

The background of the slide features a large, faint watermark of the Rutgers University seal, which is a circular emblem with a sunburst in the center and the words 'RUTGERS UNIVERSITY' around the perimeter.

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Behavioral Implications of Big Data's Impact on Audit Judgment and Decision Making and Future Research Directions

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Introduction

- Increased use of computerized systems and decreased cost of storage led to generation and capture of large amounts of data.
- While capturing large amounts of data is easy, the process of analyzing it can be problematic.
 - Specifically, the unstructured nature of big data potentially lead to greater challenges for auditors (Alles 2013; Titera 2013).
 - Decision makers have limited ability to process large amounts of information required for complex judgments (Kleinmuntz 1990; Iselin 1988)
 - Auditor judgments are vulnerable to various problems (e.g., Shanteau 1989)
- How can auditors derive value from Big Data and ensure that audit judgments and decisions are based on quality information that is relevant and trustworthy?

Introduction

- Audit judgments can be considered to exist along a continuum where the auditor applies sequential processing in making judgments:
 - Level 1: structured judgment, routine and objective, minimum judgment required (e.g. cut-off)
 - Easier decision process
 - Decision aids related to these types of judgments exists in current practice
 - Level 2: semi-structured tasks, repetitive, moderate level of judgment, high level of agreement among experts on the best approach (e.g. internal control risk assessment)
 - Adds a moderate level of difficulty to the decision process
 - Currently, technology (i.e., rules-based systems) is available to aid auditors with these decisions, but the technology is under utilized or not utilized in audit practice
 - Level 3: unstructured tasks, accounting and auditing standards are highly subjective, high level of judgment, reaching consensus is infeasible (e.g. going concern opinions)
 - Involves the most complexity
 - Tools such as expert systems are potentially best suited to these types of judgments

Motivation

- In general, the ability to collect, manage and analyze data more effectively has the potential to lead to better judgment and decision making.
- However, Big Data has the potential to change the way auditors make decisions (i.e., risk assessments) and collect audit evidence (Moffitt and Vasarhelyi 2013; Issa 2013; Kogan et al, 2011; Vasarhelyi & Halper, 1991)
- Current literature does not address implementation within an existing professional practice and does not consider the standards-driven environment in which auditors must comply (Alles 2013).

Contribution

- Address the current state of Big Data with regards to the audit environment
 - Information processing weaknesses and limitations that can impede the effective use of Big Data in an audit environment, with a focus on:
 - Information overload
 - Information relevance
 - Pattern recognition
 - Ambiguity
 - Examine the audit judgment process in order to explore the potential to formalize these judgments.
 - Focus on Level 2 judgments (semi-structured tasks with moderate judgment) and touches on Level 3 tasks (unstructured tasks)

What is Big Data?

- No unified definition:
 - Data exceeding the level of efficient manageability within traditional data bases (Harris 2013)
 - Process of analyzing a large volume of diverse data, in any variety of form, using ground-breaking apparatus to identify opportunities to improve overall value (Miller 2012; Moore et al. 2013; Wyner 2013)
- Common trait: large population of data
- Components: volume, variety, velocity
- New to accounting and audit industry: no formal means to evaluate it, has not applied it in assessments.

The power of Big Data lies in the ability to find patterns, which drives the way in which Big Data is analyzed (Alles 2013)

Behavioral Implications-Information Overload

- Information overload is experienced at the point where decisions reflect a lesser utilization of the available information (Chewning and Harrell 1988) or potentially useful information received becomes a hindrance rather than a help (Bawden et al. 1999).
 - Complications in distinguishing relevant information
 - Difficulties in recognizing correlation between details and overall perspective
 - Lengthier decision times
 - Disregard for large amounts of information
 - Inaccurate decisions
 - It is not only the amount of information that determines information overload, but also the specific characteristics of information, such as the level of uncertainty associated with information and the level of ambiguity, complexity, etc.
 - Information overload can also be due to the characteristic of the decision maker (e.g., personal skills, experience, etc.)
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- LOW QUALITY
DECISIONS**

Behavioral Implications-Information Overload

- Audit research demonstrates that many of these characteristics (i.e., irrelevant information, ambiguity, experience, time pressure, etc.) can negatively affect auditor performance
- Auditors are not accustomed to having to collect and process large amounts of information during the conduct of an audit
 - They may be limited in their abilities to effectively integrate Big Data into the audit process (e.g., Swain and Haka 2000; Simnett 1996; Chewning and Harrell 1990)

Behavioral Implications-Information Relevance

- The unstructured nature of Big Data might potentially result in the difficulty in choosing relevant data (e.g., Ede 2013; Golia 2013; Hyle 2012; Hall 2012)
- Exposure to excessive information can lead to inability to disregard irrelevant information.
- Attention to irrelevant information has the potential to significantly limit the value that can be obtained from incorporating Big Data into the audit process.
- More irrelevant information reduces the auditor's ability to identify relevant information (distraction) and consequently reduces decision making performance.
- Prior research shows that less experienced auditors are unable to discount irrelevant information (dilution effect), which negatively affects their judgment.
- Semi-structured tasks (moderate judgment) are generally conducted by less experienced auditors, using Big Data becomes more challenging.

Behavioral Implications-Pattern Recognition

- Big Data provides the decision maker with the ability to search for patterns in a large population of data that would otherwise be undetectable in samples or even smaller data sets (Alles 2013).
- Auditor judgment in this area has been shown to be vulnerable to various problems (O'Donnell and Perkins 2011; Nelson 2009; Bedard and Biggs 1991), such as
 - difficulty recognizing patterns of evidence,
 - applying prior knowledge to current judgment task,
 - weighing evidence appropriately,
 - combining information into patterns.
- Less experienced auditors pay less attention when conducting analytical procedures many of the semi-structured tasks (where Big Data has potential of improving judgment)
- Providing auditors with more contextual experience and training will improve their ability to accurately recognize patterns (similar to insurance industry).
 - Systems thinking tools focused on diagnostic patterns of fluctuations

Behavioral Implications-Ambiguity

- Ambiguity may arise from variations in the amount and type of information available, differences in the source reliability and lack of causal knowledge of observed events (Einhorn and Hogarth 1986)
- The unstructured nature of Big Data may create greater information ambiguity which has been found to result in incorrect audit judgments (e.g., Luippold and Kida 2012; Backof et al. 2011; Nelson and Kinney 1997).
- Ambiguities that auditors encounter on an audit engagement affect their ability to accurately interpret evidence

Behavioral Implications-Ambiguity

- Ambiguity intolerant individuals actively seek to reduce uncertainty by focusing on simple solutions, and neglect additional information once a solution is identified (even one that is not optimal).
- In general, ambiguity-intolerant auditors have been found to be less confident about rendering opinions on financial statements.
- Ambiguity intolerant auditors will likely be uncomfortable with the unstructured nature of Big Data and as a result may avoid or downplay ambiguous information which could result in less than optimal judgments.--> decreased overall audit inefficiency (due to ignoring information cues)

Challenges of Auditing Big Data

- Machine readable unstructured nature of the Big Data
- Pattern recognition using unstructured data vs. deriving intelligence from benchmarks and models derived from structured data
- As a result of the increased amount of data, the number of identified exceptions and anomalies are expected to increase dramatically.
 - Big Data potentially aggravates the problem that already exists with traditional data, where auditors are inundated with such identified exceptions.
 - Consequently, the analysis and examination of these exceptions lies on the shoulders of the auditors, whose human limitations lead to decreased overall audit efficiency (Issa, 2013; Alles et al. 2006, 2008).
- Lack of adequate training and necessary skills to analyze Big Data
- Increasing complexity of Big Data leads to increased cost for companies (hiring data scientists and investing in additional software)
- Some analytical tools are like a black box to auditors (e.g. Neural Networks)

Big Data Analytics

- The right tools and skills can help the auditor take advantage of Big Data, such as
 - Predictive analytics
 - Data visualization
 - Text mining
 - Dashboards (real-time analytics)
 - Data warehouses and DBMS
 - Expert systems
- Technology is available and being used by other industries
 - Audit firms should look to some of these companies to evaluate how they may be able to leverage these technologies to integrate Big Data in the audit process.

Future Research

1. *What mental models are necessary to help auditors build knowledge structures that will allow them to more effectively process and evaluate more complex data? How can these knowledge structures be developed?*
2. *Similarly, how do auditors map unstructured information into their risk assessments? Will this information even influence risk assessments?*
3. *Are less experienced auditors (i.e., the millennial generation) better prepared to integrate Big Data into their judgment process?*
4. *What strategies do individuals use in analyzing and evaluating large quantities of information?*
5. *What are the types of training interventions that can be utilized to mitigate inaccurate judgments?*
7. *What analytical tools are applicable for auditors and more likely to be used by auditors?*
8. *How should the accounting curriculum be extended to provide future auditors with the necessary skills to deal with Big Data?*