Decision Support Systems and Data Science

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INTRODUCTION

Decision support systems (DSSs) are a sub-set of information systems that support human decision-making through computerized systems that provide contextual information. DSSs allow decision-makers to improve their strategic planning and management control. (Yong & Taib, 2009). With the continual expansion of big data (Bihl, Young II, & Weckman, 2016), the expansion of DSSs at the consumer to enterprise level and the increasing demands of senior leaders for an "end-to-end set of information capabilities" (Shelton, 2000), DSS' need and use will continue to expand and grow. This will become an integral part of the data and information environment involving storing the data and information in a database/structure, understanding the information within a given model and presenting it to the user (user interface).

DSSs can be applied in a variety of areas to assist decision-makers as in controlling inventory, assessing consumer behavior, scheduling, forecasting, safety, planning, and risk assessment (Turban, Aronson, & Liang, 2008). From a business standpoint these systems have a wide-range of applications including political analysis (Berg & Rietz, 2003), investigating social implications (Turoff, Hiltz, Cho, Li, & Wang, 2002), medical/clinical decision making (Shaffer & Coustasse, 2012), developing educational programs (Tatnall, 2007), understanding consumer behaviors (Koufaris, Kambil, & Labarbera, 2001), cyber defense (Gutierrez et al., 2018), modeling and simulation result interpretation (Bihl et al., 2009, 2020), evaluating military decisions (Klimack, 2002), assessing environmental policies (Poch et al., 2004), forecast demand (Efendigil, Onut, & Kahraman, 2009), predict stock performance (Kuo, Chen, & Hwang, 2001), and understand power system loads (Santana, et al., 2012). DSSs can further be used as part of a simulation environment, Figure 1, wherein the DSS provides insights into the simulation of a larger system (Bihl et al., 2009). More recently, with the rise of artificial intelligence (AI) and concerns of the black-box nature of AI, DSS interfaces have become of interest to explain AI decisions and inferences (van der Waa et al., 2021; Wanner et al., 2020).

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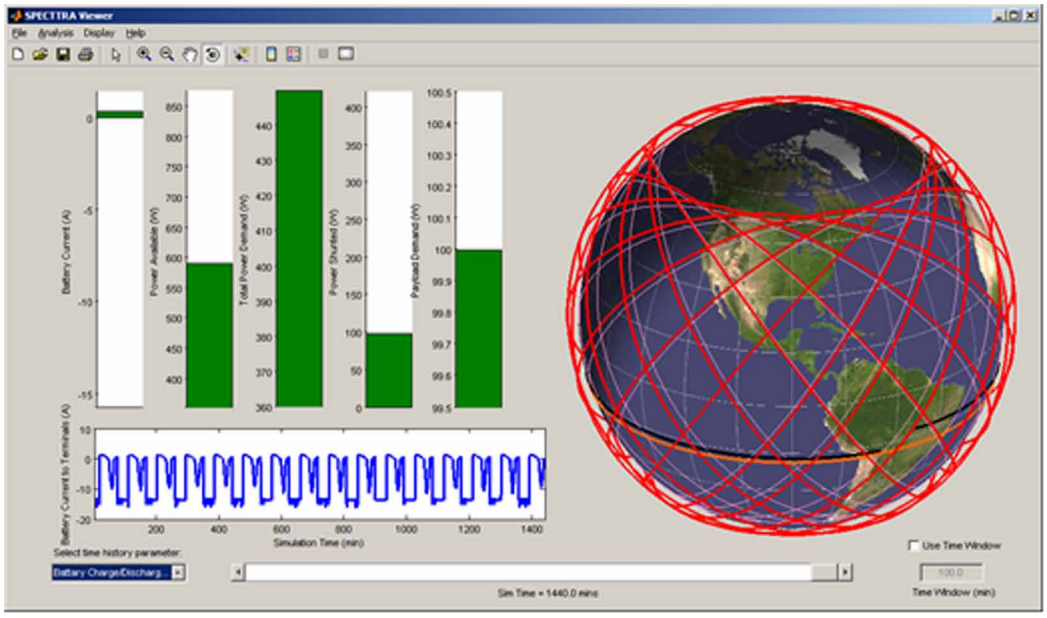
Figure 1. Example of a DSS for a satellite power simulation system, the SPECTTRA Viewer from (Bihl et al., 2009)



DSS usage, design and development have expanded to near ubiquity with the emergence of business analytics; includes internet listservs, web directories, and Google searches (Lankton, Speier, & Wilson, 2012). This has expanded in the 2010s to include dashboard applications which are embedded in web-pages (O'Brien & Stone, 2020). This expansion and use of DSSs became evident in the public sphere in the COVID-19 pandemic whereby a multitude of DSS systems became available online (Lan et al., 2021), an example of which is presented in Figure 2.

Though there are many types of DSS, considerable value will be gained from DSS that are based on business analytics and optimization strategies (i.e., model driven DSS). The increased application and use of DSS is attributed to the ability to rapidly collected data, perform timely data processing and analysis, continual increases in computing power, and modern software packages which reduce expertise required to developing robust mathematical models. The objective of this chapter is to build upon the work in (Bihl, Young II, & Weckman, 2014) and provide readers with a general background of DSSs, considerations, and their business applications. The intended target audience are those readers who are unfamiliar with DSSs. To provide a starting point for readers, the authors begin this chapter by describing foundational concepts that relate to DSS. The primary focus of this chapter is an overview of the importance and applications of DSSs, model-driven testing practices in the form of verifying and validating DSSs, and evaluation methods. The review of these topics is paramount to avoid the misunderstanding or misuse, of the data and the DSS which result in the reduced utility and benefit of the DSS. Finally, the authors list and describe various applications of DSS to specific data science endeavors for further reading.