A REVIEW OF BIG DATA RESEARCH IN OPERATIONS MANAGEMENT

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METHOD

BACKGROUND

□Operations management research seeks to develop a bridge between theory and practice (Öhman, 2019; van Aken, Chandrasekaran, and Halman, 2016).

BDR should align with this goal

□Big data research (BDR) refers to research studies that adopt large and heterogeneous datasets represented in multiple formats (qualitative, quantitative, video, image, audio, etc.) and explores large datasets with computationally intensive analysis techniques (Grover, Lindberg, Benbasat, and Lyytinen, 2020).

□ BDR in OM takes advantage of voluminous amounts of data in real time leading to effective and efficient decisions in organizations

Uthere is an increased interest in BDR from both OM researchers and practitioners (Lamba and Singh, 2017).



MOTIVATION

Several scholars have questioned the value of BDR (Sudhir, 2016; Davis, 2015; Simsek et al., 2019).

- Recently, scholars noticed the need to avoid unintended consequences of BDR (Grover et al, 2020).
 - Lested five conjectures on data collected on BDR and non-BDR empirical articles from the top three IS journals.
 - BDR can steer a field towards computationally intensive analysis techniques and evidence, rather than theory development and discipline relevance.

Similarity between information systems (IS) and OM makes it appropriate to investigate BDR concerns expressed in IS in OM (Otondo, 2019).



RESEARCH QUESTION

RQ1: Are there significant differences between BDR and non-BDR in OM in terms of theory development, hypothesis testing and research focus?

RQ2: Are the differences between BDR and non-BDR in OM similar to IS?



BDR EMBRACED IN OM

- BD provides firms with data openness and transparency at intrafirm and interfirm level enabling the holistic perspective about firms' internal and external processes (Liu et al., 2018).
 offers effective and efficient systems connectivity-focused solutions to OM research field such as ERP systems.
- Evidence shows that firms that incorporate BD to their resource portfolio have increased productivity and profitability by 5-6% (Hazen et al., 2018), among 10% of improvement in operations such as fulfilling demand and supply chain efficiency (Talwar et al., 2021).

□BDR is a resource that OM researchers have embraced for the digitalization of multiple operations and supply chains.



Firms can develop tactical decision making with proper massive data management on inventory quantities, procurement, production, pricing, and sales (Hogenboom et al., 2015; Shi, Wang, & Alwan, 2020).

□BDR in OM has been utilizing large amounts of dataset to improve supply chain network design, retail operations, and inventory management (Guha and Kumar 2017).

Current non-BDR in OM focuses mainly on abstract models that can provide a false sense of precision and might be negligible when compared to the imprecision of the original abstraction (Ferguson & Speier-Pero, 2017).

BDR will exhibit a tendency to address tactical problems while non-BDR will exhibit a tendency to address abstract problems in OM research



□BDR is diverging especially in the domain of operations and supply chain management where the research lacks a cumulative theoretical framework (Lamba and Singh, 2017).

Classic OM research covers fundamental issues in manufacturing and service operations (Guide & Ketokivi, 2015).

BDR will result in widespread local diversity in research, while non-BDR will focus on punctual issues towards cumulative traditional in OM research.



BDR in OM is still in its nascent stage and lacks contribution in terms of theory for implementation of Big data (Lamba and Singh 2017).

OM research relies on a broad base of theories including economic (e.g., transactional cost economic), micro-organization (e.g., organization behavior), and macro-organization (e.g., institutional theory, resource based-view, structural contingency theory) (Guide & Ketokivi, 2015).

BDR lacks theory

BDR will exhibit a bias toward desultory treatment of theory while non-BDR will rely strongly in theoretical underpinnings in OM research.



BDR focuses on localized dataset and advanced analytic capabilities

■BDR researchers emphasize the uniqueness of the methodological section and size of the datasets to demonstrate the performance of their algorithms (Grover et al. 2020).

□approach may reduce the importance of theoretical knowledge that is usually associated with the Non-BDR articles.

■Non-BDR papers may test existing theories or apply techniques developed in econometrics, statistics, computer science and Information systems using novel datasets (Ferguson & Speier-Pero, 2017).

BDR will tend to focus on data and methods, as opposed to theoretical knowledge associated with the Non-BDR in OM research.



PROCEDURE AND SAMPLE

❑ We collected data from three top OM journals: Decisions Science (DS), Journal of Operations
 Management (JOM) and Production and Operations Management (POM) (Ferguson &
 Speier-Pero, 2017; Guide & Ketokivi, 2015).

used the following keywords: big data research, empirical analysis, theory, machine learning, and data analytics.

□ collected 85 BDR and 85 non-BDR papers

□ 33, 26, and 26 BDR research papers in DS, POM, and JOM respectively .



PROCEDURE AND SAMPLE

The non-BDR set was randomly selected and equally matched the number of papers collected from each journal.

- **both BDR and non-BDR papers as empirical**
- excluded conceptual papers.
- each article in the sample was read in detail and coded, following guidelines used in Grover et al. (2020) to ensure validity and reliability of the coding process.
- two coders experienced in IS research and one in OM (the authors) each coded the BDR and non-BDR papers independently and discussed any discrepancy or difference between coding technique used.



ANALYSIS APPROACH

Aspect	Measure	Measured variables	Unit of measurement	Provides Evidence for:	
Phenomenon	What is the phenomenon being studied? Is it tactical (narrow), i.e., a practical problem? Or is it an abstract (theoretical) issue that transcends the specific context?	Tactical / Abstract	Number of research articles	Conjecture #1	
		Back pages (discussion and conclusions) (average)	Number of pages		
Link to Literature	What is the relative investment in terms of pages in describing method/findings vs. prestudy setup and discussion of findings?	Total pages (average)	Number of pages	Conjecture #2	
		Mid-pages (method & findings sections) (average)	Number of pages		
Theory	Is there testing of hypotheses? Is there merely passive application	Hypothesis testing / No hypothesis testing	Number of research articles		
	of received theory (instantiation)? Or is there theoretical development (modification or extension of theory)?	No theory development / Theory development	Number of research articles	Conjecture #3	
		Front pages (introduction and theory sections) (average)	Number of pages		
Technique	What is the proportion of the number of pages allocated to	Back pages (discussion and conclusions) (average)	Number of pages	Conjecture #4	
	method and results?	Mid-pages (method & findings sections) (average)	Number of pages	conjecture #4	



RESULTS

Results Contrasting BDR with Non-BDR Studies								
Variables	No. of papers or pages		% of papers		BDR vs non BDR in OM analysis		BDR vs non BDR in IS analysis (Grover et al, 2020)	
	BDR	Non-BDR	BDR	Non-BDR	Statistical test	Conclusion	Statistical test	Conclusion
Tactical / Abstract	56/29	29/56	66/34	34/66	X2 = 17.153, df = 1, p < 0.01	Significant	X2 = 14.17, df = 1, p < 0.01	Significant
Hypothesis testing / No hypothesis testing	32/53	46/39	38/62	54/46	X2 = 4.643, df = 1, p < 0.05	Significant	X2 = .78, df = 1, p = .38	No Significant
Front pages (introduction and theory sections) (average)	5.147	5.347	-	-	t =589, df = 84, p = 0.558	Not Significant	t =84, df = 78.44, p = 0.41	Not Significant
Mid-pages (method & findings sections) (average)	11.182	9.729	-	-	t=2.581, df=84, p=0.012	Significant	t = 3.19, df = 79.98 p < 0.01	Significant
Back pages (discussion and conclusions) (average)	2.629	2.594	-	-	t = .123, df = 84, p = 0.903	Not Significant	t = -1.70, df = 77.98, p = 0.09	Not Significant
Total pages (average)	20.212	18.935	-	-	t = 1.869, df = 84, p = 0.065	Not Significant	t = 2.22, df = 76.86, p = 0.03	Significant
No theory development / Theory development	61/24	39/46	72/28	46/54	X2 = 11.754, df = 1, p < 0.01	Significant	X2 = 5.75, df = 1, p =0.02	Significant



DISCUSSION (RQ1)

Conjecture	Supported?	Comment
BDR will exhibit a tendency to address tactical problems while non-BDR will exhibit a tendency to address abstract problems in OM research	Yes	- BDR papers in OM are data-driven and tactically focused
BDR will result in widespread local diversity in research, while non-BDR will focus on punctual issues towards cumulative traditional in OM research.	Partially	- Other than methodology, both BDR and non-BDR devote similar attention to traditional conceptual issues and discussion of results.
BDR will exhibit a bias toward desultory treatment of theory while non-BDR will rely strongly in theoretical underpinnings in OM research.	Yes	- BDR papers devote less attention to hypothesis testing and theory development
BDR will tend to focus on data and methods, as opposed to theoretical knowledge associated with the Non-BDR in OM research.	Partially	 BDR papers emphasizes more on data and methods sections Both BDR and non-BDR devotes similar attention to the discussion of concepts and findings



DISCUSSION (RQ2)

Conjecture	Similar?	Comment
BDR will exhibit a tendency to address tactical problems while non-BDR will exhibit a tendency to address abstract problems in OM research	Yes	- BDR papers in both OM and IS are tactically focused.
BDR will result in widespread local diversity in research, while non-BDR will focus on punctual issues towards cumulative traditional in OM research.	Yes	- BDR papers in both fields devote similar attention to traditional conceptual issues, methodology and discussion of results.
BDR will exhibit a bias toward desultory treatment of theory while non-BDR will rely strongly in theoretical underpinnings in OM research.	Yes	 Unlike OM, BDR papers in IS devote attention to hypothesis testing. However, BDR papers in both fields do not emphasize theory development.
BDR will tend to focus on data and methods, as opposed to theoretical knowledge associated with the Non-BDR in OM research.	Yes	 BDR papers in both fields emphasize more on data and methods sections devote similar attention to the discussion of concepts and findings



CONCLUSION

Big data analytics is critical in modern operations management (OM)

The current interest in big data has generated the widespread impression that such methods can solve most problems without the need for conventional scientific methods of inquiry

BDR concerns in IS are manifesting in OM

□It is vital to use theory as a guide to design for maximal efficiency of data collection and to produce reliable predictive models and conceptual knowledge (Coveney et al. 2016; Grover et al. 2020)

The field of big data is important to OM but its impact is diminished without theory.



THANK YOU

