimCorp Dimension is a sophisticated, commercially available enterprise software solution targeting the investment management industry. SimCorp (Undated)'s website states that the system is currently used by over 160 financial institutions. It is not a financial risk application, per se, but rather a comprehensive, multifaceted system with financial risk assessment functionality (SimCorp (2008)).

The system is described in SimCorp (2008) as highly modular and covers most financial instruments

and investment management processes with functionality purchased as required by the customer. Process support spans front-, middle- (financial position-keeping), and back-office functions. Per SimCorp (2008), at the system's architectural core is a central database (the DSS *knowledge system*), which houses the common data set used by all the system's installed functional modules and technical domains (the DSS *problem processing system*).

SimCorp Dimension provides functionality for market risk measurement and analysis, which allows customer organizations to define risk factors, select the risk models and calculation processes to be applied, establish and monitor key risk ratios and limits, and report risk summaries on an aggregated level (SimCorp (2008)).

The the system administrator of Riksgälden's SimCorp Dimension installation is the risk department. Approximately 7 users [Appendix I: Follow-up email (Participant 1)] at Riksgälden's risk department use the system to calculate Value at Risk (VaR), key ratios, and other performance measures [Appendix D: Interview 1|4]. The risk department is currently considering adjusting its model and adding functionality [Appendix D: Interview 1|6-8].

SimCorp re-releases Dimension with new functionality on a semi-annual basis. Technical support for the system is provided by a specialized, local support network of consultants with a range of financial industry experience who are in turn supported from SimCorp's Copenhagen, Denmark headquarters (SimCorp (2008)). SimCorp provides varying levels of training and certifications in the platform to customers (SimCorp (2008)).

Kreditrisikrapporten (“The Credit Risk Report”)

The other system evaluated in this study is an Excel program referred to internally at Riksgälden as *Kreditrisikrapporten*, or “The Credit Risk Report” in English. The application was developed, and used exclusively, as a tool for credit risk assessment. A VBA macro application [Appendix F: Interview 3|5-11], *Kreditrisikrapporten* was developed in-house by the risk department [Appendix D: Interview 1|26] and is used internally by approximately 25 employees [Appendix D: Interview 1|20]; including six analysts from within Riksgälden's risk department as well as front-office traders [Appendix E: Interview 2|35].

The program helps risk analysts monitor project accounts' counter-party credit risk [Appendix E: Interview 2|9]. The application presents a simple graphical user interface, providing analysts with a consolidated view of current counter-party exposures vs set limits; alerting the viewer when limits are breached [Appendix E: Interview 2|9,17]. This is accomplished by drawing data from the central Dimension database [Appendix F: Interview 3|15] (the DSS *knowledge system*) before transforming it within the application (the DSS *problem processing system*) and presenting the resulting information to the user [Appendix F: Interview 3|13]. Traders use the application to gauge the remaining limit they have available [Appendix E: Interview 2|37].

Kreditrisikrapporten is developed by a single risk analyst in the risk department [Appendix F: Interview 3|1-4] without the awareness, or assistance, of Riksgälden's IT department [Appendix E: Interview 2|21]. Technical service is provided by the same analyst [Appendix E: Interview 2|23].

4.1.4 Summary

As one of Sweden's most important financial institutions, Riksgälden must navigate a diverse range of complex financial risks to fulfill its many mandates. These risks are managed through a defined risk management process executed by a dedicated risk management department. Risk assessment is an important element of the risk management process that informs the organization's decision-making.

This study examines two information systems used by the risk department to help assess financial risks:

One of these systems, SimCorp's Dimension enterprise investment management system, is a sophisticated and large-scale commercial product with some market risk assessment functionality.

Conversely, the other system, an in-house-developed VBA macro referred to as Kreditriskrapporten, is a simple program dedicated to credit risk assessment.

4.2 Participants

The “named” participants, *Participant 1*, *Participant 2*, and *Participant 3*, took part in the study's telephone interviews. Each named participant is a risk analyst at Riksgälden's risk department and a user of one or both of the evaluated systems.

Participant 1 is one of three primary users of the Dimension system for market risk assessment, using the system to generate reports for around 20 others at Riksgälden. *Participant 1* is involved with Dimension system administration and related in-house development.

Participant 2 specializes in credit risk assessment and is an important and frequent user of Kreditriskrapporten.

Participant 3 has many years of experience in programming of VBA macro for finance. *Participant 3* is a user, and the primary developer, of Kreditriskrapporten and a system administrator for the Dimension system.

Anonymous participants include five participants who completed the anonymous online survey related to the evaluated FDSS.

4.3 Evaluative data

Note on section diagrams. Consolidated survey results are presented for each system and measuring variable. 0 corresponds to “neither agree nor disagree”, 1 to “agree”, 2 to “strongly agree”, -1 to “disagree”, and -2 to “strongly disagree”. More positive values denote more positive reported experience toward the variable. Blue bars end at the mean value of all experiences reported (either positive or negative); if not visible, the average experience is 0. T-bars denote minimum and maximum reported experience; if not visible, reported experience was unanimous among participants.

4.3.1 Information Quality

Accuracy

The correctness of the information output by the system.

SimCorp Dimension:

Participant 1 reveals plans underway to improve the system's current risk model and assessment capabilities [Appendix D: Interview 1|8]. Concerns regarding risk models applied by the system may indicate a perceived “room for improvement” in terms of system accuracy. Bailey & Pearson (1983) identify consistency as a component of accuracy. In line with this, Participant 1 describes the desirability of maintaining Dimension as an integrated system across the organization providing a common data source. [Appendix D: Interview 1|10].

Accuracy was captured in the user survey in terms of risk likelihood and risk exposure. On average, respondents tended neutral-to-positive in their perception of the system's accuracy, with one respondent negative toward the system's calculations of risk exposures.

Summary:

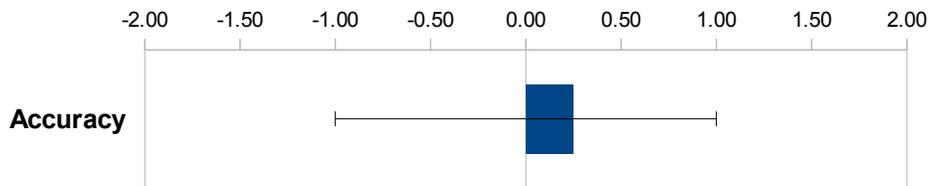


Figure 4.3: Questionnaire results - SimCorp Dimension - Accuracy

(-) Participant 1: Some risk capabilities require improvement.

(+) Participant 1: System provides the benefit of data integration across the organization.

Kreditrisikrapporten:

Questionnaire respondents attitudes toward system accuracy trended strongly toward the positive, with no respondents expressing accuracy concerns. Consistency is provided by the system's data being sourced directly from the central database provided by the Dimension system [Appendix F: Interview 3|16].

Summary:

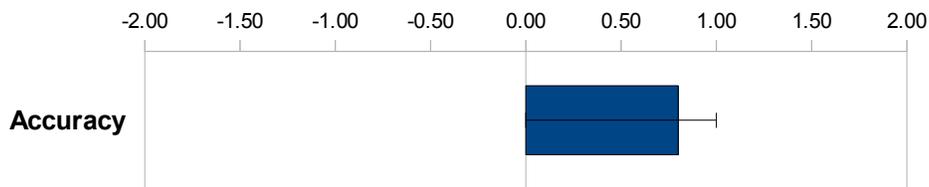


Figure 4.4: Questionnaire results – Kreditrisikrapporten - Accuracy

(+) Participant 3: System integration provides data consistency.

Currency

The age of the information being output by the system.

SimCorp Dimension:

Per SimCorp's marketing material [SimCorp (2008)] and as confirmed by Participant 1 [Appendix D: Interview 1|4], all Dimension modules draw from a common database. This would imply that data used in financial risks assessments within the system would utilize the most current data available.

Questionnaire responses seem to reflect this, with responses relating to currency being neutral to positive. No responders dissented.

Summary:

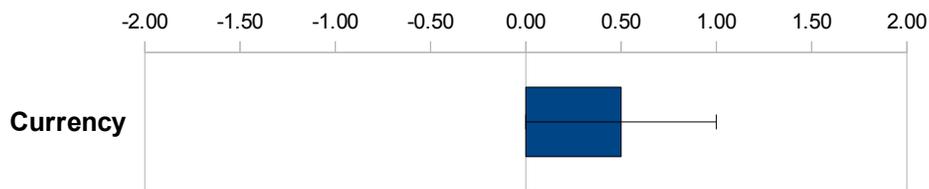


Figure 4.5: Questionnaire results - SimCorp Dimension - Currency

(+) Central database used for all financial data is used by all system modules. [SimCorp (2008)]

Kreditrisikrapporten:

Again, with the system's data sourced directly from the same database as Dimension [Appendix F: Interview 3|16], we would expect a similar degree of currency.

Survey responses were exclusively positive, with all respondents positive toward the system's currency.

Summary:

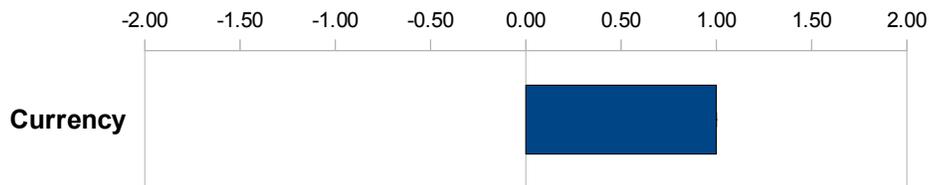


Figure 4.6: Questionnaire results - Kreditrisikrapporten - Currency

(+) Participant 3: Data sourced directly from Dimension's Central database.

Completeness

The comprehensiveness of the system's output in terms of information content.

SimCorp Dimension:

Participant 1 explains that some desirable risk capabilities are lacking in the system currently [Appendix D: Interview 1|8]. Some of these capabilities described, such as stress testing and Monte Carlo simulations, would constitute additional information content. This would indicate a perceived lack of completeness in the information provided by the current system. Other supplementary reporting tools used by the risk group, including Excel, Crystal Reports, and QlikView [Appendix D: Interview 1|

22].

Survey respondents reported neutral to positive perceptions regarding the completeness of the system's information.

Summary:

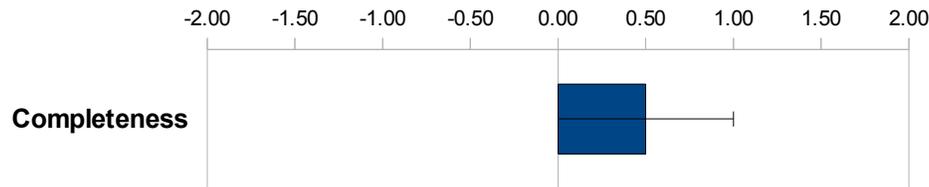


Figure 4.7: Questionnaire results - SimCorp Dimension - Completeness

(-) Participant 1: Current system lacks certain desirable outputs.

Kreditriskrapporten:

All questionnaire responses were positive toward the completeness of the system's informational output. This result may be partly related to the relatively limited purpose of the application: to collect and present current counter-party positions vs established limits [Appendix E: Interview 2|9].

Summary:



Figure 4.8: Questionnaire results - Kreditriskrapporten - Completeness

Format

The layout design, display, convenience, or ease of use of the system's informational output.

SimCorp Dimension:

Riksgälden is developing a data warehouse to facilitate analysts data access and reporting needs, with Dimension delivering data to the warehouse on a daily basis. Participant 1 explains that they found it necessary to modify this data to “make it easier to work with” [Appendix D: Interview 1|16].

Survey responses were neutral to negative toward the system's output format. No participants indicated a positive perception of this aspect of the system.

Summary:

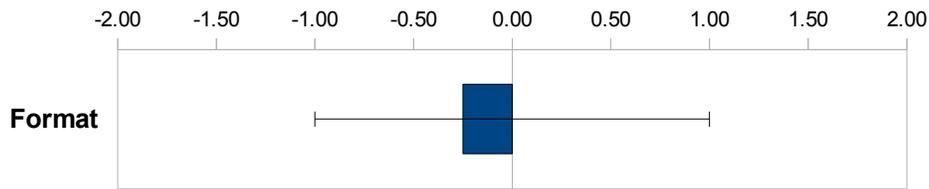


Figure 4.9: Questionnaire results - SimCorp Dimension - Format

(-) Data modifications required to meet analysts' reporting needs.

Kreditriskrapporten:

Survey respondents are overwhelmingly positive toward the format of the application's output; with all respondents reporting positive to very positive experiences.

Summary:

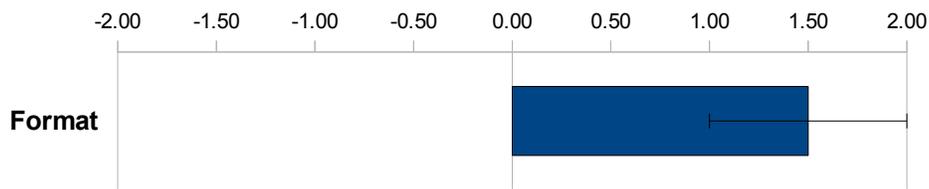


Figure 4.10: Questionnaire results - Kreditriskrapporten - Format

Relevance

The degree of congruence between what the user wants and what they get from the system.

SimCorp Dimension:

Though SimCorp bills itself as a “data warehouse platform” [SimCorp (2008)], Riksgälden's risk department is currently working with their IT department to develop a data warehouse housing data from Dimension to help meet their reporting and analytical needs [Appendix D: Interview 1|12-16].

All survey respondents found that the system's output was relevant to their needs.

Summary:

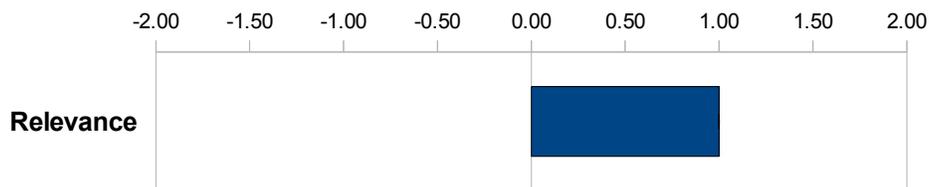


Figure 4.11: Questionnaire results - SimCorp Dimension - Relevance

(-) Participant 1: Supplementary data warehouse required to meet reporting and analytical needs.

Kreditriskrapporten:

Participant 2 indicates a high regard for the system's relevance to the team's credit risk work; stating that the team would continue to use the application even if counter-parties tracked by it were few in number [Appendix E: Interview 2|19]. Participant 2 explains that the output is also useful to Riksgälden's traders in addition to the risk analysts monitoring their activity [Appendix E: Interview 2|37].

All questionnaire respondents reported that they system output was either relevant or very relevant to their needs.

Summary:



Figure 4.12: Questionnaire results - Kreditriskrapporten - Relevance

(+) Participant 2: Application's output is useful, regardless of counter-parties.

(+) Participant 2: Application's output is useful to risk analysts and traders alike.

4.3.2 System Quality

Adaptability

The ability of an information system to adapt to new conditions, demands, or circumstances.

SimCorp Dimension:

SimCorp's marketing documentation lauds the system's modularity [SimCorp (2008)]; the ability of customers to purchase additional capabilities within the system as needed. Riksgälden is apparently taking advantage of this, as Participant 1 shares that they are in the process of adding to Dimension's risk assessment capabilities [Appendix D: Interview 1|6-8] as well as modifying some current functionality [Appendix D: Interview 1|8]. Participant 1 indicates that Riksgälden was not able to adapt the system to meet its analysis and reporting needs, instead finding it necessary to build a separate data warehouse [Appendix D: Interview 1|12-16]. Their ability to work with Dimension to integrate its data into the warehouse, however, is a plus.

Analysts who responded to the questionnaire reported that the system was rigid in their everyday work; with responses neutral to negative in terms of system adaptability.

Summary:

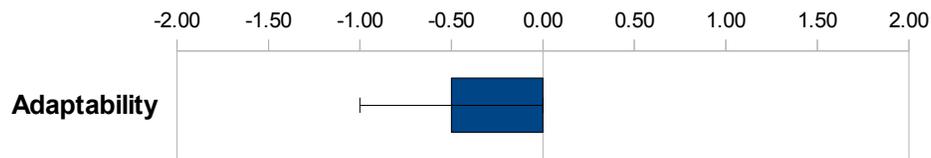


Figure 4.13: Questionnaire results - SimCorp Dimension - Adaptability

- (+) Modular system allows for additional capabilities to be added.
- (+) Some functionality is adjustable.
- (+) System is able to integrate with other systems.
- (-) Additional data warehouse needed to meet analytical and reporting needs.

Kreditrisikrapporten:

Participant 2 indicates that further development of the system is possible when needed [Appendix E: Interview 2|48].

Summary:

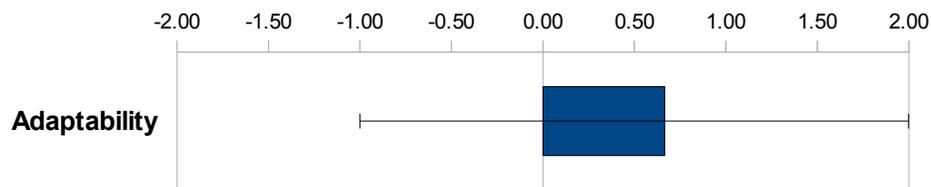


Figure 4.14: Questionnaire results - Kreditrisikrapporten - Adaptability

- (+) Functionality is adjustable if needed.

Availability

The availability of the system's output at a time suitable for its use.

SimCorp Dimension:

Perceptions of the system's availability varied across participants; with half agreeing that the system is available when needed and the other half disagreeing.

Summary:

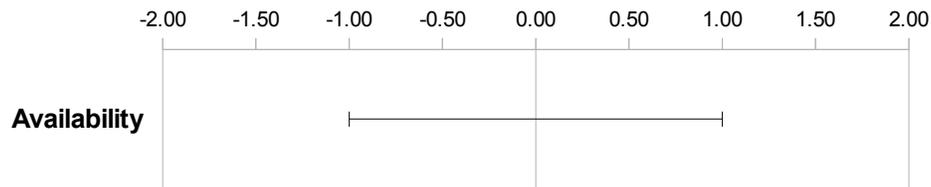


Figure 4.15: Questionnaire results - SimCorp Dimension - Availability

Kreditriskrapporten:

In the years the application has been used, Participant 2 has never had problems with the availability of the application [Appendix E: Interview 2|27].

All survey respondents were either positive or very positive in their perception of system availability.

Summary:

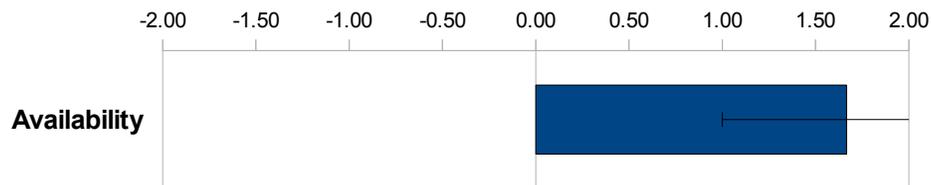


Figure 4.16: Questionnaire results - Kreditriskrapporten - Availability

(+) No major issues with system availability have been reported.

Response time

The delay between the request for system output and its delivery.

SimCorp Dimension:

Users responding to the survey reported neutral to positive perceptions of system response time.

Summary:

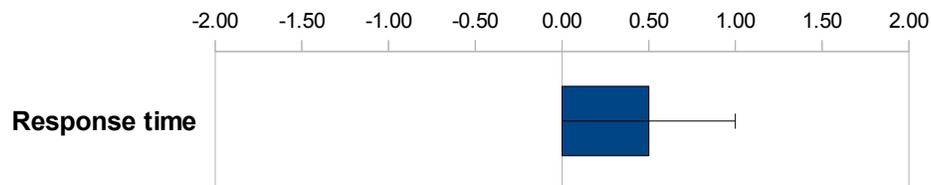


Figure 4.17: Questionnaire results - SimCorp Dimension – Response time

Kreditriskrapporten:

Questionnaire respondents reported positive to very positive experiences with system response time.

Summary:



Figure 4.18: Questionnaire results - Kreditrisikrapporten – Response time

Usability

The ease (or difficulty) that users experience using the system.

SimCorp Dimension:

All survey respondents were neutral to Dimension's usability.

Summary:

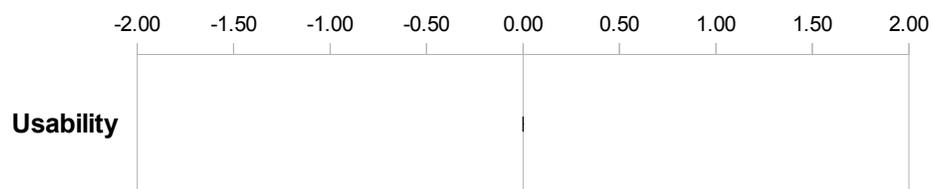


Figure 4.19: Questionnaire results - SimCorp Dimension - Usability

Kreditrisikrapporten:

All survey respondents were either positive or very positive to the application's usability.

Summary:



Figure 4.20: Questionnaire results - Kreditrisikrapporten – Usability

Ease of learning

The ease with which a new user can begin to use the system.

SimCorp Dimension:

Respondents perceptions were universally negative toward Dimension's ease of learning.

Summary:

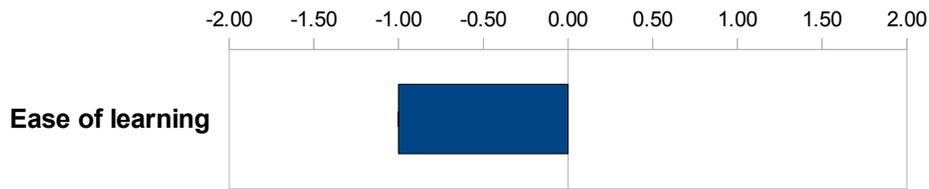


Figure 4.21: Questionnaire results - SimCorp Dimension – Ease of learning

Kreditriskrapporten:

Conversely, survey users found Kreditriskrapporten easy to learn; with all respondents reporting either positive or very positive perceptions.

Summary:



Figure 4.22: Questionnaire results - Kreditriskrapporten – Ease of learning

4.3.3 Service Quality

Responsiveness

The amount of time between when service is required and when its delivered.

SimCorp Dimension:

While marketing documentation provided by SimCorp places a strong emphasis on the quality of their customer support [SimCorp (2008)], survey respondents reported that system problems were resolved neither quickly nor slowly.

Summary:

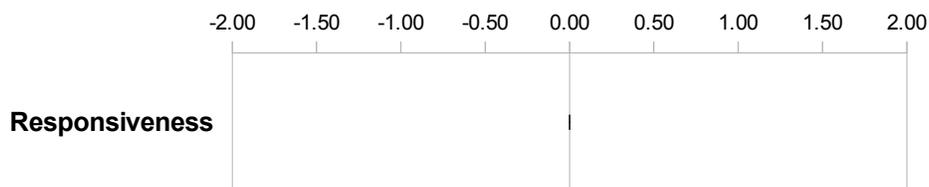


Figure 4.23: Questionnaire results - SimCorp Dimension - Responsiveness

Kreditriskrapporten:

Since the application is developed by a single risk analyst in the risk department [Appendix F: Interview 3|1-4] without the awareness, or assistance of Riksgälden's IT department [Appendix E:

Interview 2|21], system problems are resolved by the same analyst [Appendix E: Interview 2|23]. Participant 2 expresses some concern regarding the reliance on a single individual for service; noting that a breakdown would be problematic if it were to occur while the developing analyst was away [Appendix E: Interview 2|25]. Participant 3, risk analyst and developer of the application, explains that it was just easier to develop the application themselves, rather than rely on an IT department [Appendix F: Interview 3|21].

Survey respondents reported that application issues were resolved quickly.

Summary:



Figure 4.24: Questionnaire results - Kreditriskrapporten - Responsiveness

(+) Participant 3: Service provider is also a co-user with an impetus to resolve issues.

(-) Participant 2: Service provided by single analysts with no backup support.

Knowledge

The degree to which IT employees have the needed knowledge to provide quality service.

SimCorp Dimension:

SimCorp (2008) refers to its customer support representatives as business consulting experts with financial industry experience. Despite this, survey results tended neutral to negative regarding the adequacy of customer support's knowledge to help resolve issues.

Summary:

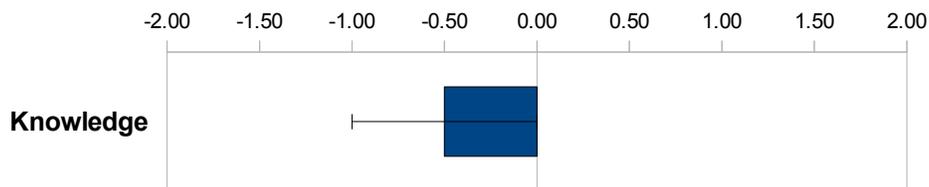


Figure 4.25: Questionnaire results - SimCorp Dimension - Knowledge

Kreditriskrapporten:

The application's developer is a trained financial analysts with 20 years of experience building Excel applications [Appendix F: Interview 3|6]. In addition, as a system administrator for the Dimension system, the developer is familiar with the underlying data structures used by the application [Appendix F: Interview 3|20]. Participant 2 expresses trust in the developing analyst's knowledge and abilities as they pertain to the application, but does not feel the same way regarding the IT department; citing the

complexity of the application's financial functions [Appendix E: Interview 2|25]. Participant 3 emphasizes the importance of financial knowledge in addition to the data structures involved when supporting such an application [Appendix F: Interview 3|26]. Participant 3 also expresses some doubts as to the IT department's knowledge of the technology used (Excel / VBA) [Appendix F: Interview 3|18].

Survey results are omitted, as the question was deemed non-applicable by respondents (no IT support).

Summary:

(+) Application is supported de facto by a well-regarded, experienced financial expert with strong VBA background and familiarity with underlying data structures. [Appendix E: Interview 2|25],[Appendix F: Interview 3|6],[Appendix F: Interview 3|20]

(-) An official, knowledgeable IT support function is unavailable for the application. [Appendix E: Interview 2|25],[Appendix F: Interview 3|26],[Appendix F: Interview 3|18]

Empathy

The degree to which service providers have users' best interest at heart.

SimCorp Dimension:

Questionnaire participants report neutral to positive experience regarding empathy shown by IT support.

Summary:

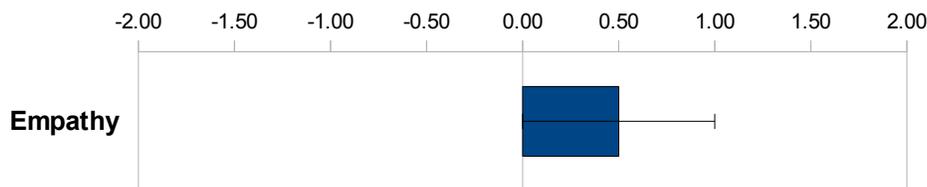


Figure 4.26: Questionnaire results - SimCorp Dimension - Empathy

Kreditriskrapporten:

The “service provider” for the application is a risk department co-worker and a co-user of the application [Appendix F: Interview 3|3].

Survey results are omitted, as the question was deemed non-applicable by respondents (no IT support).

Summary:

(+) Service provided by co-worker and co-user of application.

4.3.4 System Use

Frequency of use

How often do users use the system?

SimCorp Dimension:

Both survey respondents indicated that they use the Dimension system for financial risk assessment on at least on a daily basis.

Kreditriskrapporten:

All three survey respondents use Kreditriskrapporten at least on a daily basis.

Planned replacement

Will the system be replaced in the foreseeable future?

SimCorp Dimension:

Participant 1 states that Riksgälden currently plans to keep the current system, while adding and/or changing some capabilities [Appendix D: Interview 1|6].

Kreditriskrapporten:

Participant 2 indicates there are no plans to discontinue use or replace the application, though future changes to the application are possible [Appendix E: Interview 2|48].

Extent of use

How commonly use is the application across the organization?

SimCorp Dimension:

The financial risk components of Dimension are used by approximately 7 users [Appendix I: Follow-up email (Participant 1)].

Kreditriskrapporten:

Participant 2 estimates that the application is used by up to 25 employees at Riksgälden [Appendix D: Interview 1|20], of which six specialize in credit risk in the risk department [Appendix E: Interview 2|35]. Other users include front office traders and operational risk specialists [Appendix E: Interview 2|37].

Degree of use in decisions

How important is the system's output to the decision-making process?

SimCorp Dimension:

Participant 1 describes the system output as critical to decision-making, pointing out that the system is responsible for delivering a number of important decision inputs [Appendix D: Interview 1|28].

All questionnaire respondents strongly agree that the system's output is an important decision-making input.

Summary:

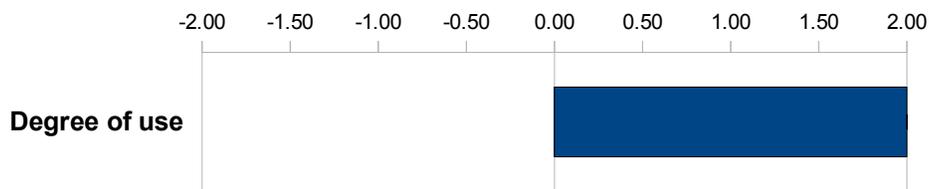


Figure 4.27: Questionnaire results - SimCorp Dimension – Degree of use in decisions

(+) Participant 1: System is “critical” to decision-making.

(+) Participant 1: System provides a number of important decision inputs.

Kreditriskrapporten:

The system is used to assist both front office traders' in making informed decisions, to see if they have credit limit left to use, and those of the risk department monitoring counter-party exposures [Appendix E: Interview 2|9],[Appendix E: Interview 2|37]. only system used at Riksgälden to assess credit risk [Appendix E: Interview 2|39]. Participant 1 considers the application critical [Appendix D: Interview 1|28].

All questionnaire respondents *agree* or *strongly agree* that the the system's output is important for decision-making.

Summary:

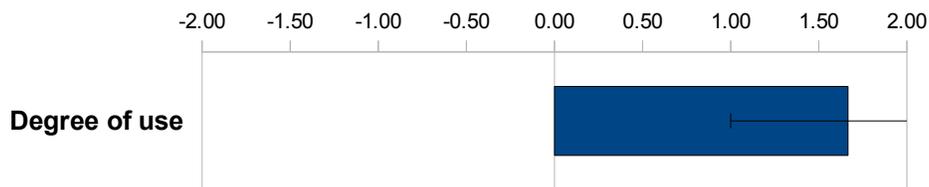


Figure 4.28: Questionnaire results - Kreditriskrapporten – Degree of use in decisions

(+) Participants 1, 2: System is critical to decision-making.

(+) Participant 2: System is used by different stakeholders in a number of decisions.

4.3.5 User Satisfaction

User satisfaction

The sum of a user's feelings or attitudes toward a system.

SimCorp Dimension:

Questionnaire respondents report neutral to positive attitudes toward the system.

Summary:

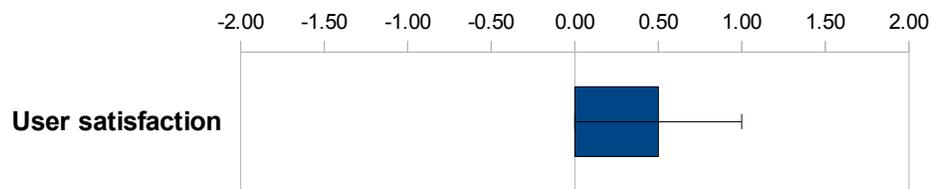


Figure 4.29: Questionnaire results - SimCorp Dimension – User satisfaction

Kreditrisikrapporten:

The majority of survey participants report positive user satisfaction. One answers feeling neither satisfied nor unsatisfied with the system.

Summary:

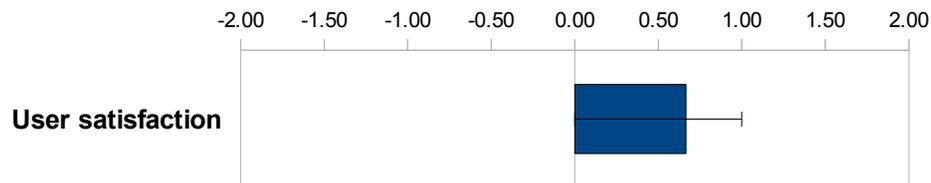


Figure 4.30: Questionnaire results - Kreditrisikrapporten – User satisfaction

4.3.6 Net Benefits

Loss prevented

Have losses to the organization been prevented by using the system?

Dimension:

Though difficult to quantify, Participant 1 believes that use of the system has had a limiting effect on losses [Appendix I: Follow-up email (Participant 1)].

Kreditrisikrapporten:

By providing a better overview of their risks, Participant 2 believes that the application has prevented losses for the organization, citing it as the application's ultimate purpose [Appendix E: Interview 2|50].

User productivity

The system's impact on users' job performance.

SimCorp Dimension:

When answering if the quality of their work was improved by the system, survey respondents reported neither agreement nor disagreement.

Summary:



Figure 4.31: Questionnaire results - SimCorp Dimension – User productivity

Kreditrisikrapporten:

Participant 2 says that users spend less time looking for information when using the application [Appendix E: Interview 2|46]. The interviewee also seems to imply a positive impact on productivity by stating that it becomes more useful as the number of counter-parties being monitored increases [Appendix E: Interview 2|19].

Summary:

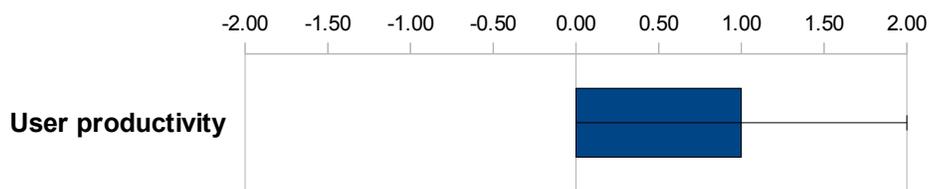


Figure 4.32: Questionnaire results - Kreditrisikrapporten – User productivity

(+) Participant 2: Employees spend less time looking for information.

(+) Participant 2: Productivity impact increases with quantity of counter-parties.

Cost savings

Has use of the system saved the organization or its stakeholders money?

Dimension:

Participant 1 is unsure whether the system had reduced cost of risk assessment Appendix I: Follow-up email (Participant 1).

Kreditrisikrapporten:

When asked if use of the application has resulted in cost savings, Participant 2 initially replies in the negative [Appendix E: Interview 2|42], but later redacts this statement, reflecting that the reduction in analyst time spent would constitute a cost savings for the organization [Appendix E: Interview 2|46].

Decision quality

Has the system improved the quality of decisions and their outcomes?

SimCorp Dimension:

While Participant 1 [Appendix D: Interview 1|28] and surveyed users report that the system provides critical input for decisions, the impact of that input on decision quality is less clear; with survey respondents reporting either neutral or positive perceptions of system impact on decision quality.

Summary:

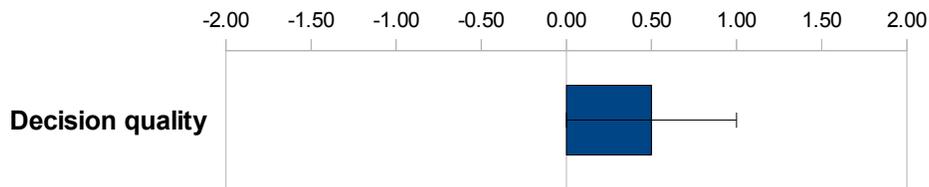


Figure 4.33: Questionnaire results - SimCorp Dimension – Decision quality

Kreditrisikrapporten:

The system is reported to provide critical input to decisions both by interviewees [Appendix D: Interview 1|28] and survey respondents. Perceptions of the application's impact on decision-making among survey respondents range from positive to very positive.

Summary:



Figure 4.34: Questionnaire results - Kreditrisikrapporten – Decision quality

Time to decision

Has the use of the system reduced the amount of time it takes to make decisions?

SimCorp Dimension:

All survey respondents agree that the system reduces the amount of time it takes to reach decisions.

Summary:

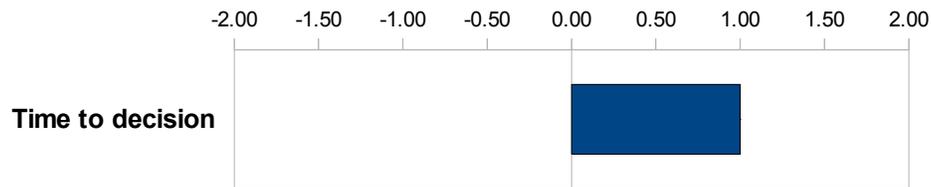


Figure 4.35: Questionnaire results - SimCorp Dimension – Time to decision

Kreditrisikrapporten:

Users' questionnaire responses range from agreement to strong agreement with the assertion that system use reduces the time needed to reach decisions.

Summary:

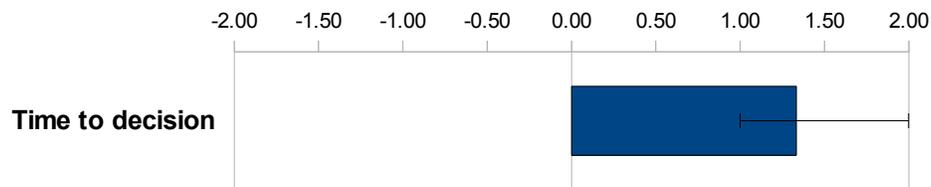


Figure 4.36: Questionnaire results - Kreditrisikrapporten – Time to decision

4.3.7 Additional themes

Additional themes emerged during interviews with analysts.

System transparency

When asked how IT could better support analysts' efforts to assess financial risks, Participant 1 stresses a desire for information: information about the data inputs and how they are processed and transformed into the outputs [Appendix D: Interview 1|29-33]. Participant 1 states that, ideally, this information should be readily available through both the system and IT support [Appendix D: Interview 1|29-33].

Risk overview

Participant 2 twice cites an improvement in overview of credit risk during discussions surrounding Kreditrisikrapporten net benefits - once in relation to its contribution to cost savings [Appendix E: Interview 2|44], and again in losses prevented [Appendix E: Interview 2|50].

5. ANALYSIS

I begin with a discussion of additional themes which emerged during data collection. I incorporate these into the DeLone & McLean (2003) model identified earlier in chapter LITERATURE REVIEW. Finally, I evaluate the systems against this model based on data presented in EMPIRICAL RESULTS.

5.1 Emergent themes

DeLone & McLean (1992) themselves emphasize the importance of context in applying their model on p. 80, where they state that “*no single variable is intrinsically better than another, so the choice of success variables is often a function of the objective of the study, the organizational context... etc.*” In applying the authors' 2003 model to the context of systems supporting financial risk assessment some themes emerge to influence this choice of variables.

Holsapple (2008) identifies *improved repute* as one of five decision-making improvements associated with DSS. During discussions with analysts, *improved repute* commonly arose to the forefront; with the desire for system assurance, trust, and confidence emerging as a recurring theme.

Confidence in financial risk systems and IT support's knowledge emerge as important elements when evaluating system quality and service, respectively. One user identifies system's contribution to the organization's understanding of its risk posture as an important factor when considering system net benefits. Finally, I propose that systems' contribution to the organization's operational risks is an important consideration when assessing DeLone & McLean (2003)'s *net benefit*.

5.1.1 Confidence in the system's output

Bailey & Pearson (1983)'s study finds users' “feelings of assurance or certainty” toward their systems to be the second most important factor in affecting user satisfaction. My discussions with risk analysts seem to reflect this importance.

When asked how IT could better support financial risk analysis, Participant 1 expresses a desire for transparency: an understanding of where data inputs come from and how these inputs are processed to produce the system's output [Appendix D: Interview 1|29-33].

Indeed, the risk group appears highly motivated to maintain a high degree of transparency into, and confidence in, their systems. I find it likely that this motivation is a factor in the group's decision to develop their own applications (Kreditriskrapporten) and to take the role of system administrator (SimCorp Dimension) [Appendix F: Interview 3|20].

To account for these needs, I propose a new variable, *transparency*, be considered in addition to those previously identified in the LITERATURE REVIEW in the measurement of the DeLone & McLean (2003) *system quality* construct for FDSS supporting financial risk assessment. *Transparency* would measure the degree to, and ease of, which a system's inputs and processing is made available and accessible to end users.

5.1.2 Confidence in IT service providers

Knowledge

All three interviewees emphasize the importance of knowledge – of IT and finance – in their IT support. Participant 1 stresses the need for IT to try to understand financial analysts needs, but acknowledges that the convergent of these two very technical, and very different, knowledge areas is not always easy to achieve [Appendix D: Interview 1|37-38]. In fact, it is this difficulty that Participant 3 cites as a rationale behind the decision to develop Kreditriskrapporten within the department [Appendix F: Interview 3|26].

To account for these views, I propose that special emphasis be placed on the *knowledge* measurement of the *service quality* when applying the construct to systems supporting financial risk assessment.

Facilitation of transparency

When asked about how IT better can support financial risk assessment, Participant 1 stresses IT support's role as a source of information for the whole chain, from data source to system output and processing [Appendix D: Interview 1|34-36].

In addition to *system transparency*, discussed previously, I infer that IT support's ability and propensity to facilitate users' access to information about the system, such as data sources and methods by which output is calculated, is an important component of service quality for such systems.

I propose a new variable, *facilitation of transparency*, to capture this aspect of DeLone & McLean (2003)'s service quality construct as it applies to systems supporting financial risk assessment.

5.1.3 Confidence in the organization's understanding of overall financial risk

When discussing the net benefits provided by a system, Participant 2 reports an improved overview of the organization's financial risks as a source of value to the organization.

While *loss prevented* and *decision quality* variables should effectively capture a system's *net benefits* as they relate to assessment of specific risks, they may neglect to address a system's direct contribution to the organization's understanding of its overall financial risk situation.

To address this, I propose a new variable to measure the *net benefits* provided by a system through its contribution to the organization's overall *financial risk overview*.

5.1.4 Confidence in the organization's IT operational risk position

The development of applications outside of a formal IT infrastructure, as in the case of Kreditriskrapporten, brings up some important questions regarding operational risk to the organization.

IT organizations are generally expected to enforce and apply accepted policies, procedures, and practices to manage IT development, service, and operations. These practices, which include IT governance, change management, security, service management, among other areas, have been adapted over time to better respond to organizations' IT needs while providing a framework to control related IT operational risks.

Like financial risk, IT operational risk cannot be eliminated completely and should ultimately be weighed against benefits provided by the system. To this end, I propose a provision be made to account for systems' impact on organizational *operational risk exposure* and tied to DeLone & McLean (2003)'s *net benefit* construct.

5.2 System evaluation

I provide evaluative interpretations based on the empirical data presented in chapter EMPIRICAL RESULTS for each of the six constructs of DeLone & McLean (2003)'s model. Each section includes a motivation for variable weightings applied for the construct. The chapter ends with an evaluative summary (Table 5.2).

5.2.1 Information quality

Greatest weight is applied to the three variables *relevance*, *accuracy*, and *currency*.

- Output should be *relevant* if it is to be of value to the financial risk assessment process.
- Bailey & Pearson (1983) find *accuracy* the strongest contributing factor in user satisfaction. I weigh it strongly in my assessment, but also acknowledge that the term “accuracy” can be open to interpretation in the case of financial risk assessment. Complete accuracy is impossible with even the best of systems, given the nature of risk assessment as a measurement of future events. On the other hand, “accuracy” as it refers to the right data inputs being transformed in the desired way can be achievable. As my questioning did not explicitly distinguish between these two interpretations, survey answers may reflect participants attitudes toward the nature of the risk itself or the method being applied by the system, as much as it does the system itself.
- I give *currency* strong weight in light of the forward-facing, predictive nature of risk assessment.

SimCorp Dimension:

I find that Dimension performs well in all three strongly weighted areas of information quality. Respondents were very positive toward the *relevance* of the system's output to their work. Analysts are also positive toward system *accuracy* and *currency*, buoyed perhaps by the system's centralized data architecture.

Planned improvements to the system and the development of a supplementary data warehouse may indicate some areas of weakness in system output, affecting *completeness*. Participants also indicated that the system's output *format* lacked clarity.

In spite of some reported weaknesses, overall analyst sentiment toward Dimension's information quality tended neutral to positive.

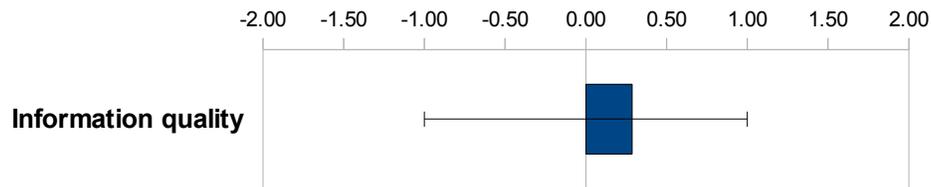


Figure 5.1: Questionnaire results - SimCorp Dimension - Information quality (all)

Kreditrisikrapporten:

Again, analysts were very positive toward the *relevance* of system output. Using the same database as Dimension, the application appears to benefit similarly in terms of output *currency* and *accuracy*.

Survey participants reported positive experiences across all other information quality factors, with overall sentiment between positive and very positive. Areas of greatest strength were identified as the system output format and relevance to analysts' work.

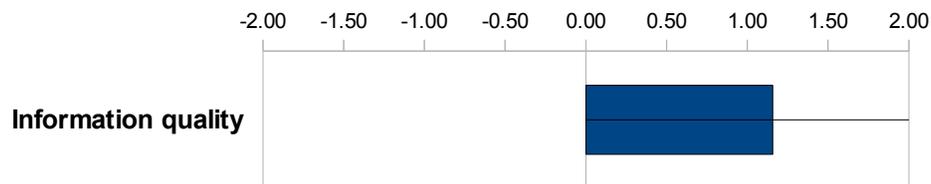


Figure 5.2: Questionnaire results - Kreditrisikrapporten - Information quality (all)

5.2.2 System quality

To measure system quality for systems supporting financial risk, I put special emphasis on system availability, transparency, adaptability.

- A system is of no use if not available when needed. I emphasize *availability* in line with Bailey & Pearson (1983)'s rating it as the third most important factor contributing toward user satisfaction.
- System *transparency* emerged from discussions as an important factor for financial risk analysts. Desire for transparency may have influenced their chosen form of organization and projects underway; risk analysts are positioned close to the system as system administrators, for example, and a data warehouse is being built to allow even more oversight and control over data. *Transparency* was not tested.
- I also find *adaptability* of special relevance to systems supporting financial risk assessment. Interviews revealed a dynamic environment where new systems, modules, and changing requirements are the norm. Adaptable systems would best fit this type of environment.

SimCorp Dimension:

System quality results for Dimension were mixed.

Dimension is designed and sold as a modular system, which allows capabilities to be added. It is also open to system integration. Both are traits conducive to system *adaptability*. Some everyday users report that the functionality is rigid for their purposes. Users find the system relatively stable; no problems are reported regarding the system's availability and experience tends positive regarding its response time.

Users' find the system neither difficult nor easy to use; but all reported initial difficulty in learning to use the system.

Overall user perception toward system quality was neutral-to-slightly negative.

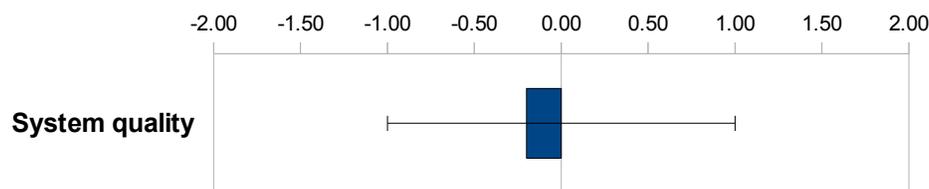


Figure 5.3: Questionnaire results - SimCorp Dimension - System quality (all)

Kreditriskrapporten:

Perceptions of system *adaptability* tended positive. The system's stability, measured in terms of *availability* and *response time*, was held in very high regard by survey participants.

The system's *usability* and *ease of learning* were held in very high regard by survey participants, but these aspects should be weighed against the application's simplicity relative to Dimension.

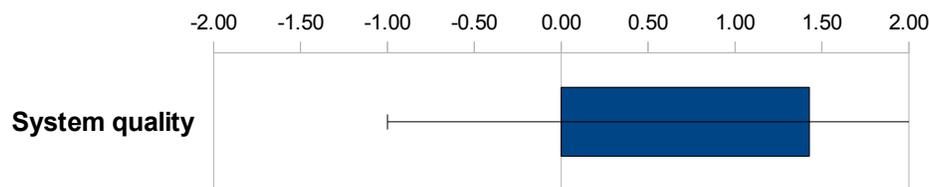


Figure 5.4: Questionnaire results - Kreditriskrapporten - System quality (all)

5.2.3 Service quality

Weight is focused on the variables *knowledge* and *responsiveness*.

- The meeting of two very technical professions – finance and IT – brings *knowledge* to the forefront of service quality. The need for appropriate knowledge is emphasized numerous times during discussions with risk analysts and even cited as a major contributing factor in the risk department's practice of developing applications internally.
- Service is of no use if it doesn't respond to users' needs. I find *responsiveness* of particular importance in measuring service quality.

SimCorp Dimension:

Analysts reported negative associations with SimCorp's service *knowledge* and indifference toward

their *responsiveness*.

Meanwhile, survey respondents felt service providers wanted to help (*empathy*). *Openness* was not tested.

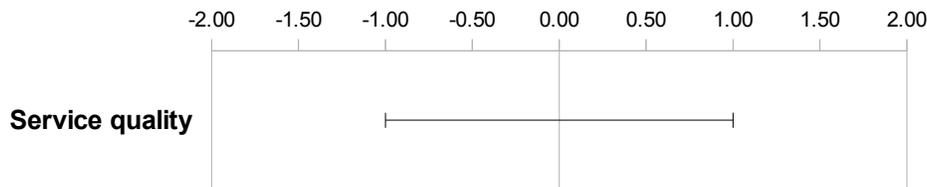


Figure 5.5: Questionnaire results - SimCorp Dimension - Service quality (all)

Kreditriskrapporten:

Results for Kreditriskrapporten's service quality are inconclusive, as the application does not receive official IT support. Instead, the analyst who built it also provides de facto support.

While this arrangement would appear to have its benefits – users receive support directly from a trusted and knowledgeable co-worker who is also a co-system user – there are also concerns associated with reliance on a single individual without knowledgeable backup for all service needs.

5.2.4 System use

In measurement of system use, I emphasize the variables *frequency of use* and *degree of use* in decisions.

- *Frequency of use* is a very popular (and sometimes the only) measurement of system success in literature. Beyond its obvious values as an indicator of user utility and satisfaction, I appreciate its objectiveness.
- Though relatively uncommon in literature, I add weight to *degree of use* in decisions. Here, *degree of use* functions as an overall indicator of both trust in the system and utility for its intended purpose.

SimCorp Dimension:

Of Riksgälden's 170 employees, around 7 use the system for market risk assessment. Of those who participated in the survey, all used the application on a daily basis. All interviewees and survey respondents agree that the system's output is critical to decision-making. The system will continue to be used for the foreseeable future.

Kreditriskrapporten:

Approximately 25 employees use the application to inform their decisions in some capacity; six of which are credit risk analysts with others using the application to inform trading and other decisions. Of those who answered the survey, all used the application on a daily basis. All interviewees and survey respondents agree that the system provides important input for decisions. Application use is expected to continue in the foreseeable future.

5.2.5 User satisfaction

I measure user satisfaction as a single, straight-forward metric.

SimCorp Dimension:

Questionnaire respondents report neutral to positive attitudes toward the system.

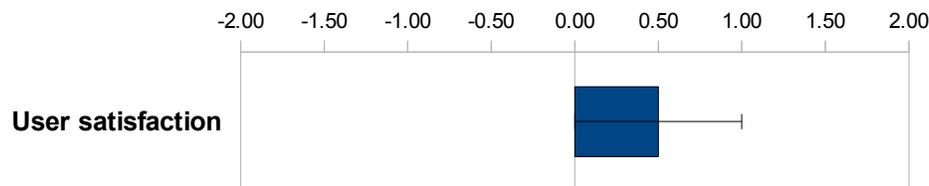


Figure 5.6: Questionnaire results - SimCorp Dimension – User satisfaction

Kreditrisikrapporten:

The majority of survey participants report satisfaction with the application.



Figure 5.7: Questionnaire results - Kreditrisikrapporten – User satisfaction

5.2.6 Net benefits

I focus weight on the variables *loss prevention*, *user productivity*, and *decision quality* in my measurement of system net benefits.

- Loss prevention could be considered risk assessment's *raison d'être* and, thus, that of the systems supporting it. This is also acknowledged by the risk analysts themselves. I apply special importance to *loss prevented* in my measurement of net benefits. It is by nature a subjective measure on account of the difficulty of calculating “what would have been” with any accuracy.
- I apply extra weight to *user productivity* as a strong indicator of user utility.
- In the case of systems supporting risk assessment, *decision quality* can be expected to be closely related to loss prevention. Thus, I stress this measure for similar reasons.

SimCorp Dimension:

Risk analysts deem the system effective in limiting loss to the organization. At least one user finds the system beneficial in terms of *decision quality*. Less clear, however, was the system's impact on *user productivity* or *cost savings*. Most survey respondents agree that the system saves time in decision-making.

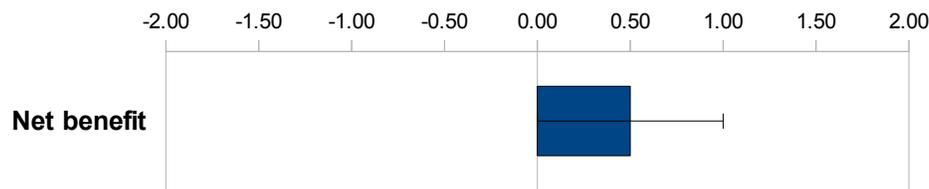


Figure 5.8: Questionnaire results - SimCorp Dimension – Net benefits (all)

Kreditrisikrapporten:

Users identified a number of benefits of system use. The clearest benefits were in terms of decision quality and time saved in the decision-making process. Users also believed that the application has a positive impact on the quality of their work and at least one user believes that using the system helps prevent losses to the organization.

Since the application is developed outside of a formal IT infrastructure, it is unlikely to be subject to many of the IT risk controls such an infrastructure is expected to provide. The program is built in VBA for Excel. While well-known to be commonly used in finance, VBA is also known to change its functionality with Microsoft's upgrades, updates, and "Hotfixes". These changes can cause unexpected syntax and/or semantic errors, which can result in incorrect output or program crashes. As a professional IT consultant, I have been hired by clients to fix such issues.

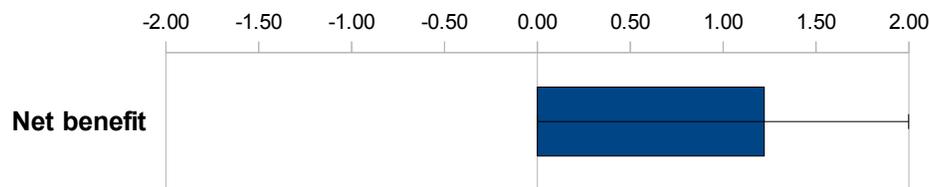


Figure 5.9: Questionnaire results - Kreditrisikrapporten – Net benefits (all)

5.2.7 Summary

The analysis is summarized in Table 5.2. The table lists those considerations which are important for systems supporting financial risk assessment to be deemed successful. Italicized entries denote variables associated with emergent themes of the study. These variables were not formally tested, and thus, not represented in overall construct scores. Otherwise, variable ratings are drawn from the respective construct sections of the analysis and weighted according to the standards described to determine overall construct ratings.

Overall, users expressed positive experience toward the systems. For variables tested, gaps were identified only for the commercial enterprise software, in which gaps in *information quality (format)*, and *system quality (ease of learning)*, and *service quality (knowledge)* were identified.

A concern surrounding the later of these gaps, IT support's context-appropriate *knowledge*, is identified as a catalyst for the risk department's decision to perform some important development activities itself. It is conceivable that, efforts to close this gap in *knowledge* by perusing development outside of a formal IT infrastructure, may result in gaps in the organization's *operational risk exposure*. The

Operational risk exposure variable, however, is not tested in the study.

Table 5.1: Key to evaluative scores

++	Very good
+	Adequate
IC	Inconclusive
-	Poor
--	Very poor
NT	Not tested

Table 5.2: Summary of evaluation analysis

Construct	Measurement	Dimension		Kreditrisikrapporten	
Information Quality	Accuracy	+	+	+	+
	Currency	+		+	
	Completeness	IC		+	
	Format	-		++	
	Relevance	++		+	
System Quality	Adaptability	IC	IC	+	+
	Availability	IC		++	
	Response time	+		++	
	Usability	IC		++	
	Ease of learning	-		++	
	Transparency	NT		NT	
Service Quality	Responsiveness	IC	IC	IC	IC
	Knowledge	-		+	
	Empathy	+		+	
	Facilitation of transparency	NT		NT	
System Use	Frequency of use	++	++	++	++
	Planned replacement	++		++	
	Extent of use	+		++	
	Degree of use in decisions	++		++	
User Satisfaction	User Satisfaction	+	+	+	+
Net Benefits	Loss prevented	+	+	+	+
	User productivity	IC		+	
	Cost savings	IC		+	
	Decision quality	+		++	
	Time to decision	+		++	
	Operational risk exposure	NT		NT	
	Financial risk overview	NT		NT	

6. CONCLUSIONS

The objective of this study was to provide insight into (a) how IS is used to support financial risk assessment at financial institutions, (b) what considerations are important for such systems to be deemed successful, and (c) to identify gaps between current IS used for risk assessment and the needs of financial institutions using them. For this purpose, I conducted an evaluative study of two systems used by Riksgälden to assess financial risk based on the general model of IS success presented by DeLone & McLean (2003) to answer the research question:

- *How successful are information systems used to support financial risk assessment?*

To answer this, context-appropriate measurements had to be identified and weighted within the DeLone & McLean (2003) model. A final list of the measurements used are listed under their respective model constructs in Table 5.2. Measurements are primarily pulled from literature (see Chapter LITERATURE REVIEW) and from discussions with system users (risk analysts) themselves in Chapter ANALYSIS. The weighting applied to the measuring variables in the final evaluation are also discussed in Chapter ANALYSIS and are heavily influenced by interviews with risk analysts.

Themes which emerged to influence the choice of success measurements and weightings for systems supporting financial risk assessment include:

- The importance of knowledge in measuring the service quality construct. Financial risk assessment is technically complex, as is the IT used to support it. The convergence of these different technical knowledge areas is both necessary and difficult.
- The identification of system transparency as an important measurement for system quality. A transparent system contributes to user confidence by making it easier for users to understand how the system's output is calculated and where input data comes from. Similarly, IT service providers' facilitation of transparency can be an indicator of service quality.
- The importance of loss prevented and the identification of the financial risk overview variables as measurements of the systems' net benefits. Preventing loss is the *raison d'être* of risk assessment, and thus, the systems supporting it. While understanding specific risks can help prevent losses, financial organizations also want a higher-level overview of the financial risks they face. Systems' contribution to this overview can also be a valued benefit.
- The identification of operational risk exposure as a (negative) measurement of system net benefit. All IS add some degree of operational risk to an organization. Though very common practice in the finance industry, development of applications outside of a formal IT infrastructure opens up some special concerns regarding IT operational risk.

Finally, the two systems were evaluated based on the weighted measurements identified previously. While both systems have their strengths and weaknesses; in general, I conclude that both systems are adequately successful in their support of financial risk assessment. I base this assessment on my analysis summarized in Table 5.2.

This final assessment, however, is given with the following caveats:

- I was unable to test for some important measurements, as they were identified in parallel with empirical data collection. Consequently, these variables are evaluated as *inconclusive*. Other factors were evaluated as *inconclusive* based on the ambivalent or neutral experiences expressed by system users.
- My analysis is largely based on the experiences of the relatively small number of end users who answered the online questionnaire survey – three for Kreditriskrapporten and two for SimCorp Dimension.
- Riksgälden is a governmental entity as well as a financial organization. This can affect generalization across the financial industry. For example, Riksgälden is not a profit-centric organization, as opposed to the majority of the financial industry and can also be expected to face a different regulatory environment.

Despite these differences, the organization's financial risks and assessment practices and processes have enough in common with the financial industry as a whole to allow for an adequate degree of generalization. The risks faced by the organization (Figure 4.1, pg.24) are similar to those faced by financial institutions in general (Figure 2.3, pg.6; Figure 2.4, pg.7). The systems used to assess those risks are also similar: SimCorp Dimension is used by more than 160 financial organizations and a quick search of online job postings will reveal a steady demand for financial analysts with VBA programming skills at major commercial banks.

The aim of the study has been to contribute to understanding of IS supporting financial risk assessment and to research addressing evaluation of FDSS by providing insight into (a) how IS is used to support financial risk assessment at financial institutions, (b) what considerations are important for such systems to be deemed successful, and (c) to identify gaps between current IS used for risk assessment and the needs of financial institutions using them.

- (a) This study is one of few addressing IS within the context of financial risk analysis and the first to my knowledge to address the evaluation of such systems. The contextual description of the paper provides some insight into a very relevant, yet neglected domain.
- (b) The resulting evaluative framework defines the considerations important for such systems to be deemed successful. The choice of measuring variables and weights can provide guidance for practitioners – IT departments, consultants, and commercial software developers – to better understand and support the risk assessment needs of financial institutions and risk analysts. The framework presented can also be utilized by the financial institutions themselves to assess their current and prospective systems used to support financial risk assessment.
- (c) Some gaps were identified where analyst end-users and their financial organizations can better be served by IS supporting financial risk assessment. A number of important measurements of success emerged only during the course of the study, however, and were not formally tested. Thus, future research applying the entire evaluative framework would be of interest.

Appendix A: Interview Guide

Question type / IS success construct

- Question? [IS success measuring variable]

MGMT

Business context & scoping:

- What is your title and level of responsibility?
- What are the financial risks being assessed in the organization/department?
- What IS are used to assess these risks?
- Were you personally involved in the development or purchasing decision for any of these systems?

Service Quality:

- Are you able to have changes made to these systems when you need to? [**Responsiveness**]
- How are system changes initiated and managed? [**TBD/Depends on answer**]

System use:

- How many use the system? [**Extent of use**]
- Are system changes planned? [**Planned replacement**]
- How is the system used? [**Degree of use**]

User satisfaction:

- How is your overall experience with the system? [**User satisfaction**]

Net benefit:

- Do you have thoughts on how technology can better support financial risk? [**TBD/Depends on answer**]
- How significant is the system to the the organization as a whole?
 - In terms of: [**Loss prevented**], [**User productivity**], [**Cost savings**] ?
- Do you feel that the system adds value to the risk assessment process?
 - In terms of: [**Decision quality**], [**Time to decision**] ?

IT

IT context:

- What type of technologies is the system based on (Excel program, web application, etc.)?
- Are systems developed in-house or commercially available?

Appendix B: Questionnaire questions with coding

Question type / IS success construct

- | |
|---|
| <ul style="list-style-type: none">• Question? [IS success measuring variable] |
|---|

Information quality:

- The system provides accurate valuations of risk likelihood. [Accuracy]
- The system provides accurate valuations of risk exposures. [Accuracy]
- Risk values provided by the system are based on current data and trends. [Currency]
- The system gives me the amount of information I need. [Completeness]
- The information provided by the system is clear and understandable. [Format]
- The information provided by the system is presented in a useful format. [Format]
- The system gives me the type of information I need. [Relevance]

System quality:

- I can make adjustments within the system to accomplish what I want. [Adaptability]
- The system is always available when needed. [Availability]
- The system responds quickly to my requests. [Response time]
- The system is easy to use. [Usability]
- The system is easy to learn. [Ease of learning]

Service quality:

- System problems are quickly resolved. [Responsiveness]
- IT support have the knowledge needed to respond to requests. [Knowledge]
- IT has my best interest in mind. [Empathy]

System use:

- How often do you use the system? [Frequency of use], [Extent of use]
- The output of the system is an important input for decision making. [Degree of use]

User experience:

- I am satisfied with the system. [User satisfaction]

Net benefit:

- The quality of my work is improved by the system. [User productivity]
- Decision quality is improved by the system. [Decision quality]
- Using the system reduces the time involved in risk assessment. [Time to decision]

Appendix C: Online Questionnaire

User survey: IS supporting financial risk assessment

[Exit this survey](#)

1.

I am a masters student at Lund University's Information Systems department. For my thesis, I am studying how information systems support financial professionals such as yourself to assess financial risks.

Your participation in the study would be very valuable and much appreciated. This voluntary, 5-10 minute survey is anonymous and results will be generalized. If you have any questions, please don't hesitate to contact me at mas08mh8@student.lu.se.

-Matt Holley

***1. Which system are you evaluating?**

(If you use multiple systems to support financial risk assessment, please complete a survey for each)

SimCorp Dimension

Kreditriskrapporten

Other (please specify)

***2. I use the system to assess the following risks:**

Market

Credit

Other (please specify)

***3. How often do you use the system to assess financial risk?**

Frequency

Figure Ac.1: Online Questionnaire (page 1)

***4. Please evaluate the following statements as they relate to the system when used for financial risk assessment:**

	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree	N/A
A) The system provides accurate valuations of risk likelihood.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B) The system provides accurate valuations of risk exposures.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C) Risk values provided by the system are based on current data and trends.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D) The system gives me the amount of information I need.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E) The information provided by the system is clear and understandable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
F) The information provided by the system is presented in a useful format.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
G) The system gives me the type of information I need.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
H) I can make adjustments within the system to accomplish what I want.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I) The system is available and ready when needed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
J) The system responds quickly to my requests.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
K) The system is easy to use.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
L) The system is easy to learn.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
M) System problems are quickly resolved.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
N) IT support for the system have the knowledge needed to respond to requests.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
O) IT support has my best interest in mind.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P) The output of the system is an important input for decision making.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Q) I am satisfied with the system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
R) The quality of my work is improved by the system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
S) Decision quality is improved by the system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
T) Using the system reduces the time involved in risk assessment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Additional or clarifying comments:

Figure Ac.2: Online Questionnaire (page 2)

Appendix D: Interview 1

Coding is represented in [Bold Brackets].
Omitted sections are identified by [CAPITALIZED BRACKETS].
Non-verbal voice is represented in [lower-case brackets].

[PLEASANTRIES - OMITTED]

- 1 M - So it sounds like you have many risks that you deal with. Credit risk is one. . .
- 2 I1 - Then we have market risk, and that is where the Value-at-Risk model applies.
- 3 M - What kind of system do you have that supports VaR?
- 4 I1 - Our main system, used throughout the organization, is SimCorp Dimension. That is an integrated system - database and UI. We can within this calculate VaR. But, we don't do everything inside the SimCorp Dimension system. We use files we receive from other suppliers for correlation and volatility calculations. So we get process data that we feed into SimCorp, and in SimCorp Dimension VaR is calculated; and also other key ratios and performance measures.
- 5 M - You mention in your email that you are switching systems. Is this one of the systems that you are going to be moving away from?
- 6 I1 - We are looking at new capabilities for risk and also, perhaps even more so, for the front office. So I'm not sure that any of these existing things that we use in SimCorp Dimension is going to be replaced, but it's more an addition of capabilities [**System Use - Planned replacement**]; [**System Quality - Adaptability**]. I can also say that we are not sure exactly how it is going to play out right now.
- 7 M - Can you say what the main catalyst was for moving to a new system? Were there some things you weren't satisfied with?
- 8 I1 - We did have front office needs, in particular, that were not met by our current system. Especially regarding position keeping. And we would also like better risk capabilities than we currently have. For example, more flexibility for setting up stress tests and Monte Carlo simulations for the VaR, and also modifications of our VaR model. That's the main driver [**System Quality – Adaptability**]; [**Information Quality – Accuracy**]; [**Information Quality – Completeness**].
- 9 M - Right. So the new system you are getting, does that incorporate all those things? Do you feel that you will be fragmented - using many different systems - to assess all the risks that you face?
- 10 I1 - The idea with the new system is to not only add capabilities independently, but also to have an integrated system by front office and for us. Because we see that we have similar needs in many ways and we don't want too complicated integrations between the systems. We want to have a main solution, at least not too fragmented solutions. [**Information Quality – Accuracy**]
- 11 M - Gotcha. I'll try to resend the survey so that other systems can be included. Overall, how many systems are we talking that you guys use?
- 12 I1 - The main one we use is SimCorp Dimension, but we also have others that feeds into this from other suppliers and we also have systems connected to SimCorp Dimension for reporting purposes. We could also call this excel application for credit risks one of these because it uses information in the SimCorp database and builds on this. Other reports do likewise. So we have some functionality in the specific reports. But we also have some calculations done in SimCorp Dimension. And if there is something that we are more

strategically working with right now, actually, it is this that we want to use a data warehouse for more of our reporting and analytical needs and applications. **[Information Quality – Relevance];[System Quality - Transparency]**

13 M - But you don't currently have this Data Warehouse?

14 I1 - Yes, we do. We have very recently put it online. We are developing those functions in there right now. We are going to use it for more things.

15 M - So does SimCorp Dimension drop data to this data warehouse?

16 I1 - Yes. Every day much of the data is transferred to the data warehouse. In there we also do some modifications to make it easier to work with. **[Information Quality – Format]**

17 M - So as far as these systems go, do you know how many users you have?

18 I1 - If you're speaking about the risk part, or?

19 M - I mean, all of them. You have this excel macro for credit risk . . .

20 I1 - The excel macro is used by 20, 25 people. I think 25 actually. And the reports we make based on the SimCorp data is also about 25 users; and SimCorp itself. . . I'm not sure. I think it's less, 15 or 20, but just for the risk part. It's more like 15, I think. **[System Use – Extent of Use]**

21 M - The reporting systems that you use, do you know if they are commercially available?

22 I1 - We use different ones - Excel, Crystal Reports, QlikView, which is a good analytical tool. We also have something called ESOP for operational risk. **[Information Quality]**

23 M - Ok, so that's mainly for your internal auditing, or. . .?

24 I1 - Yeah.

25 M - It sounds like there's a pretty strong connection between you on the finance side and IT. I often find that the people on the finance side are writing macros. You have to be pretty tech savvy?

26 I1 - Yeah. The credit risk application is developed by us in the risk department. And the many of the reports are also developed by the different departments. But IT has a crucial role in this data warehouse because with this they can add functions and help out by providing functionality through the data warehouse instead of making all these modifications in different reports. So we have more consistent data handling, I would say. **[Service Quality]**

27 M - Ok. I had a question here. The relationship between the output of the systems and financial decisions making - is it strong? Basically, does the system give a number and you're like "this is above our limits, we can't take on this risk"? Or is there still a lot of decision making made outside the system that is more roughly based on system output?

28 I1 - Well, the system provides the limits within which you have to work. And also from SimCorp we have exposure data and valuations. That is also info for the decision. So I would say that it is critical in many ways. **[System Use – Degree of use in decisions];[Net Benefits – Decision Quality]**

29 M - May I ask which of the systems you are dropping?

30 I1 - We are actually not dropping anything. The SimCorp Dimension system, which is the main one, will remain. To this we will add another system that provides better capabilities for front office and for risk, but it will be an add-on and won't affect the other parts of the organization much. It will be something independent.

31 M - Are their owners identified for these systems? So basically, a person responsible for SimCorp

Dimension?

32 I1 - Yeah. It's us, actually. The Risk Department. For SimCorp, we are the owners.

33 M - Overall, do you see any trends in how IT can better support assessment of financial risk?

34 I1 - I think that the IT department can be a source of information for the whole chain, so to speak, so you can see the information through and where the data comes from. **[Service Quality – Facilitation of transparency]**

35 M - Right. So you get numbers, but you would like to understand, internally, how the system is producing those numbers?

36 I1 - Yeah, you get a number, which should represent something, then you wonder “how did this come to be” and you want to go behind the number and see the calculations, which fields and such. Then it's important to have a transparent system. IT has a crucial role in the construction and also, I think, to inform about the different parts and how they come together. **[Service Quality - Facilitation of transparency];[System Quality - Transparency]**

37 M - I think the meeting of finance and IT is pretty interesting. The fact that they are both very technical. In finance you have some of the same kind of [mathematical] models as rocket science and then on the IT side, you have a very different, but also very technical, specialty. Is there any frustration, perhaps on your end, about IT not understanding your needs or vice-versa. Since it's difficult to be an expert in both finance and IT.

38 I1 - It's difficult, of course. Sometimes it may come up as a problem. But, I think it's good if the IT department aims to understand something about the needs. It's difficult, but we have to work together and cooperate. **[Service Quality - Knowledge]**

[PLEASANTRIES - OMITTED]

Appendix E: Interview 2

Coding is represented in [Bold Brackets].
Omitted sections are identified by [CAPITALIZED BRACKETS].
Non-verbal voice is represented in [lower-case brackets].

[PLEASANTRIES - OMITTED]

- 1 I2 - But keep in mind that this is an in-house developed excel report, so I don't really know if that's what you're looking for?
- 2 M - No, that's perfect. I think that's actually quite common in finance.
- 3 I2 - OK, yeah. Just so that you know that. It was a bit difficult to answer all your questions in the survey with Kreditrisikrapporten. But, yeah. Just keep in that in mind and I'll answer as best I can.
- 4 M - Well, you've already answered a few of my questions right there. [laughs]
- 5 I2 - Perfect! [laughs]
- 6 M - So, it's Excel, written as a macro. Like you press a button and it runs a report?
- 7 I2 - Yeah, exactly.
- 8 M - So how do you use this? Is it mostly to access the risk of, say, a corporation or . . . ?
- 9 I2 - Yeah, so we have our account projects and we have to monitor the credit risk for these counter-parties. In the report you can see the limitations we have for each counter party, you can have a look at the exposure for different instruments. That is what we are looking at in this report.
- 10 M - OK, so it's mostly exposures you're looking at and it doesn't focus so much on risk likelihoods?
- 11 I2 - No, they are not likelihoods. They are actual exposures compared to maximum limits we have for each counter-party.
- 12 M - Are the limits based on some perceived risk of the counter-party?
- 13 I2 - We're using ratings, if you familiar with like Standard and Poor and Moody's, and we have limitations for each counter-party based on the ratings they have. That's what we are doing at the moment, anyways. We are working with this, so we may change the procedure in the future, but at the moment we are only looking at the ratings.
- 14 M - So this application uses the limits that you have defined manually, using say Standard and Poor's ratings and other inputs, to establish some threshold for each counter-party?
- 15 I2 - Yes, that's correct.
- 16 M - Then this Macro may alert you when you have reached those limits and maybe show you. . .
- 17 I2 - Yes. We have signals for that in the report. So it will show you if we are over the maximum limits.
- 18 M - Is this primarily useful because of a large number of counter-parties?
- 19 I2 - No, not only for that. I would use it if we only had three counter-parties. But of course, it's more useful if you have a lot of counter-parties. [Net Benefits – User productivity];[Information quality - Relevance]
- 20 M - It looks like a couple surveys have been filled out. There is an area here, IT support; so I'm inferring

from this that there is no IT support.

- 21 I2 - No it's not really because we developed this at the risk department for ourselves. I would say that the IT department is not aware of this application. **[Service Quality - Knowledge]** So it is a little hard to answer correct on those questions.
- 22 M - Gotcha.
- 23 I2 - Cause it's [OMITTED] who helps service this application when there are problems with it. So it's not really applicable, those questions about IT support. We haven't asked them for any support.
- 24 M - Gotcha. So does it ever malfunction where you would wish you had IT support? I imagine that [OMITTED] is an analyst and maybe isn't available all the time to work on the application.
- 25 I2 - Well, the report is complicated with all its functions. If someone was as good as [OMITTED] on the report, that would be perfect. But, I don't think they are. So at the moment [OMITTED] is the only one that we really trust at doing any changes to the report. **[Service Quality - Knowledge]** It's a bit difficult to answer of course, it's not good if he's not here, and we can't do anything about it. **[Service Quality - Responsiveness]**
- 26 M - So you guys haven't run into any problems where it's not functioning and . . .
- 27 I2 - Not yet, and we've been using it for a year, or two maybe, and we haven't had any big issues with the application. **[System Quality - Availability]**
- 28 M - I'm curious - when you were filling out the survey was there anything else that seemed strange or difficult to answer?
- 29 I2 - Except the IT support thing?
- 30 M - Yeah.
- 31 I2 - [pausing to look through notes] Well, when you ask if the system provides accurate risk likelihoods, it's not applicable. I don't remember what I answered on that one. [pausing to look through notes] No, I think it was only this.
- 32 M - Great. Are you a manager in your group? It sounds like you have a pretty flat hierarchy over there. Do you have a particular title?
- 33 I2 - I'm only a risk analyst. Everyone working in my group, we are eight, is a risk analyst. We don't have junior or senior risk analysts. And we have the boss, and that's it. So we don't have any, what you would call, hierarchy in the group. I'm responsible for credit risk, but I don't have anything in my title - just risk analyst like everyone else.
- 34 M - Gotcha. Do all eight people use this report?
- 35 I2 - No we don't. There might be. . . one, two, three, four, five. . . six of us. **[System Use – Extent of use]** Cause there are other people working in securities risk and operational risks, and the third one is mostly using SimCorp Dimension, the other application are have been asking about, I think?
- 36 M - Yeah.
- 37 I2 - And then we have another department - the traders will look at this report also, to see how much limit they have left for the different counter-parties **[Information quality – Relevance];[System Use – Extent of use]** We use it to see if they stay in limits and they use it to see how much more they can use a counter-party, if they've got any limit left. **[System Use – Degree of use in decisions]**
- 38 M - Are there any other applications that you use to assess credit risks?

- 39 I2 - No, we only use this one, actually. [**System Use – Extent of use**]
- 40 [DISCUSSION OF FINANCIAL MODELS USED IN APPLICATION - OMITTED]
- 41 M - Do you know if there have been any cost reductions since you started using this application?
- 42 I2 - I don't know . . .but I wouldn't say that, no. [**Net Benefits – Cost savings**]
- 43 M - Maybe saved time?
- 44 I2 - Well, I don't know from a cost point of view, but we do have a better overview of our credits risks and that might implicate a cost reduction in one kind of view. [**Net Benefits – Financial risk overview**]
Financial risk overview
- 45 M - Great.
- 46 I2 - But we do spend less time looking for this information since we have it all in the report. So in that way we do have a cost reduction. [**Net benefits – User productivity**];[**Net benefits – Cost savings**]
- 47 M - And you guys are planning to keep using this application in the future?
- 48 I2 - As it looks now, yes [**System Use – Planned replacement**]. We might develop it a bit to get even better information, but we will keep this report, yes. [**System Quality - Adaptability**]
- 49 M - How do you think the system is for the organization as a whole? Has it prevented any losses that you know of?
- 50 I2 - Well, I hope so [laughs]. It's difficult to answer, but since we have a better overview of all the exposures and limits and such . . . so I think so. I hope so, it's kind of the point of it. [**Net Benefits – Loss prevented**]:
[**Net Benefits – Financial risk overview**]
[DISCUSSION OF STUDY, PAST WORK, PLEASANTRIES - OMITTED]

Appendix F: Interview 3

*Coding is represented in [Bold Brackets].
Omitted sections are identified by [CAPITALIZED BRACKETS].
Non-verbal voice is represented in [lower-case brackets].*

[PLEASANTRIES – OMITTED]

- 1 M - First off, how did you end up making this application? How did you decide to do it and how was it decided that you would be the one to build it - Kreditriskrapporten?
- 2 I3 - It just started because we thought that the report that we were using wasn't good enough and there were some problems with the setup in the system; then I started to build a small program on my own.
- 3 M - Ah. So basically, you needed this yourself. You needed it. You didn't have it available. So you built it.
[Service quality - Responsiveness]
- 4 I3 – Yeah.
- 5 M - So was this the first excel macro that you built?
- 6 I3 - Oh no. [laughs] I've been building Excel programs for the last 20 years. [Service Quality - Knowledge]
- 7 M - Wow, ok. Is your academic background in finance, IT, or both?
- 8 I3 - I have a background in finance, economics and a lot of statistics.
- 9 M - So you learned programming on the job, to accomplish what you needed to accomplish?
- 10 I3 - Yeah. I learned computing in the late 80s and early 90s.
- 11 M - I'm just curious. Has VBA changed much or is it pretty much the same thing?
- 12 I3 - Since VBA came out in '95, it probably the same thing. Programs made 15 years ago can run without change.
- 13 M - I take it this report pulls from some database you have there. Then it transforms that data and presents the information to the user?
- 14 I3 – Yes.
- 15 M - I understand it's the same database as Dimension uses?
- 16 I3 - Yes, yes. It takes it directly from the source. It's easily done with ADO data objects and SQL queries.
[Information quality - Accuracy]
- 17 M - I take it you don't often ask your IT department to build this kind of thing for you?
- 18 I3 - No. [laughs] Because the IT department can't use Excel. [Service Quality - Knowledge]
- 19 M - Oh, OK. So they don't use the same technology you use?
- 20 I3 - Yes. And we are the system administrators for the Dimension program. So I know the database structure. I know which data to get out. [Service Quality - Knowledge]
- 21 M - So it's basically easier for you to do it yourself.

22 I3 - Yes. [laughs] [**Service Quality - Responsiveness**]

23 M - You're kind of your own IT guy. [laughs]

24 I3- [laughs] Yeah.

25 M - I know you've been doing this for 20 years. Did that develop more as a necessity, where you felt that IT doesn't understand what you do in finance and what your needs are?

26 I3 - Because you both have to know finance. You have to know the data structure. You have to know programming. Then it's easier to do it yourself than to contact three or four other people and try to explain everything. [**Service Quality - Knowledge**]

[PLEASANTRIES - OMITTED]

Appendix G: Survey Results – Dimension

1. Which system are you evaluating? SimCorp Dimension (2)
2. I use the system to assess the following risks: Market (2)
3. How often do you use the system to assess financial risk? Daily (2)
4. Please evaluate the following statements as they relate to the system when used for financial risk assessment:

	Question	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree	N/A	Avg	Min	Max
Information quality	A) The system provides accurate valuations of risk likelihood.			1	1					
	B) The system provides accurate valuations of risk exposures.		1		1					
	Accuracy	0	1	1	2	0	0	0.25	-1	1
	C) Risk values provided by the system are based on current data and trends.			1	1					
	Currency	0	0	1	1	0	0	0.50	0	1
	D) The system gives me the amount of information I need.			1	1					
	Completeness	0	0	1	1	0	0	0.50	0	1
	E) The information provided by the system is clear and understandable.		2							
	F) The information provided by the system is presented in a useful format.			1	1					
	Format	0	2	1	1	0	0	-0.25	-1	1
G) The system gives me the type of information I need.				2						
Relevance	0	0	0	2	0	0	1.00	1	1	
Information quality	0	3	4	7	0	0	0.29	-1	1	
System quality	H) I can make adjustments within the system to accomplish what I want.		1	1						
	Adaptability	0	1	1	0	0	0	-0.50	-1	0
	I) The system is available and ready when needed.		1		1					
	Availability	0	1	0	1	0	0	0.00	-1	1
	J) The system responds quickly to my requests.			1	1					
	Response time	0	0	1	1	0	0	0.50	0	1
	K) The system is easy to use.			2						
	Usability	0	0	2	0	0	0	0.00	0	0
L) The system is easy to learn.		2								
Ease of learning	0	2	0	0	0	0	-1.00	-1	-1	
System quality	0	4	4	2	0	0	-0.20	-1	1	
Service quality	M) System problems are quickly resolved.			2						
	Responsiveness	0	0	2	0	0	0	0.00	0	0
	requests.		1	1						
	Knowledge	0	1	1	0	0	0	-0.50	-1	0
O) IT support has my best interest in mind.			1	1						
Empathy	0	0	1	1	0	0	0.50	0	1	
Service quality	0	1	4	1	0	0	0.00	-1	1	
System use	P) The output of the system is an important input for decision making.				2					
	Degree of use	0	0	0	0	2	0	2.00	2	2
System use	0	0	0	0	2	0	2.00	2	2	
User satisfaction	Q) I am satisfied with the system.			1	1					
	User satisfaction	0	0	1	1	0	0	0.50	0	1
User satisfaction	0	0	1	1	0	0	0.50	0	1	
Net benefit	R) The quality of my work is improved by the system.			2						
	User productivity	0	0	2	0	0	0	0.00	0	0
	S) Decision quality is improved by the system.			1	1					
	Decision quality	0	0	1	1	0	0	0.50	0	1
	T) Using the system reduces the time involved in risk assessment.				2					
Time to decision	0	0	0	2	0	0	1.00	1	1	
Net benefit	0	0	3	3	0	0	0.50	0	1	

Appendix H: Survey Results – Kreditriskrapporten

- 1. Which system are you evaluating? Kreditriskrapporten (3)
- 2. I use the system to assess the following risks: Credit (3)
- 3. How often do you use the system to assess financial risk? Daily (3)
- 4. Please evaluate the following statements as they relate to the system when used for financial risk assessment:

	Question	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree	N/A	Avg	Min	Max
Information quality	A) The system provides accurate valuations of risk likelihood.			1	1		1			
	B) The system provides accurate valuations of risk exposures.				3					
	Accuracy	0	0	1	4	0	1	0.80	0	1
	C) Risk values provided by the system are based on current data and trends.				2		1			
	Currency	0	0	0	2	0	1	1.00	1	1
	D) The system gives me the amount of information I need.				3					
	Completeness	0	0	0	3	0	0	1.00	1	1
	E) The information provided by the system is clear and understandable.				2	1				
	F) The information provided by the system is presented in a useful format.				1	2				
	Format	0	0	0	3	3	0	1.50	1	2
G) The system gives me the type of information I need.				2	1					
Relevance	0	0	0	2	1	0	1.33	1	2	
Information quality		0	0	1	14	4	2	1.16	0	2
System quality	H) I can make adjustments within the system to accomplish what I want.		1		1	1				
	Adaptability	0	1	0	1	1	0	0.67	-1	2
	I) The system is available and ready when needed.				1	2				
	Availability	0	0	0	1	2	0	1.67	1	2
	J) The system responds quickly to my requests.				1	1	1			
	Response time	0	0	0	1	1	1	1.50	1	2
	K) The system is easy to use.				1	2				
	Usability	0	0	0	1	2	0	1.67	1	2
L) The system is easy to learn.				1	2					
Ease of learning	0	0	0	1	2	0	1.67	1	2	
System quality		0	1	0	5	8	1	1.43	-1	2
Service quality	M) System problems are quickly resolved.			1	1	1				
	Responsiveness	0	0	1	1	1	0	1.00	0	2
	requests.			1			2			
	Knowledge	0	0	1	0	0	2	0.00	0	0
	O) IT support has my best interest in mind.			1			2			
Empathy	0	0	1	0	0	2	0.00	0	0	
Service quality		0	0	3	1	1	4	0.60	0	2
System use	P) The output of the system is an important input for decision making.				1	2				
	Degree of use	0	0	0	1	2	0	1.67	1	2
	System use	0	0	0	1	2	0	1.67	1	2
User satisfaction	Q) I am satisfied with the system.			1	2					
	User satisfaction	0	0	1	2	0	0	0.67	0	1
	User satisfaction	0	0	1	2	0	0	0.67	0	1
Net benefit	R) The quality of my work is improved by the system.			1	1	1				
	User productivity	0	0	1	1	1	0	1.00	0	2
	S) Decision quality is improved by the system.				2	1				
	Decision quality	0	0	0	2	1	0	1.33	1	2
	T) Using the system reduces the time involved in risk assessment.				2	1				
Time to decision	0	0	0	2	1	0	1.33	1	2	
Net benefit		0	0	1	5	3	0	1.22	0	2

Appendix I: Follow-up email (Participant 1)

Hi Matt! Hope your work is proceeding well.

Difficult questions.

On the first one I would say that the system have limited the size of our losses since we use it to restrict risk taking. So yes, but it is hard to quantify.

I don't think I can answer the second. It depends on what you compare with.

On the third I would say about 7 users.

Best regards,

From: Matt Holley [mailto:█@█.m]
Sent: den 3 november 2010 14:41
To: █
Subject: Couple follow-up questions

Hope all is well. A couple questions that have come up so far that I thought you may be able to answer:

- Has the use of Dimension for financial risk prevented any losses that you know of?
- Has the use of Dimension for financial risk resulted in a cost savings to the organization?
- Can you verify the number of users who directly access the system for financial risk assessment?

Thanks in advance!
//Matt

Appendix J: Example screen-shots of evaluated systems

SimCorp Dimension market risk models:



Figure Aj.1: SimCorp Dimension - market risk models. Taken from SimCorp (2008).

DEFINITION OF TERMS

Back Office – Refers in general to departments at an organization that run the organization itself. In a financial organization, this can include IT department, compliance and/or risk departments, accounting, and other administrative departments.

Collateralized debt obligation (CDO) – Asset-back security whose value is based on a portfolio of fixed-income assets.

Counter-party – The “other” party is a financial transaction or contract agreement; the borrower of a loan, for example.

Excel Macro – VBA code which runs with Excel as a host application.

Front Office – Traditionally refers to revenue generating and/or client facing departments of an organization. This can include trading, sales, and corporate finance departments.

Middle Office – Typically refers to financial departments that manage position-keeping and settlement.

Mortgage-backed security (MBS) – Bond backed by a claim on mortgage payments tied to a pool of mortgages.

Risk exposure – The amount of risk taken on.

Risk likelihood – The probability an event will occur.

Semantic error – Logical error in computer programming that results in statements that will run, but will result in incorrect, or undesirable output.

Syntax error – Error of language in programming that the computer can not understand. Will result in the statement not running.

VBA (Visual Basic for Applications) – Event driven programming language used to create Excel macros. It is an extension of Visual Basic built into Microsoft Office products.

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