Business Intelligence and Analytics Research: A Peek Inside the Black Box

Gregory S. Richards, University of Ottawa, Ottawa, Canada

ABSTRACT

The tremendous growth of data of all forms has led to an increase in research on the uses and outcomes of Business Intelligence and Analytics (BI&A). Much of the current research however, focuses on the technological aspects. The process of decision making with data is treated more or less like the proverbial black box. If one is to better understand how BI&A can help managers make informed decisions, then more effort is needed to explore the decision making process. This paper argues that decision-making in organizations is enacted by a sociotechnical system in which human information processing forms the key constraint. By considering the stages of cognition and the use of rules-based versus heuristic-based decision making, the paper identifies a number of core questions related to the contribution of a BI&A system to the decision making process in organizations.

KEYWORDS
Analytics, Business Intelligence, Cognitive Processing, Decision-Making, Sociotechnical Systems

INTRODUCTION

Despite the recent growth in Business Intelligence and Analytics (BI&A) research, few papers explore the socio-technical implications involved in making decisions with data. Cognition-based approaches to BI&A have been discussed (Niu, Lu, & Zhang, 2009), and the logic of designing information systems based on the needs of the decision maker has a long tradition in the information systems literature (Ackoff, 1967; King & Cleland, 1975). Still, current research has generally focused on the technological aspects of BI&A (Davenport, 2010; Kowalczyk & Buxmann, 2014). If organizations are to benefit from the wealth of data being created daily, the process of data-driven decision-making needs to be more fully explored (Cao, Duan, & Li, 2015; Holsapple, Lee-Post, & Pakath, 2014; Kowalczyk & Buxmann, 2014). This process typically includes multiple individuals, a mix of personal and organizational goals, connectivity with external events, and rapidly changing situations. Although ample research exists on the technologies involved in manipulating the data (Arnott & Pervan, 2008), and more recently, the question of the outputs of BI&A has been addressed (e.g., Cao, Duan, & Li, 2015), the decision-making process itself has been treated more or less like the proverbial black box.

This paper explores lines of inquiry that would provide useful insights into the socio-technical aspects of BI&A. It first discusses decision-making with data drawing on the rules-based versus heuristics literature and then addresses the cognitive processes involved in making decisions with data to finally draw conclusions about productive avenues of BI&A research.
DECISION MAKING WITH DATA: A PROCESS OF INFERENCE

The commonly accepted model in much of the BI&A research appears to be that humans, despite their limited information processing capabilities and the socially constructed power struggles that accompany life in organizations, consume the output of information systems to make informed and therefore more effective decisions. We have known for some time about the limits of human information processing capacity (Simon, 1955), and so the assumption of a purely rational decision-making process that underlies much of BI&A research is likely untenable.

Decision making with data is based on inferences drawn from cues in the data set (Chater, Tenenbaum, & Yuille, 2006). The drawing of inferences relies on inductive reasoning, which has been classified into either automatic (heuristic-based) or the more familiar rational choice model that uses rules-based processes (Ferreira, Garcia-Marques, Sherman, & Sherman, 2006). The heuristic-based approach involves pattern matching: the decision maker recognizes cues and the associated responses reflective of similar previous situations. The cues more or less trigger an automatic response selected from the range of recalled responses. In fact, the proponents of Naturalistic Decision Making (NDM) have argued that while rules-based model might apply in some situations (Klein, 2008), in the real world, most complex decisions are actually made through this process of pattern matching.

The components to be matched include organizational or individual goals, critical cues, expectancies and typical actions (Klein & Klinger, 1991). For relatively simple decisions, this pattern-matching process is very quick. In this case, the situation is immediately recognized and a match to previous decisions is quickly found. The decision maker simply implements actions similar to those applied in the past.

For more complicated situations, Klein (2008) argues that the match between the current and previous situation is evaluated through a “mental simulation” that evaluates the likelihood of success of the action taken in the past. If the evaluation is positive, the decision is implemented. If not, modifications are made and a second round of evaluation occurs. For highly complex decisions, the decision maker evaluates the similarity of the situation relative to those stored in memory, determines if more information is needed, assesses the degree to which expectancies are similar or different, and when a course of action is selected, conducts the mental simulation to evaluate the potential outcomes (Klein & Klinger, 1991).

The process of NDM has been studied under emergency conditions such as firefighting and military manoeuvres. These conditions are characterized by ill-defined goals, uncertainty, ambiguity, time stress, high stakes and multiple players, and most importantly, experienced decision makers. The latter characteristic is understandable because the matching process requires that the decision maker has prior experiences stored in long term memory (Klein & Klinger, 1991). Whether NDM applies in managerial decision-making contexts where time pressures might not be as evident, and where a number of decision makers each with varying levels of experience are present, is a question to be further explored.

In contrast to NDM, rules-based processes are based on rational choice contextualized within a framework of organizational goals. A number of different approaches are possible. For example, in multi attribute utility analysis the decision maker defines the problem, generates a wide range of solutions, identifies criteria for evaluating potential solutions, and finally rates each alternative using some weighting scheme to find the best option (Klein & Klinger, 1991). Decision trees represent another rule-based process that considers the probability of certain outcomes for each node in the decision process. One of the key challenges with this approach is that bounded rationality (Simon, 1955) kicks in: people struggle with defining problems clearly, they often cannot generate alternatives that cover the full range of possibilities, and they will tend to make final decisions under such time pressure that optimal outcomes are rarely achieved.

Whether NDM or rules-based approaches are used, not all humans are endowed with equal capabilities for drawing inferences from disparate pieces of data. In addition, important decisions in
Copula-Based Multivariate Time Series Models
www.igi-global.com/chapter/copula-based-multivariate-time-series-models/107256?camid=4v1a

Towards Private-Public Research Partnerships Combining Rigor and Relevance in DWH/BI Research: The Competence Center Approach
Anne Cleven, Robert Winter and Felix Wortmann (2010). International Journal of Business Intelligence Research (pp. 60-71).
www.igi-global.com/article/towards-private-public-research-partnerships/43682?camid=4v1a