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Application of Analytic Hierarchy Process Approach in Relative Risk Intelligence Field

Samaneh Shirani Lapari, Mahboobeh Rostami, Elham Fallah

Abstract— There is little published research about RRI (Relative Risk Intelligence), making this topic difficult to understand and under-utilized in management and decision sciences. Firestone (2006) was the first to develop a list of factors that characterize RRI. This study was designed to build upon the RRI model developed by Firestone using the AHP. Five factors that characterize RRI were researched and identified by Firestone. One factor was added by the researcher based upon professional experience and research. The results of the study included 5 to 7 attributes each for 6 factors related to RRI. The combined data for the group were analyzed for logical consistency of judgments. The result is a framework of RRI attributes with weights of importance assigned to each attribute. Recommendations include the exploration of possible variant RRI measurement models for different decision making situations. The social change aspect of the study was the development of a systematic framework for increasing the quality of knowledge in decision making to help organization leaders sustain their organization's competitiveness while insuring ethical and consistently successful decisions are implemented.

Index Terms— Measuring, Relative Risk Intelligence, Analytic Hierarchy Process, Decision Making.

1 Introduction

AS the complexity of the business environment produces increasingly challenging problems, the likelihood that decision makers will not be familiar with the vast number of causes underlying these problems escalates. This situation creates a potential that poor decisions will be made based on knowledge resources that have knowledge gaps in relationship to the problems at hand (Firestone, 2006) and the increased odds of misunderstanding the problems (Wiig, 2004). This perceptual distortion is due to two primary factors that influence decision makers, bounded rationality and misperception of dynamic feedback.

A critical component to the quality of a decision is the quality of knowledge a person's utilizes to make the decision. RRI is one way to increase the quality of knowledge. However, the problem is that there is no comprehensive way to measure RRI and therefore be able to take appropriate action to increase the quality of knowledge.

Firestone's (2006) RRI metric provided a potential foundation, as he pointed out, the model needs more detailed, empirical development to identify measurable attributes that characterize the five factors to further develop its usefulness to decision makers (J. Firestone, personal communication, August 2007.

2 Literature Review

Deshmukh and Millet (1998) conducted a study using AHP to develop a model for assessing the potential risk of management fraud for auditors. A model for assessing the likelihood of management fraud is presented in the following formula: P (MI) = f (C, M, A) (p. 88). The formula can be described as the probability of material irregularities (fraud) is a function of the evidence that conditions allow fraud to be committed, that an employee in a position of authority or responsibility has the motivation to commit fraud, and that an employee in a position of authority or responsibility has an attitude that would allow themselves to commit actions of fraud (Deshmukh& Millet). If, however, any one of these conditions is not met, in other words equal to zero, then the likelihood of management fraud is also zero. All three of the conditions must be met to some degree in order to support the probability of fraud (p. 88).

Accorsi, Apostolakis, and Zio (1999) used the AHP methodology to prepare a measurement model for prioritizing the sometimes conflicting and complexity of multiplestakeholders while preparing an environmental risk management program. This model would then be used to compare alternative courses of action so that the allocation of resources best meets the needs of the organization and the stakeholders (Accorsi et al.). A secondary goal of this type of measurement model was that the impact categories used in the first level of the hierarchy were very broad and needed to be broken down into more specific objectives that could be translated into performance measures (Accorsi et al.). Stakeholders were asked to develop the decision hierarchy and then to rate the relative importance of each level of criteria based on their representation of their corresponding institution (Accorsi et al., 1999). The individual results of the pairwise comparisons were discussed with each stakeholder, and then the aggregated results were presented. One main point of clarification made by the authors was that the exercise was not intended to prioritize the various alternatives to the environmental risk management program development, but that the intent was to prioritize stakeholder issues and concerns so that the alternatives could be systematically judged against the criteria (Accorsi et al.). Safety management programs also have multiple stakeholder and organizational

- *Department of IT Management, School of Management and Economy,Islamic Azad University of Science and Research, Tehran, Iran. E-mail: shirani.samaneh@yahoo.com*
- *Department of IT Management, School of Management and Economy,Islamic Azad University of Science and Research, Tehran, Iran. E-mail: m_rostami888@yahoo.com*
- *Department of IT Management, School of Management and Economy, Tarbiat Modares University, Tehran, Iran. E-mail: fallah.elham88@yahoo.com*

concerns, similar to environmental management programs. An organization's ability to fund certain safety management alternatives, maintain an efficient level of productivity, maintain an acceptable level of product quality, and protect against potential risk hazards are all potential issues that a manager may need to consider while developing safety programs. Cagno, Di Giulio, and Trucco (2000) recognized the complexity of thisactivity and used the AHP methodology to generate a systematic measurement model for evaluating various safety management alternatives based on the prioritization of risk hazards, their potential impact, and the likelihood of occurrence. The potential causes of safety hazards were also analyzed in the same fashion to assist with the development of effective safety management activities (Cagno et al.). One important clarification that Cagno et al. (2000) made that other studies of this nature did not point out, is that the process should be considered reiterative. Once the safety management program actions are in place, the process should be continuously reevaluated for continuous improvement and analysis of effectiveness of implemented plans (Cagno et al.). Also, in conjunction with most of the studies reviewed, the need to support quantitative and qualitative data was a primary asset for using the AHP methodology. Safety hazards can be the result of human error, machine error, or other types of incidents that can be classified as both qualitative and quantitative (Cagno et al.).

In order to effectively manage the objectives comprehensively, an appropriate methodology such as AHP is needed (Cagno et al.). Hutchison, Adair, and Leheny (2005) applied the AHP decision-making methodology to property risk scoring. Investing in property for a desired rate of investment return exposes the investor to risk of lost value (Hutchison et al.). The authors noted that research and resources are available to insure the appropriate appraisal information is generated and communicated to the investors, but that there was little research available to score potential risk factors that may occur after the investment has been secured. The potential risk factors had been previously identified as investment quality risk, covenant strength risk, and depreciation and obsolescence risk (Hutchison et al.).

Although one benefit of using AHP is its ability to support multicriteria decision making, the researchers determined that for the purpose of this study, limiting the number of criteria to be pairwise compared would expedite the process and minimize the number of questions or confusion for the study participants (Hutchison et al.). Even though the need to develop the criteria was not part of this research design, the authors of the study solicited the help of, "valuers" (p. 148) to shorten the potential risk criteria down to the top four perceived key areas of risk (Hutchison et al.).

An additional phase of this research design that was not commonly found in other reviewed studies was the use of an industry-wide feedback session regarding the potential effectiveness of the model (Hutchison et al.). Valuers and lenders both were asked for their review and concerns regarding the measurement model and its potential effectiveness of use for assessing potential property risk (Hutchison et al.). Although the general interest was positive for use of the measurement model in industry, the feedback phase did provide a number of concerns and issues that would need to be addressed prior to administering the model for professional use (Hutchison et al.).

3 METHODOLOGY

A mixed method research design was used to collect both qualitative and quantitative data sequentially. Using Team AHP and knowledge elicitation techniques,the decision panel was utilized to develop the measurable attributes for each of the sixfactors. After the measurable attributes were developed, a quantitative rating exercise was conducted to determine the priority weights of each attribute to be used during thedecision process. To validate the quantitative rating of the attributes further, a feedback session followed the rating exercise.

The overall population impacted by the results of this research, after the model istested for effectiveness in future studies, will be organizational decision makers who areinterested in leveraging their knowledge resources and reducing the risk of error in theirdecision models. Especially decision makers who seek to assign individuals or a team ofindividuals to problem solving activities with the intention of minimizing the risk oferror. Rating RRI has the potential to reduce the risk of error in the decision model usedto choose alternative solutions to business problems.

The decision panel was formed by volunteer participants who are active members of the Tehran Chamber of Commerce. Tehran Chamber of Commerce has been in existence for 90 years. The Chamber has approximately 400 members representing 21 different business categories. The Tehran Chamber of Commerce was selected to sponsor the study because of the history and experience of the businesses, and their willingness to participate.

The criteria for choosing potential participants were described to therepresentative for the Chamber of Commerce, who then screened members for possibleinclusion. The criteria were those who perceived themselves as experienced organizationdecision makers or problem solvers and who have an interest in learning about thebenefits of using risk intelligence in their decision making activities. Participantselection was purposive (Singleton & Straits, 2005), and volunteers were solicited up toand including the day of the study.

Thirty-six potential participants were contacted via telephone and email. The researcher estimated that over 75 calls were made and multiple follow-up emails were sent to solicit volunteers. The majority of those contacted were very interested in participating but had scheduling conflicts. On the day of the study, there were 10 potential participants, of whom 6 followed through with participation.

The participants each represented a different Chamber of Commerce business category, represented diverse positions within their organizations at various levels of management, and had years of decision making experience ranging from 16 years to 38years. The small number of six participants with such diverse backgrounds wasacceptable for collaborative discussion and knowledge creation. All decision panelpartici-

pants received and returned a signed consent form that explained the details of thestudy and acknowledged their agreement to voluntarily participate. Because of prior commitments two participants did not stay forthe entire study.

The research event was made possible by two primary objectives. The first was aprocess consultation; the second was the use of effective AHP technology. Because RRIis an emerging theory and the timeframe for the study was condensed, the processconsultation prepared participants to enter the facilitated discussion with backgroundinformation regarding the topic and the methods for conducting the research. Thetechnology used enabled the researcher to capture the attributes and then have theparticipants rate the attributes in a timely manner.

4 Data Analyses

After the attributes were finalized by the decision panel, the data were uploaded from EC11.5 to Comparion Core version 1.7.326, a Web based add-on to EC. There are three limitations to the quantitative rating exercise results.

First, two participants had left the study event because of prior commitments, so onlyfour members of the decision panel rated each of the factors and the attributes viapairwise comparisons to develop the measurement model.

Second, the participants rated the high-level factors at the beginning of the ratingexercise and again at the end of the exercise. The Comparion Web-based software was programmed for top-down ratings, which means the high-level factors were ratedbefore the lower-level attributes were rated. However, at the beginning of the ratingexercise, it was not evident to the researcher that the six factors were introduced to theparticipants, so the researcher added the six factors to the end of the rating exercisesimply to insure every level of the hierarchy would be rated. The data analysis revealed;however, that the six factors were rated at the beginning of the rating exercise. So thehigh level factors were rated at the beginning of the rating exercise (a top-downapproach) and at the end of the exercise (a bottom-up approach).

Third, the settings for collecting judgments and adding participants in Comparioncould not be done ahead of time. The completed EC affinity diagram had to be uploadedto create the appropriate workgroup for the rating exercise. Although the researcherproceeded cautiously through the process, one setting was missed that reduced thenumber of evaluations presented to the participants. Comparion contains a programmedfunctionality to minimize redundancy by having the participant judge only the first twodiagonal relationships of a reciprocal matrix. This setting was in place resulting in missedjudgments for the first factor data set and the attribute data sets; however, the minimumnumber of judgments required to derive a ratio scale was exceeded. The derivationprocess lowers the inconsistency ratio by assuming 100% consistency for the missedjudgments. The second factor data set was evaluated with no missed judgments, so theinconsistency ratio is more accurately reflected because the participants made allpotential comparisons. Although unplanned, all results are reported and analyzedaccordingly.

The global priority ratings shown in Table 1 represent how the attributes compare to all other attributes. These ratings are indicative of a preoccupation with social skills and leadership skills in business. The results did not reveal a high regard or appreciationfor exploring and discovering the unknown and generating new knowledge or creative solutions.

TABLE 1
Attribute Global Priority Ratings

Factor	Attribute Hierarchy Global	Priority
Six	Display trust and respect for others.	0.128
Six	Gain the trust and respect of others through credibility	0.100
Five	Have social skills and communication skills to obtain buy-in.	0.075
Five	Be willing to maintain objectivity and not demand personal ownership of effective solutions.	0.052
Six	Ability to put aside personal emotions and remain professional	0.039
Six	Demonstrated leadership skills.	0.039
One	Determine the extent of the problem.	0.037
Six	High degree of confidence.	0.032
Four	Use reason and logic to weigh pros and cons of potential solutions.	0.031
Five	Manage the flow of the process from starting point to goal point.	0.030
Four	Willingness to test possible solutions and refine prior to implementation.	0.029
Two	Willingness to explore and accept others' experience, opinions, and knowledge.	0.027
Four	Demonstrate an ability to take experiences, both good and bad, and learn from them.	0.027
One	Brainstorm to explore what you don't know.	0.025
Two	Willingness to ask questions and listen.	0.023
Six	Ability to facilitate and engage people with different personalities.	0.023
Five	Develop new standards and document all standards to prevent future problems.	0.022
One	Know the goal to determine how it is being compromised.	0.021
One	Enable a supportive environment without barriers of fear or responsibility.	0.021
Three	Look for diverse opinions or people with diverse backgrounds.	0.021
Four	Confidence and willingness to admit mistakes.	0.021
One	Being aware of surroundings and engaged in one's work.	0.020
Three	Retain what was learned from the past and build on it.	0.018
Four	Understand and recognize the acceptability and cost of the potential risk.	0.018

Two	Diverse life experience.	0.017
Two	Confidence in personal abilities to allow openness to search for other alternatives.	0.015
Six	Self-motivation to actively participate.	0.014
Four	Not afraid of failure; failure may result in a solution.	0.012
Two	Willingness to compromise with things they disagree with or agree to disagree.	0.010
Three	Make sense of situational conditions and transfer previous experience.	0.010
Five	Maximize decision making with available resources.	0.009
Three	Understand and recognize available resources with respect to feasibility and practicality.	0.008
Three	Identify other stakeholders and ask questions or ask for input.	0.006
Three	Willingness to network and benchmark against other industries or businesses.	0.006
Five	Overlay effective solutions with other areas of the business.	0.006
One	Eliminate wrong possibilities.	0.004
Four	Willing to look at things that haven't been done before and find out why.	0.003

5 Conclusion

The development of the attributes and the judgments of the attributes and the factors provide a foundation for a RRI measurement model that decision makers,managers, or executives can use to rate and score the RRI of alternatives so that problemsmay be solved with a higher likelihood of success. The aggregate ratings for the factorsand the attributes indicated a consistent high priority assigned to social skills and theability to collaborate with a team. In order to create new knowledge and develop creativesolutions to complex problems, the decision panel regarded trust, respect, and high levelsof self-confidence as being the key to generating a higher quality of knowledge andthereby solving problems with a higher likelihood of success.

RRI is an emerging theory that has received little attention in academic literatureto this point. The advances in decision sciences, the changes in the global economy, thecomplexity and problematic nature of business, and the changes in the demographiccharacteristics of modern decision makers all support further research and developmenton this topic. The likelihood is increasing that problems or challenges will arisethroughout organizational operations for which decision makers and problem solvers willnot have the necessary knowledge or previous experience to successfully chooseappropriate actions. RRI is an attribute in and of itself that has the potential to assist withthe goal to fill these knowledge gaps and increase the likelihood of making decisions witha higher chance of success.

This research sought to provide a contextual framework to RRI by identifying themeasurable attributes that individuals may display that characterize RRI and to rate theimportance of these attributes to create a measurement model for scoring RRI. Not onlywould such a tool help decision makers make higher quality choices, the model alsostands to provide a basis for how individuals and organizations may increase their RRI byknowing what the factors are that characterize it. This research has the potential to addvalue to academic literature and management literature.

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