Integration of decision support systems to improve decision support performance

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Abstract Decision support system (DSS) is a well-established research and development area. Traditional isolated, stand-alone DSS has been recently facing new challenges. In order to improve the performance of DSS to meet the challenges, research has been actively carried out to develop integrated decision support systems (IDSS). This paper reviews the current research efforts with regard to the development of IDSS. The focus of the paper is on the integration aspect for IDSS through multiple perspectives, and the technologies that support this integration. More than 100 papers and software systems are discussed. Current research efforts and the development status of IDSS are explained, compared and classified. In addition, future trends and challenges in integration are outlined. The paper concludes that by addressing integration, better support will be provided to decision makers, with the expectation of both better decisions and improved decision making processes.

Keywords Literature review · Integrated decision support · Multiple-perspective integration · IDSS classification

1 Introduction

A decision support system (DSS) is defined as an interactive computer-based information system that is designed to support solutions on decision problems [7, 65, 101, 118]. The origin
of DSS can be traced back to preceding work in two main research streams: theoretical study of organisational decision making undertaken by Simon et al. at the Carnegie Institute of Technology during late 1950s and early 1960s, and technical work on interactive computer systems carried out by Gerrity et al. at the MIT in 1960s [54]. Simon’s model of decision making process consisted of three phases: intelligence, design and choice [103,104]. In the model, intelligence is concerned with the search for problems, design involves the development of alternatives, and choice is about analysing the alternatives and selecting one for implementation. This classic problem-solving model of “intelligence-design-choice” has been widely accepted and adopted. Even though Simon [105] later extended the model with a fourth monitoring phase, DSS research remained primarily focussed on the original three-phase model.

Work from MIT researchers including Gerrity et al. were also widely acknowledged. Gerrity’s [42] influential publication focusing on the DSS design issues. Keen and Scott Morton’s [54] work provided a broader behavioural orientation to DSS analysis, design, implementation, evaluation and development. Nevertheless, the study of decision making and DSS has been, and still is, undertaken in various ways and by various scholars and practitioners working in the area [35,46,87], as well as researchers from other disciplines such as artificial intelligence, operations research, organisational studies and management information systems that have added richness and complexity to DSS research [47].

Decision support system research and its applications evolved significantly over the 1970 and 1980s, and DSS was considered as one of the most popular areas in information systems during the time period. Diverse DSS were developed to support decision makers at all levels in an organisation including systems that could support problem structuring, operations, financial management and strategic decision making, even extending to support for optimisation and simulation. Phenomenally, group decision support systems (GDSS) and executive information systems [now called enterprise information systems (EIS)] were both developed as complementary to but more powerful support tools than DSS. GDSS can provide brain-storming, idea evaluation and communication facilities to support team problem solving [3,25,30,70]. EIS extended the scope of DSS from personal or small group use to the corporate level. EIS can provide a wide variety of information such as critical success metrics, key information indicators, reports with the ability to drilldown to underlying detail, budget information, plans and objectives, competitive information, news and more [38,57,92]. However, a closer look revealed that the interest in traditional problem solving DSS appeared to be declining in the 1990s [22] because of many new challenges arising for the isolated, stand-alone DSS.

The main challenges included: (1) technology shifts from database to data warehouse and on-line analysis processing (OLAP), from mainframe to client/server architecture, and from single user model to World Wide Web access; (2) growing interconnection with more dynamic business environment and intelligence that has been addressed by many other information systems such as enterprise resource planning (ERP), supply chain management (SCM) and customer relationship management (CRM); (3) increasing complexity of the decision situations which puts enormous cognitive workload on decision makers where a user needs to have considerable knowledge and must exercise initiative to perform decision-related tasks. One common key issue behind the above challenges is that the traditional problem-solving characterisation of DSS has to be expanded and integrated to be compatible with new technologies, business environments and intelligence, to allow more transparent interaction between decision makers and systems, not only for improvement of the efficiency and effectiveness of the decisions, but also for collaborative support and virtual team working. While criticism of “stand-alone” DSS and the need for closely linking DSS with business intelligence and modern technologies has been voiced, many researchers have already