Data Flow Diagram Use to Plan Empirical Research Projects

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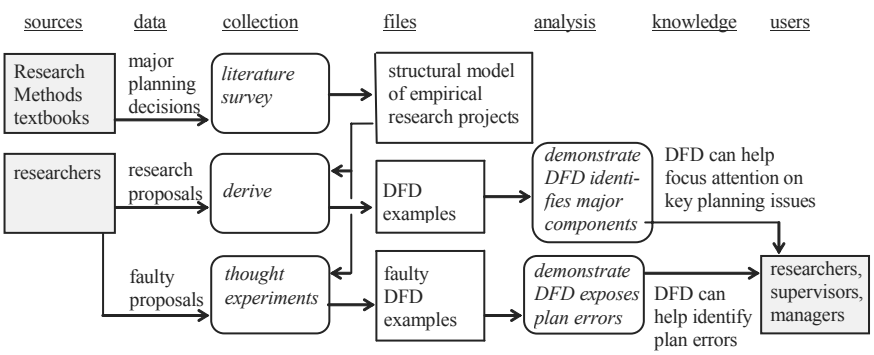
INTRODUCTION

Yourdon and Constantine (1979), De Marco (1979), and Gane and Sarson (1979) introduced the data flow diagram (DFD) more than a quarter of a century ago, as a systems planning tool that is particularly useful in the fields of software engineering and information systems development. But the DFD is not restricted to those fields. Empirical research projects are systems too (which consist of interconnected sources, data, collection processes, files, analysis processes, knowledge, and users), and those systems are similar to information systems. This article reports how the DFD can also be useful in planning empirical research projects. This finding should be advantageous to research planners, individual researchers, research advisors, research supervisors, or research managers. And it should be especially advantageous to research planners in information and communication technology (ICT) because they know DFDs already, so they can get the planning advantages with little or no extra learning effort. This finding was obtained from two research projects. The first was planned without the aid of a DFD and failed. It was then replanned with a DFD and redone in a second project, which succeeded. The DFD that turned failure into success is Figure 1.

The second project had the exploratory aim of demonstrating that DFDs *can* be useful in planning empirical research projects (the more ambitious aim *should* calls for further research). Figure 1 shows that the aim was achieved by means of DFD examples that speak for themselves: so no elaborate data collection was necessary and neither was any sophisticated data analysis. First, textbooks of research methods were surveyed to develop a structural model of empirical research projects: that model identifies seven major types of components as key planning issues. Then DFDs were drawn from the research proposals of three recent research projects to demonstrate that those DFDs explicitly identify the major decision components. This means that DFDs can be useful in focusing attention on the key planning issues. Third, faulty DFDs were drawn, some from initial proposals of old research projects, and others by conducting thought experiments that distorted the structural model in various ways (Brown, 1992): these examples demonstrate that DFDs readily expose planning errors. This means that DFDs can be useful in identifying planning errors. Therefore, by focusing

Figure 1. DFD of research on DFD's in research



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researchers' attention on key planning issues and by enabling them to identify planning errors, DFDs can be useful in planning empirical research projects.

BACKGROUND

DFDs were introduced in 1979 by Yourdon and Constantine, De Marco, and Gane and Sarson, and thereafter were recommended by many other authors (e.g., Awad, 1985; Budgen, 1994; Burch, 1992; Buxton & McDermid, 1991; Coleman & Baker, 1997; Conger, 1994; Fairley, 1985; Hawryszkiewycz, 1991; Jeffrey & Lawrence, 1984; Kendall & Kendall, 2002; McDermid, 1990; Millet, 1999; Powers, Cheney, & Crow, 1990; Satzinger, Jackson, & Burd, 2004; Schach, 1993; Sommerville, 1992; Stevens, 1981; Weinberg, 1980; Whitten & Bentley, 1998; Wieringa, 1998). DFDs have mostly been used to plan software packages and information systems by outlining their major components in a top-level DFD, and then decomposing major processes into more detailed lower-level DFDs. But only top DFDs are considered here. Yourdon and Constantine noted that the major processes in the top DFDs are usually afferent or efferent (this important insight has largely been ignored by current textbooks). In the case of an information system, afferent means data collection, and efferent means information extraction: so the top DFD of an information system can be drawn as a series of rows shaped like Figure 2 (Mende, 2007).

Therefore, Figure 2 serves as a structural model of an information system.

An empirical research project normally has a similar structure. This emerges from textbooks on research method (e.g., Babbie, 1989; Bailey, 1987; Breakwell, Hammond, & Fife-Shaw, 1995; Heiman, 1995; Huysamen, 1994; Kerlinger, 1986; Leedy, 1989; Mason & Bramble, 1978; McMillan & Schumacher, 1997; Mouton, 2001; Neuman, 1994; Robson, 1993; Singleton, Straits, & Straits, 1993; Terre, Blanche, & Durrheim, 1999; Welman & Kruger, 2001; Williamson, Karp, Dalphin, & Gray, 1982; Zikmund, 2003). These textbooks mention seven major components of a research project:

- The people who require knowledge of a particular phenomenon (knowledge users);
- The specific items of knowledge they need in order to cope with that phenomenon;
- The analysis processes that derive the needed knowledge from file data;
- The files that store data for analysis;
- The collection processes that get data into the files;
- The data to be collected, and
- The sources of the data.

Thus, an empirical research project normally has the structure of Figure 3.

Figure 4 compares Figures 2 and 3.

It shows that information systems and research projects are similar in two ways. First, they are similar in the interconnections of the components; second, they are similar in the functions of corresponding components.

The general system theory of von Bertalanffy (1972) predicts that when two academic fields are concerned with systems that are similar in structure or function, that is, homologous, then some of the knowledge in the one field can be transferred to the other. That prediction was confirmed earlier by cases of homological knowledge transfer between the field of information systems and several related fields (Mende, 1990). Now the prediction is confirmed further, by a case of homological knowledge transfer between the field of information systems and research method.

Figure 4 shows that information systems and research projects are homologous. So (although the two systems differ in other dimensions, e.g., run frequency), general system theory suggests that the homologies should allow some principles of information systems to be transferred to the field of research method. Subsequent sections confirm that indeed one principle can be transferred, namely the DFD.

Figure 2. Structural model of an information system

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