

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

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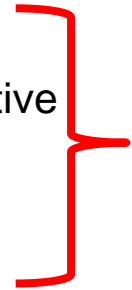
Contribution

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
- Challenges in auditing Big Data
- Questions for future research

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 & 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.)



**LOW QUALITY
DECISIONS**

Behavioral Implications-Information Relevance

- The unstructured nature of Big Data might potentially result in the difficulty in choosing relevant data (Costonis 2012; Davenport et al. 2012; Golia 2013; Hyle 2012; Hall 2012; Ede 2013)
- Exposure to excessive information can lead to inability to disregard irrelevant information.
- 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, which negatively affects their judgment.
- Semi-structured tasks (moderate judgment) are generally conducted by less experienced auditors, using Big Data becomes more challenging.
- Attention to irrelevant information has the potential to significantly limit the value that can be obtained from incorporating Big Data into the audit process.

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).
- Big Data analyses Correlations vs causation (patterns)
- Auditor judgment in this area can 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 in auditing (where Big Data has potential of improving judgment) are generally conducted by such auditors.
- Providing auditors with more contextual experience and training will improve their ability to accurately recognize patterns (similar to insurance industry).

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)
- Unstructured data may be viewed as ambiguous and information ambiguity has been found to result in incorrect audit judgments (e.g., Luippold and Kida 2012; Backof et al. 2011; Nelson and Kinney 1997).
- 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).
- Ambiguities that auditors encounter on an audit engagement affect their ability to accurately interpret evidence

Behavioral Implications-Ambiguity

- 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, leading to decreased overall audit efficiency (due to ignoring information cues)
- The use of data analytic tools can help auditors overcome ambiguity-related cognitive limitations.

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, Debreceeny et al. 2003).
- 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), leading to decreased popularity.

Future Research

Major Findings	Selected Questions for Future Research
<p><u>Auditor Characteristics Skills</u></p> <p>1. Individuals tend to consider only the information that is explicitly represented in their <u>mental models</u> in decision making and more elaborate mental models facilitate acquisition and processing of information cues (Legrenzi et al. 1993; Legrenzi and Girotto 1996).</p>	<ul style="list-style-type: none"> • 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? • Similarly, how do auditors map unstructured information into risk assessments? Will this information even influence risk assessments?
<p>2. Research demonstrates that <u>domain and task experience</u> accounts for different cognitive processes used by auditors (Libby and Tan 1994; Bedard and Biggs 1991b; Bonner and Lewis 1990).</p>	<ul style="list-style-type: none"> • Is this effect evident in environments where there are significant amounts of data? • What are the effects of experience, if any? • Along the lines of experience, are less experienced auditors (i.e., the millennial generation) better prepared to integrate Big Data into their judgment process? In other words, are they more comfortable with information overload and ambiguity because they have grown up in the age of more advanced technology and they are big users of social media?
<p><u>Information Processing</u></p> <p>3. In order to deal with too much information a decision maker <u>may stop searching once a satisfactory solution</u> has been found; i.e., the satisficing heuristic (Buchanan and Kock 2001).</p>	<ul style="list-style-type: none"> • What strategies do individuals use in analyzing and evaluating large quantities of information? Think aloud verbal protocols can be employed to gather evidence about the auditors' reasoning and judgment process in the Big Data context. • What successful strategies can be leveraged from strategic systems auditing (i.e., top down approach) to assist auditors in the integration of Big Data in the audit process? As an example, Brazel et al. (2007) find that consideration of both financial and non-financial performance measures result in an auditor's increased ability to predict fraudulent activities.

Future Research

Major Findings	Selected Questions for Future Research
<p><u>Training and Development</u></p> <p>4. Lombardi and Dull (2013) develop an expert system to help less experienced auditors filter out irrelevant information in a fraud risk assessment task. Can a similar system be used to improve auditors' ability to more effectively recognize patterns or discount irrelevant information in large data sets?</p>	<ul style="list-style-type: none"> • What are the types of training or decision aid interventions that can be utilized to mitigate inaccurate judgments? • How should the accounting curriculum be extended to provide future auditors with the necessary skills to deal with Big Data? • What skills should the audit engagement team now possess? Since audits are conducted by teams of auditors (both experienced and less experienced), the overall skill sets of the audit teams and roles of the members will likely need to change to fit the new mold to incorporate Big Data. For example, cross functional and interdisciplinary audit teams (e.g., IT specialist, statisticians, etc.) may take on greater importance.
<p><u>Technology</u></p> <p>5. As audited financial statements are becoming more predictive in nature (i.e., fair value measurement) as opposed to just historical data, utilizing already available technologies (i.e. decision aids such as expert systems) from other industries, and adapting them to the audit industry may aid evaluating and assessing Big Data. Lombardi (2012) demonstrates that through the use of an expert system, adapted from the medical profession, fraudulent financial reporting could be mitigated with Big Data.</p>	<ul style="list-style-type: none"> • What predictive models currently used by other industries (i.e., insurance industry) are relevant for use by audit firms? • What analytical tools are applicable for auditors and more likely to be used by auditors? A study similar to the study conducted by Russom (2011), as well as a field study interviewing practitioners could be initiated to gain a better understanding of practitioner needs and potential roadblocks to the use of technology such as predictive analytics to examine the analytical tools that prove applicable and more popular to auditors. Additionally, research can also examine auditors' adoption of such new analytical tools following various technology acceptance models. This direction may lead to additional research that would propose improved analytical tools specific to the auditing area. Such improved tools should support the evidence collection requirements of the audit profession.



Thank You!