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Housel, Thomas J.

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# EXPLORATORY AND EXPLOITATIVE KNOWLEDGE LEARNING BY INVESTMENT ANALYSTS

## 1. Introduction

Corporate executives attempt to educate investment analysts about their company's potential as an investment option by providing traditional financial and supplemental information. As an example, the Spanish companies examined by Garcia-meca et al. (2007) typically disclose information regarding strategy, customers, business processes, and intellectual capital in regular presentations to sell-side analysts. Corporate executives' attempts to influence analysts' perceptions about their company's future potential through announcements about information technology investments are well documented in the recent literature (Im et al., 2001). Yet, much of the knowledge that is critical for success involves new knowledge asset performance information (i.e., customer relations and responses, competitors, regulations, brand name, etc.), in which decision makers' traditional knowledge endowment may not be enough. Hence, they may have to proceed by coupling exploratory trial and error techniques with their established traditional knowledge bases. The motivation for this study stems from the dearth of research that empirically examines processes through which traditional financial and new knowledge asset performance information influence professional analysts' decisions. That is, the growing interest of researchers and investors reflects their discontent with traditional information sources which suffer from a lack of timeliness, inaccuracy, and a limited ability to convey prospective data, risks, and intangibles (Garcia-meca et al., 2007). At best, this information indicates predictable stability (Crossan, 1998; Kamoche et al., 2003). For example, Barker (1999) examines the valuation practices of investment analysts and fund managers concluding that both

sets of decision makers use their own assessment of management quality (influenced by interacting with company management) thus limiting the role of valuation models based on traditional financial information. As a possible solution, a small but increasing body of organization researchers proposes that different knowledge forms can be combined into exploratory and exploitative knowledge (Kamoche et al., 2003; Mirvis, 1998).

The knowledge process model in this study enables us to examine how analysts process new information through several stages of information processing en route to their decisions. This is consistent with the Szulanski (2000) argument that as information (i.e., new knowledge asset information) is processed knowledge is exploited and/or explored. Our measures of exploitation and exploration also go beyond existing research. Whereas much of the research on exploration uses dichotomous measures of exploration, we have measured exploratory and exploitative knowledge along a continuum depicted in a knowledge process model. The likelihood of incorporating knowledge asset performance information into analysts' knowledge structures is supported by the knowledge-based view of the firm (Kogut and Zander, 1992) and inspired from the resource-based view of the firm (Coff, 1997; Wernerfelt, 1984). The knowledge-based view argues that a resource (e.g., knowledge assets) that is valuable, rare, and inimitable can contribute to the competitive advantage of individuals<sup>1</sup> possessing it and therefore the performance of these assets will reflect this. Further supporting the importance of knowledge assets is that they are most likely to "generate rents" or added leverage when they are bundled with other resources in a complementary fashion (Carpenter et al., 2001).

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<sup>1</sup> This paper uses the term "individual" processes or decision, although it is meant in the organizational level as well.

Knowledge<sup>2</sup> is a combination of framed experience, values, contextual information, expert insight, and grounded intuition that furnishes an environment and framework for evaluating and incorporating new experiences and information to achieve intended ends (Autio et al., 2000; Griffith and Northcraft, 1996). As a result of technological change and the workplace becoming more people-knowledge oriented, organizations are placing more consideration in their knowledge assets (Osterloh and Frey, 2000). For example, a recent report stated that between 1978 and 1998, the non-book value of all organizations rose from 5% to 72% of market value (Boulton et al., 2000; Rodgers, 2003). Knowledge assets represent a nonphysical claim to future benefits and are difficult to determine with certainty or precision (Lev, 2001). They include patents, brands, trademarks, and digital content that can be specified, protected, and traded (Contractor, 2001). Knowledge assets that cannot be bought or sold include ethics, trust, organizational culture, and organizational experience – often captured in knowledge databases.

New knowledge integrated with existing knowledge helps to develop unique insights and creates even more valuable knowledge. Organizations can therefore seek areas of learning and experimentation that can potentially add value to their existing knowledge via a synergistic combination of exploitive and explorative learning (March, 1991). This objective is somewhat unclear, given that the two activities of explorative and exploitative knowledge are clearly distinct and that they often require different types of risks and management approaches. Explorative knowledge captures the creation of new knowledge through search, variation, risk taking, experimentation, flexibility, discovery,

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<sup>2</sup> A definition of knowledge on which everybody agrees does not exist yet. In some of the management literature data is considered as facts and information is processed, interpreted data; whereas, knowledge is personalized information (Fahey and Prusak, 1998). Finally, explicit

and innovation. Whereas, exploitative knowledge captures the use of knowledge that already exists by emphasizing refinement, choice, production, efficiency, selection, and implementation (March, 1991). Research efforts in the context of process management have not addressed the issue of whether and how these activities affect the development of decision making stages and organizational processes (Benner and Tushman, 2003). Therefore, the purpose of this research is two-fold. First, we present a theoretical decision making model that incorporates explorative and exploitative learning strategies in the processing stages of information acquisition followed by knowledge utilization. Second, we empirically explore the effects of explorative and exploitative knowledge on investment decisions by analysts from two countries with distinctly different viewpoints on the use of knowledge asset performance information for management and investment decision making.

The paper proceeds with a review of the literature on explorative and exploitative learning and knowledge followed by a description of the knowledge process model that allows us to examine the extent to which investment analysts use knowledge asset and traditional financial performance information in their decision making. Next, we propose hypotheses about the explorative and exploitative learning strategies analysts use in processing knowledge assets and financial information. Subsequently, we discuss the research methods employed and related results. Finally, we explore the implications and limitations of the study as well as opportunities for further research.

## **2. Theory and Hypothesis Development**

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knowledge is knowledge that can be formalized and codified; while tacit knowledge is difficult to place in writing or code, and is acquired through expertise (Polanyi, 1966).

## ***2.1. Explorative Exploitative Knowledge***

Research has clearly indicated that financial analysts benefit from exploiting their knowledge about the performance of firms to reach investment decisions (Rodgers, 2003). This is not surprising. However, in their quest to leverage new knowledge about the performance of firms, they are forced to learn how to explore new sources of performance in order to leverage this information in investment decisions. Prior research has shown that one source of new knowledge that analysts are willing to explore is the performance of firm knowledge assets (Boland and Tenkasi, 1995). The knowledge-based view asserts that the creation and utilization of knowledge is the driver of individuals' productivity and profitability of organizations (Grant, 1996). The knowledge-based view of the firm regards knowledge as the most important resource of an organization and is acquired by individuals. Due to the cognitive and time limitations of individuals, they must specialize in their acquisition of knowledge. Thus, increased depth of knowledge can be generally attained through sacrificing breadth of knowledge (Kogut and Zander, 1992). The creation of value through the transformation of inputs into output normally requires the application of different types of specialized knowledge. That is, knowledge as a resource can provide competitive advantage to an organization by integrating its exploratory and exploitative knowledge. An organization's competitive advantage can occur by establishing employees' knowledge integration techniques that extend capabilities by bringing in new knowledge and reconfiguring existing knowledge (Nickerson and Zenger, 2004). However, the need to access new knowledge may create complex organizational issues with regard to choices between explorative and exploitative knowledge. Therefore, we contend that organizations should strive to use their learning experiences to build on or complement knowledge positions that provide a current or future competitive advantage. Organizations that map, capture/retain, categorize, and benchmark knowledge not only can help make knowledge more

accessible throughout an organization, but, can also prioritize and focus learning experiences in order to create greater leverage for its learning efforts by using a decision making model.

At the theoretical level there is generalized support for the premise that the degree of success for organizations depends on the capability to both exploit and explore (Benner and Tushman, 2003). Studies of organizational learning (Levinthal, 1997; March, 1991) have suggested that the problem of balancing explorative and exploitative knowledge is revealed in differences made between refinement of an existing technology and invention of a new one. That is, exploration of new alternatives reduces the rate with which skills at existing ones are improved. Further, enhancements in ability at existing procedures make experimentation with others less attractive. Using such explorative learning strategies is not without costs. Analysts may be forced to abandon existing performance knowledge that they have been able to leverage in their investment decision making. Being a risk averse crowd (Rodgers and Housel, 2001), such a move is problematic unless they can incorporate the new performance information within an existing knowledge framework or can construct new knowledge scaffolding with minimal effort. One other alternative is that the new information is so promising that they are willing to explore it and create new knowledge structures to eventually be able to exploit it.

Exploratory knowledge can be viewed as the adoption of an idea or behavior that is new to the organization (Damanpour, 1991). Diversity of knowledge is critical for creative, complex, and swift problem solving. Organizations help utilize this knowledge by providing goals, however the knowledge base should be augmented by various indicators (Hage, 1999). For example, the fundamental nature of “exploration” can be



described as the experimentation with new alternatives depicted by non-traditional knowledge asset information. Its returns are uncertain, distant, and sometimes negative. Improvements from returns from exploration are systematically less certain, more isolated in time, and organizationally more distant from the locus of action and adaptation. The fundamental nature of “exploitation” is the enhancement and extension of existing competences, technologies and paradigms depicted by traditional financial information methods. Its returns are positive, proximate and predictable. That is, some may view what is good in the long run may not be good in the short run. Exploration and exploitation are not mutually exclusive. Investment analysts may need to develop one area of knowledge while simultaneously exploiting another. An ideal situation for analysts is to maintain a balance between explorative and exploitative knowledge. Exploration provides the knowledge assets to drive an organization into new places while maintaining the viability of existing ones. Exploitation of that knowledge provides analysts the basic financial tools to fuel successive rounds of innovation and exploration (Zack, 1999).

Such features of the investment analysis context lead to a tendency to substitute exploitation of traditional financial methods for the exploration of non-traditional knowledge asset measures. This property of adaptive processes can be harmful to the organization. That is, it can degrade organizational learning in a mutual learning situation regarding a new and productive way of analyzing a company. Mutual learning leads to convergence between organizational and individual beliefs (March, 1991).

The explorative and exploitative learning framework provides a strong theoretical basis for describing how traditional and new performance information influences investment stock analysts' decision processes. *Learning* is described as stored information from an

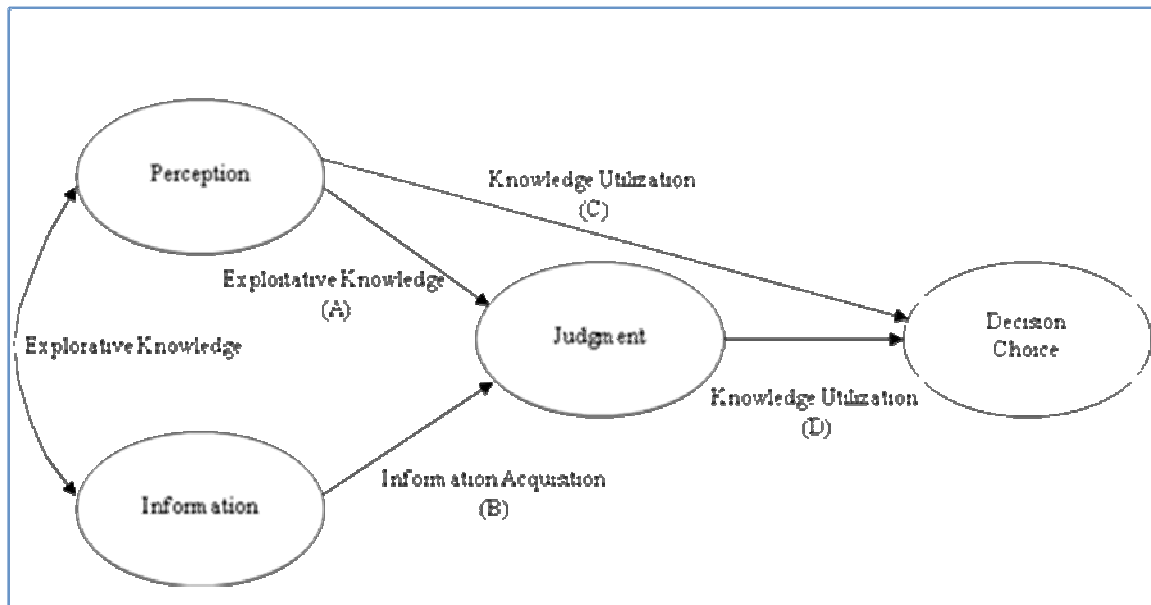
individual's past (Argote, 1999; Walsh and Ungson, 1991) and shared interpretations of the past (Darr and Kurtzberg, 2000). For example, prior research shows (Rodgers and Housel, 2001) that investment analysts exploit traditional financial performance information as well as explore new performance information about the performance of telecommunication companies from news reports and information trends that indicate growth or decline. This research indicates that investment stock analysts identify certain traditional financial variables that are more likely than others for exploitative learning strategies such as the projected price earnings and cash flow ratios. From an exploratory learning strategy perspective, the research identifies certain knowledge asset indicators such as the return on knowledge (ROK). Taking revenue and cost allocation independently derives ROK. That is, ROK establishes a productivity ratio (revenue over cost). This ratio allocates a percentage of revenue to a given process based on the amount of knowledge required to produce the process outputs in the numerator, over the cost to employ the knowledge in the denominator. See Pavlou et al. (2005) for a more detailed description of this approach.

When an organization finds itself to be at an insufficient level of knowledge it may require new knowledge in order to defend its position or close the competitive knowledge gap. To the extent that knowledge in the investment industry is changing rapidly, an organization may need to create new knowledge just to keep pace. For example, an analyst's explorative learning strategies may influence exploitative learning about a company's reduced wages and salaries due to recent purchases of technologically advanced systems or markedly improved inventory systems.

## **2.2. Decision Making Model**

Decision making in regards to limited rationality theories posits that there is a balancing act between exploration and exploitation that emphasizes the role of targets or the decision makers' aspiration levels in regulating allocations to search (March, 1991). Typically, search can be inhibited if the most preferred alternative is above the target. Whereas, search can be motivated if the most preferred known alternative is below the target. For example, an investment analyst may be motivated to select certain types of financial information (exploitative knowledge) to satisfy conditions that are necessary to purchase a company's stock. However, if the financial information is not as revealing (i.e., below the target), then exploratory knowledge may assist in the process of stock selection. These ideas are found in theories of satisficing (Simon, 1957) and prospect theory (Kahneman and Tversky, 1979). Further, research studies led to attempts to specify conditions whereby target-oriented search rules are optimal. Hence, in the limited rationality convention, discussions of search emphasize the significance of the adaptive character of the decision makers.

The current study advances theory on the relationship among explorative and exploitative learning strategies for information acquisition and subsequent incorporation within knowledge structures as they affect decision making processes within a single knowledge process model. A knowledge process model (Rodgers, 1997; Rodgers and Housel, 2004) is presented that depicts the interactions of four major processes of decision making including perception, information, judgment (i.e., analysis), and decision choice (Figure 1).



**Figure 1. Knowledge Process Model**

Tsoukas' (1996: 14) research supports this type of latent knowledge modeling in that it recognized that "tacit and explicit knowledge are mutually constituted... [essentially] inseparable." Others (Boland and Tenkasi, 1995; Cook and Brown, 1999; Davenport and Prusak, 1998) also argue for an integrated approach that affords a view of knowledge as process oriented, dispersed, and inherently indeterminate.

Organizational decision makers learn from experience how to partition resources between exploration and exploitation. This process allows for the distribution of consequences across time and space thereby affecting the lessons learned. The sureness, quickness, closeness, and clearness of feedback ties exploitation to its consequences more rapidly and more accurately than is the case with exploration. That is, the search for new concepts or methods to depict and analyze information has less certain outcomes, longer time horizons, and more diffuse effects than does the further development of existing ones. Therefore, traditional methods and techniques for

financial analysis purposes are more amenable to exploitative processes than exploration. These advantages for exploitation build up over time. Each competent prediction of a company's future profitability correlated to traditional financial methods increases the likelihood of rewards for engaging in that activity, thereby further increasing the competence (Argyris and Schon, 1978).

The central insight of the knowledge process modeling approach is that information inputs are necessarily embedded in a cognitive, behavioral, individual, and social context. This context constrains their creation, transfer from one set of actors to another, and usefulness in different problems (Postrel, 2002). We depict this insight as "perception" in our model. *Judgment*, the second stage, involves a more detailed analysis; therefore, the decision maker must know an adequate set of operations. Judgment allows knowledge to rise above and beyond opinion based on rule-based operation rules. Our sample of experienced analysts shares a common knowledge of financial analysis and the insights obtainable from multiple sources of information. *Decision choice* is the final stage of processing that represents a culmination of information acquisition, knowledge creation, knowledge transfer, and knowledge utilization.

In the *first stage* of processing, exploitative strategies are used as decision makers process information more intuitively, and the information processed becomes interdependent with perception ( $P \leftrightarrow I$ ) (Alloy and Tabachnik, 1984). Explorative strategies are essential when there are gaps such as how to assimilate new knowledge asset performance information with a decision maker's existing knowledge (Choo, 2002). Cohen and Levinthal (1990) add that imitating others' technologies or absorbing new ideas requires explorative learning strategies. Therefore, this processing stage can

influence latter stages of processes by providing a fresh look at a problem or creating new knowledge to assist in problem solving.

Once acquired, new knowledge can be exploited. The operation of exploitative strategies is implied when perception affects judgment ( $P \rightarrow J$ ). When information (i.e., new or traditional performance information) affects judgment, this implies that the decision maker is acquiring information ( $I \rightarrow J$ ).

In the *second stage* of processing, perception and judgment can affect decision choice ( $P \rightarrow D$ ;  $J \rightarrow D$ ). Perception-like heuristics and more deliberate information processing strategies (judgment) are involved in most decision choices (Rodgers, 1992). Also, the  $P \rightarrow D$  and  $J \rightarrow D$  pathways involve knowledge utilization impacting decisions. This knowledge utilization process can be influenced by explorative knowledge, exploitative knowledge, as well as information acquisition. Decomposing the model into parts (i.e.,  $P \leftrightarrow$ ,  $P \rightarrow J$ , and  $I \rightarrow J$ ) can facilitate the analysis of knowledge aspects influencing the decision making process.

### ***2.3. Investment Analysts' use of Explorative and Exploitative Knowledge***

The first step in understanding whether analysts from any country will move to incorporate new performance information in their knowledge structures is to provide a group of representative professional analysts from at least two representative countries with supplemental new performance information. Further, to determine whether they are actually exploring or exploiting this new information, it is necessary to model their decision making behavior. The current research examines whether analysts would explore and/or exploit new performance information (i.e., knowledge asset performance) in their decision making processes. Management professionals from some countries,

most notably Sweden (Edvinsson and Malone, 1997), have been exploring the potential of knowledge asset performance information for improved management and investment decision making for a number of years. That is, due to a more proactive knowledge stance in the Swedish Society (Edvinsson and Malone, 1997) we might expect that Swedish investment analysts should be more ready to include new knowledge performance information in their decision-making. The analysts in these countries would be more likely to have learned enough from exploring such performance information that they would be more likely to exploit this information than analysts from countries where this type of performance information is relatively new. In this study we selected investment analysts from Sweden and the United States.

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The first hypothesis examines the relationship between explorative strategies and information utilization on analysts' judgments and decisions, respectively (see Table 1). The goal of explorative knowledge is the procurement of flexibility and the development of new knowledge and new means of solving problems that the individual or organization encounters (March, 1991). In addition, exploration is related with new procedures used to uncover different interpretations of knowledge assets, organizational processes, tasks, and functions. These include intricate search, fundamental research, discovery, innovation, risk-taking, and reduced control. This leads to the first hypothesis.

<b>Table 1: Processing Routines</b>		
	<i>First Processing Stage</i>	<i>Second Processing Stage</i>
Framing Routines	Explorative strategy/ <b>P←→I</b> Exploitative strategy <b>P→J</b>	Knowledge Utilization  <b>P→D</b>
Information Processing/Analysis	Information Acquisition  <b>I→J</b>	Knowledge Utilization  <b>J→D</b>

**H 1:** Perception of knowledge asset performance information (explorative strategy) by analysts represents a significant coherence of their perceptions with this information.

By contrast, the goals of exploitative knowledge are intended to meet clearly defined and short-term objectives and immediate targets as related to traditional knowledge of a company (March, 1991). Further, it attempts to improve short-run efficiency, reduce slack, and to increase the reliability, accuracy, and precision of selecting a company stock by developing a trend over the years of traditional knowledge about the company. Research on management risk assessments argues that the formation of managers' perceptions depends on the relevance of its investment projects (Miller, 1993). Relevant knowledge asset information facilitates inflows of knowledge into nodes (Schulz, 2003). Investment analysts' ability to understand and represent knowledge asset metrics is structured and constrained by their existing domain experience (Markman, 2001). The "I" in the process model represents traditional financial and knowledge asset information. The ease with which analysts can transform their existing domain structures (P) to accommodate discrepant information presented by knowledge asset information will



largely determine how to judge (J) a company's productivity/profitability (Sloman et al., 1998) before a decision is made (D). This leads to our second hypothesis.

**H 2:** Analysts' perceptions (exploitative strategy) of a given telecommunication management and economic environment will positively influence judgment.

Some researchers (Miner et al., 2001) theorize that new information may affect how analysis is formulated before a decision is made. Further, Brown and Eisenhardt's work (1997) implies a positive impact of new external information on certain types of decision making tasks. Given the importance of knowledge assets in providing firms with leverage in the Information Age, we selected a relatively rudimentary performance measure derived from the knowledge value-added theory (KVA): return on knowledge (ROK) (Housel and Kanevsky, 1995; Rodgers and Housel, 2001). ROK is a ratio resulting from the allocation of revenue to knowledge assets as well as the cost to use those assets to produce firm outputs. The efficacy of this measure, while widely documented (Housel and Bell, 2001; Elliot, 1994), is not the focus of the current study. The focus is on whether the new performance information provides such a measure that will be explored or exploited by seasoned analysts in their decision making. This leads to the third hypothesis.

**H 3:** Information acquisition of (a) projected price earnings ratio, (b) cash flow ratio and (c) knowledge asset performance information (i.e. return on knowledge – ROK) will influence analysts' judgment.

The focus in the second processing stage ( $P \rightarrow D$ ;  $J \rightarrow D$ ) is on knowledge utilization, which refers to knowing the techniques for how to analyze situations based on previous

experience (Wiklund and Shepherd, 2003). In this study, analysis of an investment opportunity in terms of its “projected price earnings ratio”, “cash flow ratio” and “return of knowledge” represents knowledge utilization. Organizations can communicate to investment analysts about their performance using both traditional financial and new knowledge asset performance information. If these resources are deemed to be valuable and relevant to a company’s ongoing performance, a company can provide a sustainable competitive advantage from the sale of its common stock. This leads to the final hypothesis.

**H4:** Investment analysts’ utilization of knowledge asset performance information will have a positive influence on their decisions.

### **3. Methodology**

#### **3.1. Participants**

Data were collected from employees at several investment banking firms in the Gothenburg Sweden area and the southwestern United States. Swedish investment analysts were selected primarily due to Sweden’s proactive use of knowledge asset metrics (Edvinsson and Malone, 1997). In addition, due to organizations engaged in high technology activities in Southern California, investment analysts were selected from this area (Rodgers, 2003). The subjects for this research included 15 professional investment stock analysts from Goteborg, Sweden and 25 professional investment stock analysts from Southern California. Total sample size (responses) was based on repeated measures across the four company cases (60 for the Swedish stock analysts and 100 for the American stock analysts). The average age was 34 years for the

Sweden subjects and 35 for Americans. The average tenure for both groups was 5 years and all were college graduates.

### **3.2. Instrument**

In this quasi-experiment, subjects were required to evaluate four different companies as potential investment opportunities. The questionnaire provided subjects company information consisting of financial statement information, prospective financial information, and core knowledge asset performance information (return on knowledge-ROK). Two of the companies were classified as having positive trending earnings, and two were classified as having negative earnings. The order of presentation of these companies was random across all subjects. The five year company data provided ratios, prospective financial information, ROK information, income statement, balance sheet, and statement of cash flow. For the subjects, ROK was defined as a ratio that measures the revenue attributable to knowledge (k) assets divided by the cost to use the knowledge assets.

We wrote an initial draft of the questionnaire implementing a combination of scales taken from prior studies (Rodgers, 1999) and original questions derived from issues revealed in this study. We then pulled together a reference group consisting of high technology investment managers from several investment-banking firms separate from subjects in this study. This group met twice to discuss the face validity of the questions and any revisions or enrichments that they felt were appropriate of the case scenario materials. This procedure resulted in several modifications to the questionnaire.

Pretests were conducted in Boras, Sweden and Southern California (Rodgers and Housel, 2001). We took great care to translate the instrument in a manner meaningful to

individuals in Sweden. A Swedish native who spoke English as a second language was selected to translate the instrument from English into the native language. One of the authors talked through each question with the native assistant to develop a shared understanding. After the survey was translated, a native English speaker along with a Swedish research assistant translated the instrument back into English. When discrepancies occurred, both the translator and one of the authors met to reconcile the differences.

### ***3.3. Procedure***

The subjects' average time of response completion for the four company case analyses was one hour. The professional subjects were instructed to compare the importance of various information items in forming their decisions about whether a company should receive an investment amount of \$1,000,000.

Research assistants of the authors administered a pretested, self-administered structured survey during work time to employees at the investment banking firms. This personal approach resulted in a 97 percent response rate (only a small number of surveys were refused).

### ***3.4. Construct Operationalization***

All constructs were measured using existing interval scales where possible, and using carefully modified scales where not. Economic and management risk factors in this study related to information that the subjects used for their projections of a company's future performance similar to Rodgers (1999); whereas judgments related to their current analysis of the company's liquidity, profitability, leverage, cash flow, and ROK metrics in

terms of an investment were similar to Rodgers (1992). Table 2 provides a summary of the constructs, the source of the measurement scale, and shows the reliabilities of the scales.

<b>Table 2: Cronbach's Alpha Values for the Three Constructs</b>		
<b>Construct</b>	<b>Scale Measurement &amp; Validity</b>	<b>Source of Scale</b>
Perception	4 items ( $\alpha = .74$ )	Rodgers, 1999
Judgment	5 items ( $\alpha = .67$ )	Rodgers, 1999
Decision Choice	2 items ( $\alpha = .40$ )	Rodgers, 1999
Projected price/earnings ratio	Single item	
Cash flow	Single item	
Return on knowledge (ROK)	Single item	

### **3.5. Model Equations**

The subjects' responses were recorded on an interval scale. The independent variables were financial statement information and subjects' perceptions of economic and management of an Internet infrastructure telecommunication company, while the dependent variables were the subjects' judgments and decision choices.

The following represent the structural model equations for the first stage of processing (see Table 1) of decision making that represent the effects of subjects' perceptions (represented by the manifest variables: P1-P4) of factors affecting the Internet infrastructure telecommunication market space (see link a in Figure 1) and the effect of these perceptions on their judgment (represented by the manifest variables: J1-J5, see link b in Figure 1). The second stage of processing (see Table 1) represents the effects of perception (see link c in Figure 1) and judgment (see link d in Figure 1) on decision choice. The structural equations are:

$$\eta_1 = \beta_1\xi_1 + \beta_2\xi_2 + \beta_3\xi_3 + \beta_4\xi_4\zeta_1 \quad (1)$$

$$\eta_2 = \beta_5\xi_1 + \beta_6\eta_1 + \zeta_2 \quad (2)$$

Interpreted in the context of a multiple regression equation, equation 1 indicates that  $\beta_1$  value for the effect of perception on  $\eta_1$  is the effect of perception after having controlled for  $\beta_2$  (projected price/earnings ratio),  $\beta_3$  (cash flow ratio), and  $\beta_4$  (ROK) variables in the equation. Equation 2 shows the  $\beta_5$  value for the effect of perception on  $\eta_2$  after having controlled for  $\beta_6$  (judgment).  $\zeta_1$  and  $\zeta_2$  represent the residuals of the structural equations.

$\xi_1$  represents subjects' economic and management perception. This latent variable is measured by the following four indicators:

1. Telecommunications technology [i.e., the Internet infrastructure] is improving business and society (P1),
2. Telecommunications industry [i.e., the Internet infrastructure industry] will be a growth area in the future (P2),
3. Management's performance has positively affected the value of the company (P3),
4. Management's ability has positively affected this company's P/E (P4).

$\xi_2$ ,  $\xi_3$ , and  $\xi_4$  are measured in terms of projected price/earnings ratio, cash flow, and ROK.

$\eta_1$  (equation 1) represents subjects' judgments. Also, in equation 2, judgment is represented by  $\eta_1$ . This latent variable of subjects' judgment analysis of a company's information and their evaluation of the investment is measured by five indicators, which represent the firm's (J1) liquidity, (J2) profitability, (J3) riskiness, (J4) cash flow, and (J5) ROK.

$\eta_2$  (equation 2) represents subjects' decision choices, a latent variable that is measured by two indicators: whether to invest into the company (DC1) and conditions of the investment (DC2).

## **4. Results**

### ***4.1. Descriptive Statistics and ANOVA***

Descriptive statistics are given in Table 3. The data were analyzed by a 2 (country: Sweden versus U.S.) x 2 (financial information) x 2 (knowledge asset performance information) mixed ANOVA. Supporting hypothesis 1, a main effect of explorative learning strategies (using knowledge asset performance information) was significant ( $F [1, 38] = 7.46, p = .01$ ; Table 3). Investment ratings were higher for the companies with positive knowledge asset performance information than for the companies with negative knowledge asset information. The interaction between country of investor and financial information was significant ( $F [1, 38] = 3.92, p = .05$ ; Table 4). Contrary to expectations, the difference was due to the stronger effect of financial information on investment decisions for Swedish analysts than American analysts.

**Table 3: Descriptive Statistics****Means, Standard Deviations, and Correlations Among the Variables for Analysts Data, N = 160**

Variables	Mean	SD	P1	P2	P3	P4	J1	J2	J3	J4	J5	DC1	DC2	ProjPE	CashFlow
P1	72.78														
		18.07													
P2	75.07		.756												
		16.33													
P3	58.70		.221	.251											
		23.80													
P4	52.93		.214	.244	.779										
		23.66													
J1	49.46		.113	.073	.235	.196									
		23.75													
J2	51.09		.106	.132	.380	.472	.446								
		24.71													
J3	54.37		-	.049	.096	.122	.110	.182							
		25.16	.016												
J4	56.31		.218	.189	.404	.429	.334	.622	.329						
		23.44													
J5	53.38		.196	.205	.326	.334	.113	.306	.133	.270					
		24.43													
DC1			.002	-	-	-	-	-	-	-	-				
	101.55	53.48		.024	.253	.200†	.116	.320	.003	.311	.038				
DC2			-	-	.061	.010	.003	-	.042	-	-	.247			
	296.52	132.72	.017	.037				.085		.008	.135				
ProjPE			.111	.080	.240	.342	.242	.598	.133	.509	.085	-	-		
	8.16	53.00										.283	.056		
CashFlow			.073	.031	.134	.049	.255	.358	.026	.362	-	-	-	.249	
	5385.00	6621.96									.066	.264	.032		
ROK			-	-	-	-.086	-	-	-	-	.191	.318	.047	-.569	-.607
	198.50	83.79	.136	.110	.019		.317	.431	.052	.436					

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ ; †  $< .10$ .

Notes: P1-P4 denote four manifest variables about perception; J1-J5 denote five manifest variables about judgment; DC1-DC2 denote two manifest variables about decision making. Where P1 = Telecommunications technology [i.e., the Internet infrastructure] is improving business and society; P2 = Telecommunications industry [i.e., the Internet infrastructure industry] will be a growth area in the future; P3 = Management's performance has positively affected the value of the company; P4 = Management's ability has positively affected this company's P/E. J1 = liquidity,



J2 = profitability, J3 = riskiness, J4 = cash flow, and J5 = ROK. DC1 = whether to invest into the company; DC2 = conditions of the investment. Finally, ProjPE=projected price/earnings ratio, Cashflow = firm's cash flow ratio for the year, and ROK = return on knowledge.

**Table 4: ANOVA Results**

Tests of Within-Subjects Contrasts							
Source	FIN	N_FIN	Type III Sum of Squares	df	Mean Square	F	Sig.
FIN	Linear		7224.540	1	7224.540	3.058	.088
FIN * COUNTRY	Linear		9266.940	1	9266.940	3.923	.055
ERROR(FIN)	Linear		89773.460	38	2362.459		
N_FIN		Linear	18117.015	1	18117.015	7.462	.010
N_FIN * COUNTRY		Linear	2658.615	1	2658.615	1.095	.302
ERROR (N_FIN)		Linear	92259.260	38	2427.875		
FIN * N_FIN	Linear	Linear	4061.202	1	4061.202	2.403	.129
FIN * N_FIN * COUNTRY	Linear	Linear	105.002	1	105.002	.062	.805
ERROR(FIN*N_FIN)	Linear	Linear	64233.273	38	1690.349		

Note: FIN denotes Financial information, and N\_FIN denotes Non-financial information (ROK).

#### **4.2. Analysis of the Model**

The generalized least square statistic was used to estimate the models using the computer program LISREL 8 (Joreskog and Sorbom, 1993). The chi-square test disclosed moderate discrepancies between the observed correlation matrix and that implied by the knowledge process model ( $\chi^2 = 150$ , where degrees of freedom = 67). Yet, for the model, the goodness of fit (GFI) index surpassed the threshold of 0.90 and the adjusted goodness of fit (AGFI) surpassed the 0.80 threshold indicating reasonable fits (Bentler and Bonett, 1980).

#### **4.3. Confirmed Model for Professional Analysts**

The interdependency between perception and knowledge asset performance information (ROK) in Figure 1 was tested to corroborate that explorative knowledge was instrumental in analysts' processes. Table 5 indicates that analysts' perception was statistically interdependent with ROK information ( $p < .01$ ). This implies that analysts' recognition of new sources of performance information was related to their framing of the problem.

<b>Table 5: Perception and Information Interaction Effects</b>	
	<b>Perception</b>
PROJECT P.E.	0.11*
CASH FLOW	0.09*
KNOWLEDGE (ROK)	0.08*
* $p < .01$	

Hypothesis 2 was supported in that analysts' perception had a statistically significant ( $p < .05$ ) effect on judgment (Table 6). Apparently, analysts' exploitative knowledge enabled their perceptions to influence their analysis stage (i.e., judgment). Analysts were very adept at building on what was already available. This is, operating within a technological business environment they have their own initial endowment of knowledge that they wish to exploit. Hypothesis 3 was partially supported for information acquisition in that the projected price earnings ratio and cash flow ratio had a statistically significant ( $p < .01$ ) effect on judgment, whereas ROK information did not (see Table 5).

Interestingly enough, subjects appeared not to be able to integrate new knowledge performance information (ROK) along with the traditional information (i.e., projected price/earnings and cash flow) for implementation in the analysis (judgment) stage. Accordingly, new knowledge performance information may have been downplayed when subjects formed their decisions about whether a company should receive investment funding. Hypothesis 4 was partially supported for knowledge utilization in that judgments had a statistically significant ( $p < .01$ ) effect on decisions, while perceptions on decisions were non-significant (see Table 6).

<b>Table 6: Causal Model Parameters</b>	
<b>Regression Weights<sup>1</sup></b>	<b>Process Model</b>

$\gamma_{JP}$	0.53*
$\gamma_{JE}$	0.13*
$\gamma_{JC}$	0.28*
$\gamma_{JK}$	0.01
$\gamma_{DP}$	0.06
$\beta_{DJ}$	0.87*

<sup>†</sup>Where **P**-Perception, **E**-Projected Price Earnings Ratio, **C**-Cash Flow, **K**-Knowledge Asset Performance Information, **J**-Judgment, **D**-Decision Choice. The subscripts associated with regression weights are ordered so that the first subscript signifies the dependent variable, while the second refers to the antecedent variable (or "cause").

\*  $p < .05$

$R^2$  is a rough measure of the amount of variance in the outcome variable that is explained by the two equations. The  $R^2$  for the first equation for the analysts was 0.69. We attribute this high level of variance accounted for in the first equation to explorative knowledge of ROK information as well as exploitative knowledge of traditional information. Whereby for the second equation, the  $R^2$  of 0.08 indicates unfamiliarity with the use and integration of knowledge asset performance information, such as ROK, in their judgments.

## 5. Discussion and Conclusions

Research on the knowledge-based view has focused on knowledge production, however less on knowledge dissemination and impact. This study highlights how analysts' perception and judgment may be influenced by explorative and exploitative knowledge. The knowledge process modeling perspective used in this paper reinforces the importance of different stages in identifying the importance and use of explorative and exploitative learning strategies, information acquisition, and knowledge utilization. For example, analysts recognized the importance of new sources of information since our study demonstrated a statistically significant covariation between perceptions and

knowledge asset metrics. This first stage process helps to illustrate how analysts transfer knowledge (using exploitative strategies) and acquire information in their second stage of processing (i.e., judgment).

Jointly, first stage and second stage processing helps analysts in arriving at a stock selection for their company's portfolio. Organizational development and learning literatures suggest that as organizational practices become ingrained and are repeated, organizations tend to make the most of existing knowledge and capabilities, possibly crowding out variance-increasing, exploratory activities (e.g. Levinthal, 1997; March, 1991). Our research, based on investment analysts' use of old and new knowledge, supports and extends these ideas. That is, we noted that the first stage processing accounted for a large explained variance depicting analysts' integration and identification of explorative and exploitative knowledge for further processing in stage two. Yet, it appears that analysts did not fully understand how to implement explorative strategies in the context of the new knowledge metrics along with other traditional types of financial information in the second stage resulting in a weaker explained variance. This opens the door for the training, education, and employment of future benchmarks for the utilization of explorative and exploitative learning strategies in new knowledge acquisition.

In spite of the fact that our sample of analysts were not trained to use new knowledge asset performance information, they appeared to include this information in their decision making processes demonstrating strong evidence of the use of explorative and exploitative learning strategies. It follows then, that there is truth in the assertion by members of the investment community that analysts want new, non-traditional financial accounting metrics.

The knowledge process model connects quantitative indicators with qualitative measures of organizational knowledge in order to understand knowledge and information impact on decisions. Future research must include the effects of training with the new metrics on analysts' use of such metrics in decision making. Further, such research should consider the inclusion of decision modeling to account for the various paths that analysts follow to make their decisions. Such an understanding will help the investment community determine which metrics are most desired by analysts based on their use of the metrics in actual decision making settings. Finally, the profession should set guidelines for the acceptability of such new metrics in order to meet their obligations to management and analysts for the reliability and validity of such metrics.

### ***5.1. Limitations of the Study***

The metrics reviewed in this study should serve as a very preliminary set for further review and research. The current study had several significant limitations including:

1. The small sample size of expert analysts. Securing the commitment of such professionals to complete study forms is a major imposition on their very limited time for such activities.
2. New knowledge asset performance metrics should be developed that meet the normal reliability and validity requirements of accounting professional standards.
3. This study is limited to decision makers domiciled in Sweden and the United States, so the results might not generalize to other contexts.
4. This study is based on cross-sectional data and thus does not test decisions over time. For such tests, longitudinal data may be more desirable.

## **5.2. Implications**

Future research is required to address the current study limitations. However, the current study has provided an approach to depicting the interactions of explorative knowledge, exploitative knowledge, information acquisition, and knowledge utilization in arriving at a decision. That is, the different types of knowledge and information are divided into several parts in the decision making model and knowledge transfer forms from one stage to knowledge utilization in another stage. The knowledge process model illustrates that the access and transfer of knowledge does not ensure that knowledge will be used. Hence a utilization phase is included in the knowledge process model. Furthermore, the findings of this research highlight the fact investment analysts failed to fully grasp how to implement explorative strategies thus imploring organizations to raise the awareness and competency level of analysts to properly incorporate explorative and exploitative learning strategies in new knowledge acquisition processes. Lastly, this perspective may assist organizations in strategically realizing the objectives of an organization as interwoven in a knowledge process model.

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