Patterns of business intelligence systems use in organizations

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1. Introduction

Business intelligence (BI) is often used as the umbrella term for large-scale decision support systems (DSS) in organizations. BI is currently the largest area of IT investment in organizations and has been rated as the top technology priority by CIOs worldwide for many years. The most important use patterns in decision support are concerned with the type of decision to be supported and the type of manager that makes the decision. The seminal Gorry and Scott Morton MIS/DSS framework remains the most popular framework to describe these use patterns. It is widely believed that DSS theory like this framework can be transferred to BI. This paper investigates BI systems use patterns using the Gorry and Scott Morton framework and contemporary decision-making theory from behavioral economics. The paper presents secondary case study research that analyzes eight BI systems and 86 decisions supported by these systems. Based on the results of the case studies a framework to describe BI use patterns is developed. The framework provides both a theoretical and empirically based foundation for the development of high quality BI theory. It also provides a guide for developing organizational strategy for BI provision. The framework shows that enterprise and smaller functional BI systems exist together in an organization to support different decisions and different decision makers. The framework shows that personal DSS theory cannot be applied to BI systems without specific empirical support.

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the firm. At senior managerial levels, it is the input to strategic and
tactical decisions. At lower managerial levels, it helps individuals to do
their day-to-day job.” (p. 189). Audzevyea and Hudson [8] argued in
their study of BI benefits that “Key organizational benefits of BI ... in-
clude better management decisions at both middle management and
strategic levels and support for the accomplishment of strategic busi-
ness objectives.” Arnott and Pervan [7] as part of a critical analysis of
25 years of general DSS research examined the level of decision tasks
addressed in BI research. They found that 22.5% of BI research concerned
strategic decision tasks. Isik et al. [35] reported “many companies cur-
cently utilize BI primarily for structured decision making based on inter-
nal data” (p. 14). Collectively this means that, to some extent, BI aims to
address many types of decision making in organizations.

Based on this discussion, the phenomenon of interest of this project
is the pattern of use of BI systems in organizations. The unit of analysis is
a BI system, a large-scale IT artifact that supports decision making in or-
organizations. The formal research question that guided this project is
“What are the patterns of BI systems use in organizations?” The paper
is organized as follows: first, the theory background and the design of
the secondary case study research is described. Case study research in-
volving eight BI systems is then described and analyzed. From the
cross-case analysis a framework for the pattern of BI systems use in or-
organizations is developed. After considering the limitations of the re-
search, the paper concludes with a discussion of the academic and
professional implications of the research.

2. Theory background

To explore the patterns of BI systems use, two groups of theory were
used. The first is the seminal framework of Gorry and Scott Morton. The
framework led to the development of the DSS field and is still influential
in DSS and BI research. The second theory background is the dominant
temporary approach to understanding human decision-making from behavioral economics. This is followed by a note about the transfer of
theory between DSS types and the nature of frameworks in IS theory.

2.1. The Gorry and Scott Morton framework for decision support systems

Defining management processes and decision-making tasks in three
level typologies has been a persistent theme in business research since
the 1960s. These typologies have attained paradigm status and are
often used without citation (for example, [1,2,63]). The most popular
management process typology is Anthony's strategic planning/manage-
ment control/operational control continuum [3]. According to Anthony
and Dearden [4] strategic planning is the process of deciding on the
goals of the organization, the resources needed to attain these goals,
and the policies for acquisition and use of these resources; management
control is the process by which managers assure that resources are ob-
tained and used effectively and efficiently in the accomplishment of the
organization’s goals; and operational control is the process of assuring
that specific tasks are carried out effectively and efficiently. The process
typology is not isomorphic with management tiers but is in a sense re-
lated. For example, an executive who is at the highest level of an organi-
zation can tackle strategic and tactical tasks and use a range of
operational and management control processes. However, the general
argument is that the higher that a manager is in an organization the
more likely they will be to use strategic planning processes and make
strategic decisions. Anthony's typology is widely accepted in business
research and critiques are rare. An exception is Langfield-Smith [47]
who argued that in terms of management accounting “the artificial
boundaries between, operational, managerial and strategic control, as
initially described by Anthony [3], may no longer hold.” (p. 209). Most
IS researchers view Anthony's typology as a continuum rather than dis-
crete categories.

The three-level typology of decision tasks that has reached paradigm
status is Nobel Prize winner Herbert Simon’s phase model of decision-
making [67,68]. The phase model views decision making as taking place in three staged, iterative and recursive processes of intelligence
(gathering data), design (arriving at alternative solutions), and choice
(choosing the best alternative). An important part of the phase model
is the concept of decision structuredness. A totally structured decision
is one where all decision phases can be specified; a totally unstructured
decision is one where no aspect of the decision phases can be articulat-
Lying on a continuum between structured and unstructured deci-
sions are semi-structured decision tasks that exhibit varying degrees
of structure or clarity of definition and understanding.

The seminal article of the general DSS discipline is the 1971 paper A
Framework for Management Information Systems by Anthony Gorry
and Michael Scott Morton. Their framework was based on a combination
of Anthony's management process and Simon's decision structuredness
typologies and is shown in Fig. 1 ([28], p. 62). The tasks below the dotted
line in Fig. 1 have decreasing levels of structure and Gorry and Scott
Morton termed the IS that can support these tasks “decision support
systems”. Above the line they typified IT support as structured opera-
tional IS; today many of these would be regarded as DSS. The important
implication is DSS can support most of the cells in the framework. Fur-
ther, they argued that over time, with increasing research and practice,
the line would move down the figure as semi-structured tasks become
structured. In Fig. 1, structured operational control tasks are the easiest
for an IT professional to conceptualize and then develop systems to sup-
port. Keen and Scott Morton [41] suggested that unstructured tasks, es-
pecially the bottom right hand side of Fig. 1, are mainly supported by human
intuition. Kirs et al. [44] provided an experimental validation of the
Gorry and Scott Morton framework that, at the time, justified the
framework's seminal position.

Gorry and Scott Morton's framework is one of the most important
contributions to DSS research and with 2233 citations1 it is one of the
most cited papers in all IS research. Fig. 2 shows citations of the frame-
work over time and the most interesting aspect of the figure is that the
1971 framework is more popular with researchers today than when it
was published. The DSS framework has attained paradigm status and is
often used uncritically as the basis of recent research. For example,
Isik et al. [35] in developing their project's hypotheses relate: “Gorry
and Scott Morton's [28] framework of management information sys-
tems is a well-established, theoretically grounded representation of
the decision environment.” (p. 16).

The main issue with the Gorry and Scott Morton framework is the
validity of Simon's phase model of decision making – the source of the
vertical axis of the framework. Simon’s phase model was developed in
the 1940s and Simon’s is a different kind of scholarship to current busi-
ness research; most of Simon's publications would now be classified as
conceptual studies. The nature of business and behavioral science re-
search is radically different today and the standards of rigor and validity,
and the statistical techniques that are currently used, did not exist when
Simon developed his theory of decision-making. The problem is as
Lipschitz and Bar-Ilan [49] relate “Considering the variety and ubiquity
of phase models, it is surprising to find that the empirical evidence for
their descriptive and prescriptive validity is very slim.” (p. 48). Lipschitz
and Bar-Ilan conducted experimental research that found disconfirming
evidence for the phase model's prescriptive validity and only weak sup-
port for its descriptive validity. The conclusion from the empirical test-
ing of the phase model is that it lacks the necessary scientific validity
to be part of an important and influential framework like Gorry and
Scott Morton’s. Another issue with the Gorry and Scott Morton frame-
work is that, like Simon’s research on decision making, it is a conceptual
study and the assignment of decision tasks and systems in the frame-
work was based on opinion, rather than on empirical research.

1 Google Scholar, February 2017.
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