Knowledge Management and Enterprise Risk Management Implementation in Financial Services

Eduardo Rodriguez
John S. Edwards

Abstract

This paper starts from the viewpoint that enterprise risk management (ERM) is a specific application of knowledge in order to control deviations from strategic objectives, shareholders' values and stakeholders' relationships. This study is looking for insights into how the application of knowledge management processes can improve the implementation of ERM. This article presents the preliminary results of a survey on this topic carried out in the financial services sector, extending a previous pilot study that was in retail banking only.

Five hypotheses about the relationship of knowledge management variables to the perceived value of ERM implementation were considered. The survey results show that the two people-related variables, perceived quality of communication among groups and perceived quality of knowledge sharing, were positively associated with the perceived value of ERM implementation. However, the results did not support a positive association for the three variables more related to technology, namely network capacity for connecting people (which was marginally significant), risk management information system functionality and perceived integration of the information systems. Perceived quality of communication among groups appeared to be clearly the most significant of these five factors in affecting the perceived value of ERM implementation.

Key Words*:*

Knowledge Management, Enterprise Risk Management, Financial Services, Information Systems, Knowledge Sharing, Knowledge Management Systems.

Introduction

This study is part of a research program about the potential application of knowledge management (KM) to enterprise risk management (ERM). One of its aims is to understand the value of people interaction and technological support in an ERM program that implies multiple disciplines, profiles, groups of people with different knowledge and experiences working together.

The current state of the global economy makes a better understanding of risk and its management all the more important. The editorial (Sawyer, 2008) of *RISK* March 2008 says "Clearly, plenty of lessons will be learned from the past six months. Hopefully, one of those will be that all dealers and investors ought to embrace transparency…" Brealey and Meyers (2002) referred to the 1987 crash as a case to study where the causes have to be identified and presented different views about these causes that included some lessons to learn: markets do not have memory; it is not possible to search continuously for an extraordinary benefit; and the prices were too high. The question from this is: how much have we learned and improved our risk knowledge management? Von Krogh et al. (2000) identified a clue that can be applied to this need for knowledge and learning capacity: "beliefs, commitments, and actions cannot be captured and represented in the same manner as information." In summary, it is necessary to have a better understanding of knowledge use in a discipline such as risk management; the way risk knowledge is shared represents an important step to have in ERM.

Previous work has hypothesized and begun to investigate KM and risk management (RM) relationships. Rodriguez and Edwards (2008a) described a methodology to analyze the risk modeling process based on KM principles. Pilot results for the retail banking sector were presented by Rodriguez and Edwards (2008b), showing that quality of risk knowledge sharing was associated with the perceived value of ERM implementation, but the hypothesis that the perceived integration of information systems was associated with the perceived value of ERM implementation was rejected.

In this article the evidence search has included more organizations in the financial services sector than just retail banks, such as diversified financial institutions, investment banks, asset management organizations and insurance companies. The KM and ERM theoretical framework used was the same as Rodriguez and Edwards (2008b) based on the two conceptual pillars: "Risk management is frequently not a problem of a lack of information, but rather a lack of knowledge with which to interpret its meaning" (Marshal and Prusak, 1996); and that banking is a business based on information and knowledge (Shaw, 2005), where once a new risk is identified it implies that new knowledge is required (Fourie and Shilawa, 2005).

The close relationship between different types of institution in the financial services sector—illustrated by their common difficulties at present—justifies examining the KM and ERM relationships for the sector as a whole. Banking businesses have evolved from traditional deposit-taking institutions to financial conglomerates with diversified business and diversified exposure. Businesses that appear in these financial conglomerates include bank insurance, assets management, investment advisory and the bank services and products. All these components of the business possess different kinds of risks and require different organizational capacities to control them. However, our hypothesis is that the relationship between KM and ERM will be similar across the whole sector.

Part of the reason for the diversification was the threat of new financial institutions in the market given a disintermediation wave, the increment of technology in service delivery such as ATMs or payment systems. Regulation was changing as well, and it was not easy to protect the original banking services with the development of competition. Simultaneously, financial innovation was growing and many new products and services emerged. Even the operational funding has changed and the transaction business model has been modified as well. New risks have appeared and new capacities were demanded (DeYoung, 2007). This is the new view of banking as a diversified financial business.

To reach the Basel II requisites, knowledge sharing plays an important role; particularly in consulting activities (Stein and Zwass, 1995). The banking business, currently, includes consulting as a key piece in business development. Additionally, business complexity and the cost of knowledge

show the need for providing more meaning to the risk information and better KM (Sutcliffe and Weber, 2003) in order to build actionable answers to risk threats. However, the exposure to more risks and the losses in previous years introduced doubts about the RM practice (Degagne et al., 2004).

The competitive advantage of the financial organization can be limited because of risk of potential losses, caused by expansion, cultural pressures, reduced controls, communication of business values, learning systems and concentration on information (Simmons, 2001). The implementation of ERM is a dynamic process, and the new ways of risk control identify new risks to analyze. Therefore, risk control is a factor influencing ERM implementation (Ong, 2003). Thus knowledge, experience and feedback in an organization have a flow in both directions: top-down and bottom-up; however, ERM requires a policy from the top-down direction for developing and implementing the ERM processes and bottom-up analysis in order to identify enterprise risk (ER) and to establish an accurate solution of risk mitigation.

ERM implementation requires information systems design. There are information systems for different risk processes; however, no advance has been found in creating a KMS to manage risk, which means to organize people's knowledge in order to be more effective and efficient in the RM endeavors. There are several requirements in a risk management information system, and a wide spectrum of functional attributes are required in order to provide capacity and support to risk knowledge sharing among different areas.

This paper explains to the identification of five hypotheses based on the literatures on knowledge management and risk management, and presents a preliminary analysis of the results of administering a survey to 121 risk management practitioners in financial services.

Theoretical Framing

This section presents the main concepts that are used in this article regarding knowledge management (more detail may be found in Rodriguez and Edwards, 2008a and 2008b).

KM, KM Strategy and KMS as an Enabler of RM

KM and knowledge management systems are based on the interactions among people, which correspond to the movements from tacit and explicit knowledge to tacit and explicit knowledge on the individual and organizational level (Nonaka and Takeuchi, 1995). In risk management this interaction is expressed through:

- Socialization: social interaction among the risk management employees and shared risk modeling experience
- Combination: merging, categorizing, reclassifying and synthesizing the risk modeling process
- Externalization: articulation of best practices and lessons learned in the risk modeling process
- Internalization: learning and understanding from discussions and mathematical modeling review.

These movements of knowledge are related to knowledge exchange. Cress and Martin (2006) expressed that there is a difference in knowledge between small and large groups. ERM people represent a big group across the organization. They identified that in large groups knowledge exchange using questions is not very efficient because of similar questions coming from different people. This means that probably it is better to create some repositories of experience, data and collaboration tools in order to enhance the knowledge exchange.

In the context of RM, the KM processes play an important role as potential enablers of working skills and to improve the capacity of the teams to enhance the ways that they share knowledge and the tools that they use (Wang et al., 2006). In this article the KM processes in RM are considered as follows:

- Knowledge creation: in risk management new risk implies new ways to measure it and to identify the potential effects that it could have. Acquisition, synthesis, fusion and adaptation of existing risk knowledge are parts of the way to understand new and current risks.
- Knowledge storage and retrieval: RM actions and methods require codification, organization and representation of risk knowledge. This includes the activities of preserve, maintain and index risk knowledge.
- Knowledge transfer: ERM is a multidisciplinary work; interdepartmental development and a holistic view of risk across the organization require knowledge dissemination and distribution in order to support individuals, groups, organizations and inter-organizations to develop RM capacity.
- Knowledge application: Risk knowledge can be converted into competitive advantages for financial institutions adopting the best practices, developing products and methods for risk control.

There is a basis for knowledge transfer in the culture and trust of the organization in order to develop an informal learning process and without intention of teaching (Singh and Premarajan, 2007). From these processes knowledge sharing has an important influence in KM implementation because it provides a connection between people and the organization, producing dissemination, collaboration, innovation and acquisition of knowledge (Ipe, 2003). Small and Sage (2006) carried out a review on KM and knowledge sharing. They regarded knowledge sharing as critical in knowledge creation and found that factors influencing knowledge sharing included: business context, organizational structure and roles, business processes, motivation, means, ability, etc. The study also found that many factors

enabled knowledge sharing such as the strategy link with knowledge sharing or the proper adjustment to leadership, human networks, organizational culture and learning processes.

Knowledge sharing and effective communication depend on the overlap and amalgamation of knowledge bases among people. Knowledge sharing requires more than IT; it requires the creation of a means, and a willingness to share. This means that it takes into account the differentiation of knowledge sharing between and among groups, for example the knowledge adapted to be communicated among individuals and groups.

Additionally, the KMS that supports the KM processes includes the technological aspects and people interaction components, which, in particular, can modify the quality of the knowledge sharing attributes from risk management language to organizational roles, communication channels and technological means for knowledge transfer. As a final point in this section, Bosua and Scheepers (2007) continue looking for insights regarding the explanation of knowledge sharing. They presented preliminary results from a complex organization, that can be related to a financial organization, that "formal and informal SNs (social networks) complemented by a shared network of integrated information and knowledge-based artifacts are determinants for effective knowledge sharing in complex environments." This tells us that the analysis of technological and people interaction variables are important in these kinds of studies where a holistic view and action are required for implementing ERM.

Research Model and Hypotheses

One common way to look at knowledge management is in terms of people, processes and technology (Edwards, 2009). In this study, we concentrate on variables relating to people and technology. This is not to underestimate the importance of process-related influences, but rather because the influence of processes on their own is difficult to determine. Processes are implicit in all the people and technology variables considered here, and in virtually any other such variables of which we can conceive.

On the basis of the literature review (Rodriguez and Edwards, 2008a), we identified five variables that might be expected to influence the perceived value of ERM implementation in an organization. Our research model thus sets up five hypotheses for the five independent variables, with perceived value of ERM implementation as the dependent variable (Figure 1).

Figure 1
Research Model
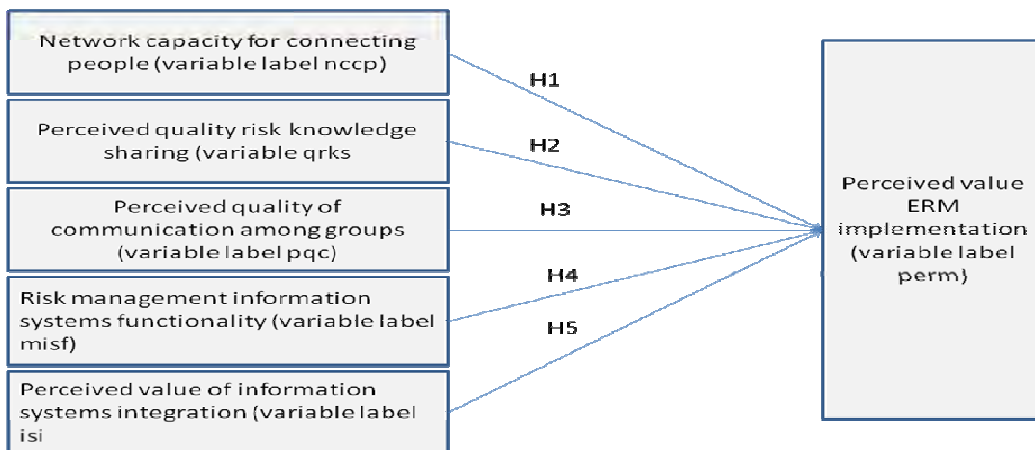
Each variable was measured by a number of items, again derived from previous studies reported in the literature.

Perceived Value of ERM Implementation

In measuring the value of ERM implementation, we take the position that this can only be answered by an individual, not for an organization. Because of the cost of ERM systems, it would be very difficult for an organization to declare an ERM implementation as anything less than a complete success, especially in the current climate. However, anonymous individual RM practitioners can express their opinions more freely, and this is the basis on which our measures have been developed.

Matyjewicz and D'Arcangelo (2004) wrote, referring to the value of using Sarbanes-Oxley framework: "Senior executives learned the importance of establishing objectives, identifying risks that will prevent them from meeting those objectives and establishing controls that will mitigate those risks," and they said that a ERM solution can take two or three years to implement. From these points the reflection is that the performance evaluation of the whole organization takes into consideration risk as a factor that can change the results; this means a control of risk across the organization might be a good enabler of an organization's results.

Bowling and Rieger (2005) wrote that the benefits of ERM are some such as: support to the governance process, better administration of RM costs, and "through increased communication, ERM

leads to broader understanding and recognition of risks throughout the bank" and many other related to the reduction of risk profile. However, there is not a clear identification of specific fields, activities or resources where ERM can provide value. This study introduces the potential value through better data management, better knowledge creation in modeling processes and better communication among and within teams. In summary, there is an interest in discovering how ERM provides value as a blend of people, methodologies and resources.

In addition, Nocco and Stultz (2006) presented a different view differentiating macro and micro benefits of ERM. From the macro perspective probably the most important is to identify how the organization takes ERM as an advantage to compete. From the micro point of view these authors presented that products definition, trade-off between risk and return and capital allocation represent something that is improved by ERM implementation.

Thus, the variable of perceived value of ERM implementation (variable label perm) was therefore constructed from nine items, as listed below:

- ERM improves collaboration.
- ERM promotes our experience sharing.
- ERM reduces the number of times we reinvent the wheel.
- ERM improves the quality of data.
- ERM improves our interdisciplinary work.
- ERM improves our interdepartmental work.
- ERM improves our understanding of model results.
- ERM improves our problem solving process.
- ERM improves our capacity of mathematical modeling.

Network Capacity for Connecting People

In financial services, as elsewhere, the view of Von Krogh and Roos (1995) applies, namely that the bases of knowledge creation are the individual minds and their relationships. The process of knowledge creation relevant to ERM by individual minds within an organization requires three elements: first, identification of the ways to transfer tacit to explicit knowledge and vice versa (Nonaka and Takeuchi,1995); second, understanding about the flows of information, how they produce knowledge (Choo, 1998; Weick, 2001); and third, the way that the risk knowledge is organized (Wiig, 1993). All of these requirements are related to the organization's capacity to connect people for knowledge mobilization.

Typically, there is emphasis put on the cost of integrating risk analyses, control, and risk policy creation, deployment and application (Cumming & Hirtle 2001). This could be a step toward the construction of a risk knowledge portal in order to connect many sources of experience (content integration), explicit and tacit knowledge, measurement process and the capacity to manage operations at an acceptable cost (Firestone, 2000; Kesner, 2001, 2003; McNamee, 2004; Detlor, 2005; Spies et al., 2005; Warren, 2005).

Such portal support can be a good vehicle for risk knowledge sharing, given the difficulties of the language spoken inside the organization related to risk and of applying expertise to solving different problems (Dickinson, 2001; Warren, 2005; Shaw, 2005). Considering that web search tools are crucial in RM (Simoneau, 2006), some support must be provided to make users more effective in the search process, because people do not search when there is a high volume of knowledge available, as in RM (Alavi and Leidner, 2001).

Equally, there are other requests for better risk knowledge sharing such as: consolidation and integration of internal information, reporting, data for reducing operational risk in banking (Marshall, 1996; Shaw, 2005) and better cross-selling and web services (Anderson et al., 2005) as support to people's work . Thus KMS and information management can be needed for actionable answers to risk threats (Sutcliffe and Weber, 2003) and taking into consideration that the technical and organizational strategies for KM affect knowledge transfer (Alavi and Leidner, 2001).

KMS implementation needs the identification of stakeholders and the association of their different types of knowledge (Lehaney et al., 2004). Additionally, Earl (2001) introduced as a success factor for KM implementation the networking capacity for connecting people in the organization, since interrelating technological, methodological and business factors can be an advantage to ERM implementation. Thus, we reach our first hypothesis.

H1: The quality of the network capacity for connecting people is positively associated with the perceived value of the ERM implementation.

Network capacity for connecting people (variable label nccp) is constructed from the following five items:

- There is an enterprise portal structure supporting interdepartmental work.
- There are collaboration tools easily available.
- People use Web-based workspaces for working on projects.
- Solutions are created because of multidepartment work.
- Sharing my work with others is easy.

Quality of Risk Knowledge Sharing

Dickinson (2001) introduced knowledge as a factor to reduce risk. Knowledge contributes to control, business strategy and underwriting processes: most risks are not possible to transfer or to hedge, because they depend on human actions. The organization needs to learn how to deal with non-transferable risks such as lack or loss of knowledge, and with risk minimization actions: legal actions, outsourcing and risk retention.

RM can be influenced by knowledge transfer attributes and signs, such as work satisfaction, and the capacity to share knowledge without a number limitation of people sharing. People find it easier to share explicit knowledge (almost by definition) and knowledge transfer is more internal than external (Dickinson, 2001; Alavi and Leidner, 2001; Liao, 2003). Knowledge-intensive industries, such as financial services, are often organized by projects: trust and professional rules are fundamental for the development of projects (Schamp et al., 2004). Additionally, head offices have to be more effective and efficient in knowledge transfer given the high value of the branch office today to provide advice and support for transactions, investment and acquisition of new products such as insurance or credit (Moore, 2006).

Knowledge transfer can be adversely influenced by organizational silos, and business units can require assistance in knowing how to transfer their practical experiences (Horton-Bentley, 2006), taking into consideration that the speed of change can reduce the value of experience in some specific fields (Hayward, 2002). However, it seems that independent intranets, a lot of emphasis on IT for knowledge sharing and KM processes based on networked IT systems reduce knowledge sharing (Swan, 1999).

Various different vehicles have been used for knowledge transfer in banking and financial services—for example, the use of communities of practice at the World Bank (Wenger, 2000) and several methods and tools for collaboration; however, neither the value of knowledge databases nor the way to develop them is clear (Samoff and Stromquist, 2001; McClernon, 2003). Similarly, the questions about the use of e-learning and communities of practice (CoP) in banking work practices and learning (Samiotis et al., 2003) have not been addressed, and it seems that they require permanent IT-based KM solutions with continuous access (Lamb, 2001). These solutions can be complemented by the importance of the social network, building trust for sharing and possible creation of inter-firm collaboration (Kubo et al., 2004). These inter-firm relationships (with external clients) affect the knowledge transfer and learning benefits (Uzzi and Lancaster, 2001). In general, the communication capacity of the organization can influence risk knowledge sharing.

In ERM particularly, knowledge exchange requires more than IT; it requires the creation of a means to share. Knowledge sharing and effective communication depend on the overlap and amalgamation of knowledge bases among and between people. IT is considered a tool for providing knowledge amalgamation and knowledge classification, which are bases for KMS design and for

contextual information analysis. Knowledge sharing is the main KM process allowing the improvement of the definition and organization of risk knowledge use in ERM implementation.

Therefore sharing experience is a factor influencing ERM implementation (Ong, 2003). Ong identified challenges and issues that provide insights about a KMS design. Some of these issues are: lack of buy-in from the board, unattractive and inconsistent measurement and reporting, redundancies and gaps across risk functions, insufficient human interaction, systems, data resources and failure to clearly demonstrate early positive results. Therefore, ERM implementation can require proper risk knowledge sharing in each step to deliver adequate integration of the ER analysis. The second hypothesis is thus.

H2: The perceived quality of risk knowledge sharing is positively associated with the perceived value of the ERM implementation.

Perceived quality of risk knowledge sharing (variable qrks) is constructed from the following five items:

- People are willing to share risk knowledge.
- The availability of documentation is good.
- The access to experience is good.
- There is an appropriate environment to discuss results interdepartmentally.
- There is an appropriate environment for the creation of shared solutions.

Communication Among Groups

As discussed in the previous subsection, knowledge sharing has an important influence on ERM implementation, and this goes even further. The assumptions behind decisions in hedging strategies or investment can be different: a lack of risk knowledge sharing can create issues in the RM processes and the controls may not be enough. The search for reasons outside an isolated area or unit is important in order to get better answers. Lack of knowledge access can create failures. Weak means for transferring knowledge can provide insufficient knowledge of the operation, poor assessments of the lessons learned and poor understanding of the present and forecasts based on risk knowledge. This lack of knowledge can be created because of interruptions in the flow of information which are a component of the risk management work that is complemented and used properly by the expert.

Goovaerts et al. (1984) wrote that only incomplete information is available and it is the risk professional who decides the principles and distributions to use. Information use, with interpretation and context content, or better to say knowledge, is part of the risk modeling process as a common area of risk management processes.

Different groups provide reports and risk assessments in different areas such as market risk, operational risk, strategic risk, credit risk and actions of risk mitigation, risk transfer and risk capacity evaluation. All these groups have specific goals, systems to work with, and the flow of information for risk knowledge in risk assessment requires people and data to develop models, carry out analysis and to share the outcomes with different levels of the organization in order to make better decisions. The consequences of limited communication among groups can be a barrier to overcome for the holistic view that ERM needs to have. Then the hypothesis is:

H3: The perceived quality of communication among groups is positively associated with the perceived value of the ERM implementation.

Perceived quality of communication among groups (variable label pqc) is constructed from the following five items:

- The communication between the RM groups is good.
- The communication within my RM group is good.
- The communication environment fosters the interchange of different points of view.

- There is a good capacity to get conclusions easily during meetings.
- The communication environment promotes teamwork.

Risk Management Information Systems (RMIS)

The functionality of information systems is an attribute that organizations as a whole and users look for in order to perform their activities. Support to risk modeling processes, development of experience in risk analysis, adequate management support, improvement of work flow and capacity to work with multiple groups in a project are some of the new conditions for designing information systems (Dinner and Kolber, 2005) according to the demands of regulatory frameworks in risk management and thus need to form part of the IT strategy in the financial institutions.

In general, the information systems architecture needs to deal with different information systems and how to achieve goals of compliance with new market conditions. There are many difficult and complex tasks to perform in order to follow regulations, and technology should support them. The tasks to perform include transformation of processes, data, control, maintenance, design of the information and technology architecture, reports and the ways to adapt the organization to new conditions. The reason for changes and modifications in some of the processes and the need for integration are both related to the demand for activities oriented to providing transparency, governance, accuracy, accountability and integrated reports.

Peterson (2006) stated that "implementing an ERM program can change the way everyone does their jobs." Compliance means reviewing everything that the organization is doing to achieve the goals under the regulation constraints. This is reviewing how all the steps are affecting risk control, learning processes for new work conditions, operational risks, actions and decisions based on the outcomes of changes.

Crouhy et al. (2001) identified the required technology attributes in order to build a banking RMIS. They said, "Many risks arise from the fact that today's banks are engaged in a range of activities. They trade all types of cash instruments, as well as derivatives…either for their own account or to facilitate customer transactions." The information systems for ERM thus need to deal with different products, different users, different needs, different organizational roles, etc., all these within the one organization.

A risk management system is much more than just another accounting system. The system should provide reporting capacity under accounting principles, help to manage, understand operations and products and create capacity to review potential losses, causes of risk and measures of risk related to different exposures. The required attributes comprise technology for integration and to address solutions through "information collection and normalization, storage and dimensioning, analytics processing, information sharing and distribution."

There are four main requirements when implementing an RMIS: first, management of the project cost and competing priorities (Levine, 2004); second, technological attributes, such as a flexible architecture, data model and risk measurement capability; third, an overall view of different factors and controls more than solutions in individual sections of risk; And fourth, include data management, structure of documents and reports, and data mining in knowledge discovery (Hormozi, 2004). These requirements show a wide spectrum of functional attributes for RMIS is required and its capacity to support risk knowledge sharing among different areas can be affected.

The enterprise risk management information system (ERMIS) has to go further in managing data and information. As Apte et al. (2002) said, the problem is not just to describe what the organization needs or the request; it is to predict, to optimize and to classify. The ERMIS requires a dynamic bridge between KM processes and ERM processes passing through people, business processes and technology. The risk management information is based on a context: it requires interpretation. The information without knowledge of the context could be dangerous. The point here is that risk management does not have a problem with information: it has more problems with interpretation and communication of meaning. To achieve an ERMIS requires many attributes, with the potential of using lessons learned, understanding of the present and possible scenarios. This leads to the formulation of the next hypothesis

H4: The risk management information system functionality is positively associated with the perceived value of the ERM implementation.

RMIS functionality (variable label misf) is constructed from the following five items:

- The systems provide support to the risk modeling process.
- The systems provide access to experience in risk analysis.
- The systems provide adequate data management support.
- The systems provide capacity to improve work flow.
- The systems provide capacity to work with multiple groups on a project.

Integration of Information Systems

Complex, large organizations and multidivisional businesses require the design of an enterprise architecture plan in order to support the business's access to data, data that should be in formats that are accessible and usable by many different users, of sufficient quality to share and to adopt in business processes.

The Zachman framework (1997) differentiates data, processes and technology factors for the architecture plan, by thinking about the evolution through time that the organization will have. This means the architecture plan takes into consideration the evolution of the information systems, the user evolution, changes in the policies, experiences, culture, documentation, etc.

Evolution of information systems, according to Galliers et al. (2001), has different goals, such as: better productivity, alignment to business processes, alignment to business objectives, support strategy and factors associated with people skills, system, processes, goals, organization structure, guiding principles and strategy. The strategy level includes the concepts of control, coordination and integration. Organizational processes require information from different sources and with different applications, the orientation to integration policies can be positive to the organization

There are many concepts used in management that show the search for enterprise-wide answers. These concepts are based on principles of integration and consolidation, and seek to develop capacity for managing multiple business units, gaining synergies and sharing experience in order to provide better answers, service and products to the customers. As well as ERM, other examples are: Enterprise Resource Planning (Stevens, 2003), Enterprise Architecture (Zachman, 1997) and Enterprise Content Management (Smith and McKeen, 2003). From this enterprise-wide evolution of information systems and enterprise integration appears the question: Does an integrated information system exist for managing risk management information in the financial services institution? The final hypothesis is thus:

H5: The perceived integration of the information systems is positively associated with the perceived value of the ERM implementation.

Perceived value of information systems integration (variable label isi) is constructed from the following six items:

- The same standards are used.
- A common data structure is used.
- A common data-warehouse is used.
- A common user interface is used.
- A common report system is used.
- A common application access is used.

Research Methodology and Analysis

A survey comprising the items explained above was distributed to a random sample of full-time employees in the risk management area in the financial services sector. The population was based all around the world, although more than 50 percent were from North America. The unit of analysis is the RM employee who is involved in RM activities in any of the RM processes in the sector. In order to generalize the results to the population, a random sample was selected from the RM employees. The random sampling method is appropriate because those involved in activities in the field of RM in financial institutions represent a homogeneous population. The groups of RM employees are by definition exposed to the KM processes, reducing the variance in the estimation of the population's proportions for perceptions relative to the attributes analyzed. This project only intends to investigate RM employees as whole, not any subdivisions within the financial services industry.

The survey was Web-based and face-to-face. Although this can have its limitations as a general survey method, all RM employees in the financial sector need to be computer-literate and all have Web access at work. It was therefore thought unlikely that responses would be biased as a result. The survey was pilot tested by RM professionals and academics: only minor modifications were made as a result of the pilot. The initial questions in the survey covered demographic information such as number of years in RM work, followed by the actual item questions. In total, 121 responses were received. The percentage of answers of the online survey was close to 20 percent because most of them were members of the Professional Risk Managers Association worldwide.

Measurement and Data Transformation

All 35 items in the survey were rated on the same Likert scale: 1 strongly disagree, 2 disagree, 3 neutral, 4 agree and 5 strongly agree. Values for the six variables (perceived risk knowledge sharing quality, perceived integration of information systems, risk management information system functionality, network capacity connecting people, perceived quality of communication among groups and perceived ERM implementation value) were then derived from the item scores associated with that variable.

Missing values for item scores were dealt with by replacing the missing value with the mean score for that item, as recommended by Han and Kamber (2006). A total of 45 of the responses contained one or more missing values.

An important issue in aggregating item scores was not to assume that simple addition of the item scores (i.e., equal weight) would be accurate (Alfares and Duffuaa, 2008) Three different methods were reviewed for assigning weights to the original item score results. The first method was the calculation of the total sum of scores for an item divided by the total sum of all item scores. This method does not take into consideration the mean and the variance of the item scores. The second method was based on the construction of a matrix that has as its rows the accumulated relative frequency per point of the scale. The original score is changed by the score given by the accumulated relative frequency. This method does not take into account the variance of the distribution.

The third method, that is the selected one, uses the transformation of the original data to a new scale given by the z-score $(x-\mu)/\sigma$, where μ is the mean and σ the standard deviation. This transformation allows the comparison of items with different mean and standard deviation because there are converted to a same scale, so that all the results are comparable. The z-scores do not change the skewness and kurtosis of the distribution, or the correlations between items.

The items used to construct each of the variables were tested according the Cronbach Alpha test. The cut-off value considered to be acceptable is 0.7 (Cortina, 1993). The Cronbach-Alpha coefficients (Table 1) show that the items for each variable are consistent and the scale reliable. The transformed z-scores for the items may therefore be added together to give the value to be assigned to the variable.

TABLE 1
Reliability Measure of the Items in Each Variable

Variable Labels	Cronbach's Alpha for Items
Perceived value of ERM implementation (perm)	Score index of nine items, each measured on a five-point scale (Cronbach's alpha 0.93)
Network capacity for connecting people (nccp)	Score index of five factor items, each measured on a 65-point scale (Cronbach's alpha 0.86)
Perceived quality of risk knowledge sharing (qrks)	Score index of five items, each measured on a five-point scale (Cronbach's alpha 0.79)
Perceived quality of communication among groups (pqc)	Score index of five items, each measured on a five-point scale (Cronbach's alpha 0.88)
Risk management information systems functionality (misf)	Score index of five items, each measured on a five-point scale (Cronbach's alpha 0.88)
Perceived value of information systems integration (isi)	Score index of six items, each measured on a five-point scale (Cronbach's alpha 0.89)

Statistical software (SAS® version 9.1) was used to manage the data, to test the hypotheses and to search for relationships between the variables. Each hypothesis was tested in the form of a null hypothesis that there was no association (correlation $\rho=0$) and a one-tailed test carried out. The results are shown in Table 2.

TABLE 2
Correlations Between Independent and Dependent Variables

Dependent Variable: Perceived Value of the ERM Implementation	Correlation	p-value
Network capacity for connecting people, label used nccp	0.1568	0.0857
Perceived quality of risk knowledge sharing, label used qrks	0.20937	0.0212
Perceived quality of communication among groups, label used pqc	0.29994	0.0008
Risk management information system functionality, label used misf	0.14564	0.111
Perceived integration of the information systems, label used isi	-0.11415	0.2125

Findings

Table 3 presents the summary of the hypothesis test results, using a $p<0.05$ (using t statistic) the significance level. At the stated level of significance, two of the variables, perceived quality of risk knowledge sharing (qrks) and perceived quality of communication among groups (pqc) were found to be positively associated with the perceived value of the ERM implementation. Two more of the variables, network capacity for connecting people and risk management information system functionality, showed a positive association with the dependent variable but not a significant one. Although also not significant, we were surprised to find that the correlation between perceived integration of the information systems and the perceived value of the ERM implementation had a negative sign.

TABLE 3
Summary of Hypothesis Test Results

Hypotheses	Results
H1: The quality of the network capacity for connecting people is positively associated with the perceived value of the ERM implementation.	Not Supported
H2: The perceived quality of risk knowledge sharing is positively associated with the perceived value of the ERM implementation.	Supported
H3: The perceived quality of communication among groups is positively associated with the perceived value of the ERM implementation.	Supported
H4: The risk management information system functionality is positively associated with the perceived value of the ERM Implementation.	Not Supported
H5: The perceived integration of the information systems is positively associated with the perceived value of the ERM implementation.	Not Supported

A stepwise regression was then carried out, using the same dependent variable and five independent variables. Again using a p-value of 0.05, the first variable to enter was the perceived quality of communication among groups (pqc), and no other variable was significant. The resulting output from SAS® 9.1 is shown in Table 4.

Table 4. Stepwise Regression Results

```
                       Model: MODEL1
                  Dependent Variable: perm

             Number of Observations Read        121
             Number of Observations Used        121

                  Stepwise Selection: Step 1


      Variable pqc Entered: R-Square = 0.0900 and C(p) = 1.6589


                     Analysis of Variance

                         Sum of       Mean
    Source       DF      Squares      Square     F Value    Pr > F

    Model         1     554.56318   554.56318     11.76     0.0008
    Error       119    5609.88540    47.14189
    Corrected   120    6164.44858
      Total


                  Parameter    Standard
    Variable      Estimate      Error    Type II SS   F Value    Pr > F

    Intercept                  0.62418   1.17269E-30    0.00     1.0000
              9.84462E-17
    pqc         0.52059       0.15178    554.56318     11.76     0.0008

                  Bounds on condition number: 1, 1
------------------------------------------------------------------------------
                         --------------


      All variables left in the model are significant at the 0.0500 level.

   No other variable met the 0.0500 significance level for entry into the model.
```

The stepwise regression confirms the perceived quality of communication among groups as the most significant variable affecting the perceived value of ERM implementation, although the variance accounted for is low, with an R-squared of 0.09.

Discussion

Our findings remain preliminary at this stage, with further investigation to be carried out. Nevertheless, it appears from the analysis so far that the variables representing people interaction have more effect on the perceived value of ERM implementation than those representing technology factors.

The most influential variable in our study was found to be the perceived quality of communication among groups. To enhance the value of ERM implementation, people need to be able to communicate in their own teams and with other teams. They need to be able to develop activities where they can interchange points of view and can reach conclusions during meetings. People's positive work environment for good communication helps successful ERM practice considerably by providing motivation and openness to the reception of different views.

The perceived quality of risk knowledge sharing had a positive correlation with the perceived value of ERM implementation, but did not significantly improve the regression model. This suggests that respondents mainly see knowledge sharing as an issue of communication between groups of people.

None of the technology variables had a significant effect on the perceived value of ERM implementation, and the coefficient for the effect of the variable perceived integration of the information systems was negative. It appears, therefore, that respondents regard ERM implementation as an issue of people rather than technology, although possibly they take the latter for granted. It will be recalled that the survey was Web-based, thus requiring a certain (although hardly exceptional) level of proficiency in using IT. The negative sign of the correlation for integration of information systems suggests that too great a degree of integration could be counter-productive.

However, it has also been seen that there is a great deal of unexplained variation. Our survey collected data on other variables that we have not yet analyzed, and further analysis of the data presented here also needs to be considered—for example, combining some of the people and technology items to form different variables.

Conclusions, Implications and Limitations

Financial services, as a knowledge- and risk-based business sector, requires the coordination and alignment of actions in order to achieve the expected strategic results. We believe that considering risk and knowledge management together gives a much stronger basis for the organization in order to implement ERM. The KMS and RMIS can then be defined and structured in order to connect people and to develop the capacity of sharing risk knowledge.

Five hypotheses have been tested in order to relate KM concepts to the perceived value of ERM implementation. A survey obtained responses from 121 risk management staff in financial services. Two of the five hypotheses were accepted. Perceived quality of risk knowledge sharing and perceived quality of communication among groups were each found to be positively associated with the perceived value of the ERM implementation. A stepwise regression suggests that perceived quality of communication among groups is the more important influence. Overall, the survey found that variables representing people-related KM concepts did have an influence on the perceived value of ERM implementation, whereas technology-related KM concepts did not.

There are some limitations to the research process. Validated scales were not available for most of the items and variables analyzed, so we cannot be certain that the constructs definition was totally clear for all of the participants in the research, given the wide spectrum of risk to analyze and backgrounds that people have working for different risk management processes. Also, the Web-based nature of the survey may have rescued the response rate from older (and perhaps more senior) risk management staff.

The results at this stage remain preliminary. Other variables from the survey are yet to be analyzed, and more advanced techniques may shed more light on the relationships. Nevertheless, this study already points to a set of questions for new research in order to find more and clearer relationships between ERM and KM. One of these is related to the concept of information system integration, which unexpectedly revealed a negative association with the perceived value of ERM implementation, albeit not a statistically significant one. There may be a difference between top-down business needs and bottom-up user perceptions here. On the other hand, there is scope to identify value in ERM that is related to risk control, communication channels and communication with stakeholders—means used to transfer and to share risk knowledge.

New studies to perform can be important with regard to the modeling processes, the understanding of the outcomes and the process to commercialize products based on models, validation of assumptions and development of risk indicators to support decisions and avoid crises. However, the most important implications from these studies will be to identify the soft part of the risk management and the influence in the decision making process plus the capacity for people to develop their activities in a better and reliable environment.

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Eduardo Rodriguez is a Ph.D. Candidate at Aston Business School, Export Development Canada EDC in Ottawa, Canada and a principal at IQAnalytics in Canada. He can be reached at *eduardo.rodriguez@iqanalytics.com.*

John S. Edwards is professor of O.R. and Systems in the Operations & Information Management Group, Aston Business School, Aston University in Birmingham, U.K. He can be reached at *j.s.edwards@aston.ac.uk.*