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Technology-driven and Model-driven approaches to Group Decision Support: focus, research philosophy, and key concepts

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Abstract
There are (at least) two distinct traditions within Group Decision Support: what we will call the "Technology-driven" tradition, which originates in the Information Systems discipline, and what we will call the "Model-driven" tradition, which originates in OR/MS. Although proponents of the two traditions share many of the same objectives, there is little communication between the two groups. In this paper, we describe the basic distinction between the two traditions in terms of two primary categories: research focus (i.e., what the researchers find of interest) and research philosophy and methodology (i.e., how researchers go about studying their chosen subject matter); and we trace these implications of these differences through the key concepts of each tradition. We note that the differences between these two traditions are not as stark as a number of years ago: but we hope that this paper can help clear up those misunderstandings and miscommunications which persist.

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1. Introduction

Group Decision and Negotiation (GDN) has been an academic growth area in recent years. There is now both an INFORMS subdivision and a EURO working group dedicated to "Group Decision and Negotiation". Since 1992, the INFORMS journal *Group Decision and Negotiation* has provided a forum for researchers interested in helping groups decide and negotiate, and the first full-scale GDN conference, Group Decision and Negotiation 2000, was held at the University of Strathclyde in July 2000. And, of course, accompanying all this research activity is an upsurge in publications: Pervan (1998) counts 234 journal papers between 1984 and 1996, and numerous papers have appeared outside of journals in collections of original papers (e.g. Bostrom et. al., 1992; Jessup and Valacich, 1993a)

GDN is a multi-disciplinary area of study, and active researchers can come from a range of different backgrounds. The GDN research community as a whole is interested in *whatever* can be utilized to improve group decision making and negotiation, whether it be computer technology, formal decision modelling, or cognitive and behavioural theory. The multi-disciplinary nature of GDN research makes it, in our view, a particularly stimulating area in which to work. However, because GDN researchers come from different disciplines, differences in priority and perspective are often misunderstood. Research which excites one subcommunity, leaves another subcommunity cold; words commonly used in the field ("system", "group") carry quite different connotations for different researchers.

We believe that an increased awareness of the similarities and differences between the various traditions in the field would pay dividends for all GDN researchers. A greater understanding of each others' motivations and outlook would help us build on our colleagues' work, collaborate and share expertise more effectively, and deliver better-directed, more useful, criticism and feedback. In the interests of progressing toward this goal, in this paper we shall review and contrast two of the main traditions within GDN, which we shall call the *Technology-driven* and *Model-driven* approaches to Group Decision Support, on two dimensions, namely, research focus (*what* researchers in each tradition are interested in) and research philosophy and methodology (*how* they go about studying this). We shall then go on to argue that these differences are reflected in the key concepts of the two traditions. We hope that this will help others to be more aware of the differences of approach within GDN.

2. Two approaches to Group Decision Support

In this paper, we are interested in Group Decision Support, or GDS, which we take to be a subset of GDN. As far as we are concerned, the term "Group Decision Support" contains within it its own definition: we apply it to research which focuses, firstly, on group decision making, rather than on negotiation (thus we will not discuss research on "Negotiation Support Systems", as described in, for example, Kersten and Cray, 1996); and secondly, on how group decision making can be supported, rather than described on the

one hand, or replaced on the other (in the words of Bell et. al. (1998), we are interested in *prescriptive*, rather than descriptive or normative, approaches to group decision making).

The term "GDSS", for Group Decision Support *System*, is more common than our term, GDS: for example, Huber's (1984), DeSanctis and Gallupe's (1987), and Pinsonneault and Kraemer's (1990) influential papers all discuss GDSS. However, appending the work "system" can give the impression to some that the only interesting GDS tools are computer-based systems (notwithstanding Huber's, 1984, p. 195, original definition, which describes GDS systems as built of "language components" as well as of software and hardware). We are keen to avoid this impression, as many of the tools we shall discuss in this paper are not necessarily computer-based, but nevertheless provide group decision support.

In talking about "GDS" we have in mind two separate streams of research, which we shall refer to as the "Technology-driven" and "Model-driven". The traditions can be clearly distinguished, as they are associated with markedly different bodies of literature and academic subcommunities. Research in the former tradition has centred on systems such as GroupSystems, SAMM and EIES, and is associated with the names of Nunamaker, Dennis and Vogel (e.g. Nunamaker et al., 1989, 1993); DeSanctis and Gallupe (e.g. 1987); Hiltz and Turoff (e.g. 1992) ; and others. Research in the latter tradition takes as its focus methodologies such as SODA, Soft Systems Methodology, Strategic Choice and Decision Conferencing, and is associated with the names of Eden and Ackermann (e.g. 1998); Checkland (e.g. 1981); Friend and Hickling (e.g. 1997); Phillips, Phillips and Rohrbaugh (e.g. Phillips and Phillips, 1993); and others.

Neither the Technology-driven nor the Model-driven traditions are universally identified by their proponents as GDS, or even as GDSS, traditions, although, as both aim to support group decision making, the label seems an appropriate one. Proponents of the Technology-driven tradition tend to identify the focus of their interest as "Group Support Systems", following Jessup and Valacich's (1993) usage. (This term embraces systems whose role is the support of communication as well as, or instead of, decision making.) Proponents of the Model-driven tradition tend to identify their methods as "soft OR" (Rosenhead, 1989b), "problem structuring methods", or "decision analysis", although this almost invariably means working with groups with decision making responsibilities.

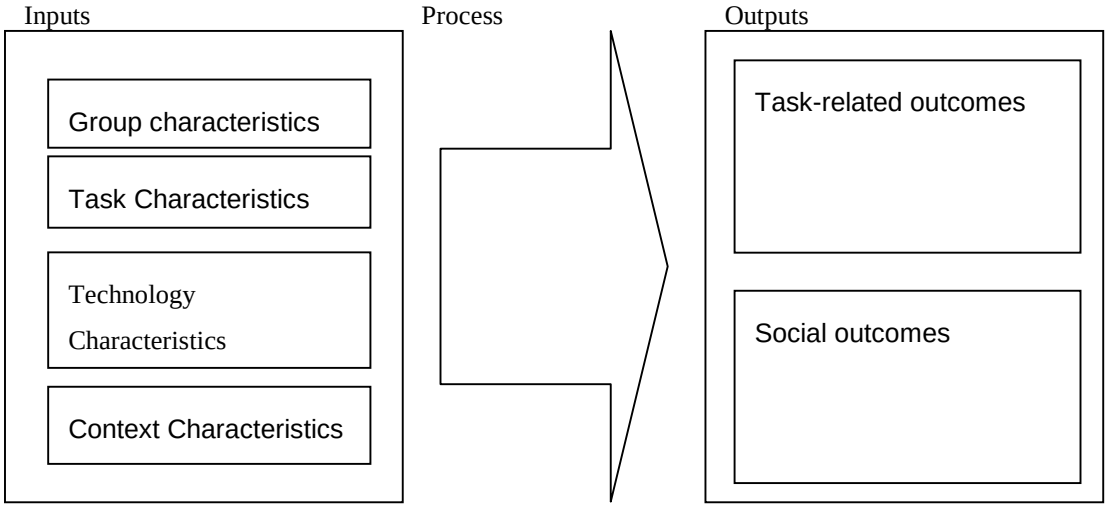
The distinction we wish to make in this paper is similar to the distinction which Eden (1995) makes between "narrow-band" and "wide-band" GDSS (see also the discussion in Ackermann, 1991, 1997). However, in this paper, we will amplify and deepen this distinctions. We have not used Eden's terminology as we feel that "wide-band" has laudatory overtones, whereas "narrow-band" could be interpreted as pejorative. It is not our intention here to pass judgment on either tradition.

Two existing recent reviews of GDS research discuss work from both the Technology-driven and Model-driven traditions, namely Stevens and Finlay (1996) and Pervan and Atkinson (1996). However, Stevens and Finlay base their research framework almost entirely on two works, namely Pinsonneault and Kraemer

(1990) and Eden (1992) and so there is much scope for a more comprehensive review. Pervan and Atkinson's paper contains much interesting material, but their sample is confined to the key IS journals, whereas Model-driven GDS research tends to be found in other sources (in particular, the OR journals). Having selected this review strategy, it is not surprising that they find that "research on [GDS within the Technology-driven tradition] is predominant", p. 480. There is, therefore, space for a review which treats the literatures of both traditions in full, and draws out the differences.

Our intention in this review is to present a systematic and even-handed comparison of Technology-driven and Model-driven traditions, building on Eden (1995), Stevens and Finlay (1996) and Pervan and Atkinson (1996). This has not been an easy task because the structures of the two literatures are quite different. Firstly, researchers in the Technology-driven tradition tend to share an input-process-output meta-model, shown in **Figure 1.**, and so it is relatively easy to compare results confidently across the different schools (Arizona, Minnesota, New Jersey and so on) within the tradition; in the Model-driven tradition there is no equivalent shared meta-model. Secondly, in the Technology-driven tradition there is a wealth of statistical meta-analyses and qualitative overviews using relatively consistent review procedures; in the Model-driven tradition, reviews tend to be more personal and more eclectic. Thirdly, proponents of the Technology-driven tradition tend to publish papers in journals of edited collections; Model-driven researchers, on the other hand, tend to publish authored books.

Figure 1. American GDSS Input-Process-Output meta-model (adapted from Pinsonneault and Kraemer, 1990)



Because of these three differences in the structure of the literature, we were compelled to use somewhat different review strategies for the Technology-driven and Model-driven traditions. While our aim – to

cover the most widely cited publications in order to arrive at a representative picture of the themes in each tradition– was the same in both cases, we went about this in a slightly different manner for the Technology-driven and the Model-driven tradition.

We base our comparison on a relatively large number of Technology-driven meta-analyses and qualitative reviews (DeSanctis and Gallupe, 1987; Pinsoneault and Kraemer, 1990; Rao and Jarvenpaa, 1991; McLeod, 1992; Benbasat and Lim, 1993; Nunamaker *et al*., 1993; DeSanctis, 1993; Dennis *et al.*, 1996; Nunamaker *et al*., 1996; Fjermestad and Hiltz, 1997; Nunamaker, 1997; Hwang; 1998; Pervan, 1998). This listing of papers includes all the review articles of GDS to be found in BIDS (the standard UK on-line bibliographic database), or in the authors' collective memories. As none of the review articles discussed here references review articles outside our sample, we are fairly confident that this "review of reviews" is complete.

As the most widely cited texts in the Model-driven tradition are not papers, but books, our review of that tradition had to be structured somewhat differently. We have chosen to focus on four core Model-driven texts: Checkland (1981), Bryant (1989). Friend and Hickling (1997) and Eden and Ackermann (1998). These are the fullest theoretic statements of four of the six classic Model-driven GDS schools described in Rosenhead (1989a): the schools associated with Soft Systems Methodology; hypergame analysis; Strategic Choice; and SODA. Checkland (1981) is the core text for Soft Systems Methodology; Bryant (1989), one of the developers of hypergame analysis, gives a personal view of some themes in the Model-driven literature; Friend and Hickling (1997) is the second edition of the classic book on the Strategic Choice approach; and Eden and Ackermann (1998) describe an approach to strategic development, *Journey Making*, which has grown out of SODA. We have excluded from the review two Model-driven approaches which feature in Rosenhead (1989a), namely Robustness Analysis and Metagame Analysis, because there are no book-length theoretic statements available for either of them. (Howard, 1971, focuses on the formal aspects of metagame analysis, rather than its use for group decision support.) There are also other Model-driven schools, not represented in Rosenhead (1989a) for which no book-length theoretic statement exists (most notably, Decision Conferencing – see Phillips and Phillips, 1993).

We have structured the comparison by looking at *focus* of research within the two traditions (i.e. *what* is studied); by looking at the underlying research philosophy and methodology (i.e. *how* studies are conducted); and by looking at the main differences in the key concepts of the two traditions. In order to better understand the conceptual differences between the traditions, we have used a variant of the input-process-output framework of the Technology-driven school.

3. Focus of the Technology-driven and Model-driven approaches

3.1 Introduction

We have already explained what we mean by GDS, identified two traditions within GDS research, and developed the methodology of our review. We shall now describe in more detail the main differences between the traditions. Many of the differences can be understood by contrasting the focus of the Technology-driven and Model-driven traditions. Our view of the key differences in focus is summarised in **Table 1.**

Table 1 Differences between Technology-driven and Model-driven traditions in terms of focus

	Technology-driven	**Model-driven**
Originating discipline	Information Systems	OR/ Systems
Focus	Emphasis on technological aspects	Emphasis on modelling aspects
Uptake	Largely in the US	Largely in the UK and the Netherlands
Objectives	Meeting support	Problem consultation

3.2 Focus of the Technology-driven tradition

Technology-driven GDS research originates within the Information Systems field. According to Wagner *et al*. (1993), arguably the first GDS system was ISDOS, developed at the University of Arizona from the early to mid-seventies. ISDOS was originally intended to aid Information Systems development projects, but its creator, Jay Nunamaker, came to realise that it had a much broader potential for supporting group interaction in general. At about the same time, Hiltz and Turoff were working on a conferencing system (EMISARI) to support communication and decision making by members of the US Government in crisis

situations: as the technology became cheaper, it became clear that this system, too, was of potentially very wide application.

A central focus of Technology-driven GDS research is the underlying computer system (we take this to be an important characteristic: hence our choice of label "Technology-driven" for this tradition). The various schools within the tradition are associated with particular computer systems: Nunamaker *et al.* (1996) and the Arizona school are associated with GroupSystems; the system belonging to DeSanctis and Gallupe (e.g., 1987) and the Minnesota school is SAMM; and the focus of the work of Hiltz and Turoff (e.g. 1996) and the New Jersey school is EIES (pronounced "eyes").

Technology-driven GDS systems have been fairly widely diffused, both in academia and industry, but have been most successful within the US. Wagner *et al*. (1993) identify Technology-driven GDS research programmes at the Universities of Georgia and Indiana, Queen's University, Claremont Graduate School, and the University of Hohenheim in Germany, and list in excess of thirty research institutions with Technology-driven-style decision rooms installed. Pervan (1998) lists the ten most prolific research institutions in Technology-driven GDS research: these are the University of Arizona, the University of Georgia, the University of Minnesota, Indiana University, New Jersey Institute of Technology, the University of Mississippi, the National University of Singapore, New York University, the University of Texas at Austin, and the University of Colorado, in that order. Beyond academia, Technology-driven GDS systems have been introduced on a large scale at IBM (see, for example, Nunamaker, *et al*, 1989), and there are a number of other triumphs, for example at Boeing, and Burr-Brown and in the US Navy (e.g. Dennis *et al*, 1990). Research has accompanied this technological diffusion and Nunamaker (1997) reports "field studies of thousands of cases in hundreds of organisations" (p. 357).

Despite this apparent success, some Technology-driven GDS researchers have expressed concern at the slow take-up of their systems, and these concerns give an insight into what is seen as the objective of the field. Lewis *et al*. (1996) claim that:

> Recently we have discussed, among ourselves and with several other GSS [i.e. Technology-driven GDS systems] researchers and developers, the current state of affairs in the application of GSS for solving real problems… The *general consensus* seems to be that the adoption of GSS for meeting support has been a slower process than anyone predicted. [p. 189, our italics]

This concern has grown rather than diminished over recent years, and "adoption dynamics" was a major theme of the GDN2000 meeting (e.g., Lewis *et al*., 2000; Pollard, 2000). On inspection, this disappointment seems to stem from a comparison of GDS systems with other forms of computer software:

> Compare sales of GSS to other software products like spreadsheets and word-processors. Clearly, there is no Excel in the GSS world, and none of the major software companies are currently marketing a product like GroupSystems or MeetingWorks [Lewis et al., 2000, p. 189]

This comparison is significant, as it indicates the objective which Technology-driven GDS researchers set themselves. The objective of the research programme, as seen by Lewis *et al.*, seems to be to provide support for meetings in much the same way as word processors support the writing of documents. Indeed, the term "Electronic Meeting System" is sometimes used in the literature as a synonym for GDS system (e.g. McLeod and Liker, 1992).

3.3 Focus of the Model-driven tradition

Model-driven GDS research, on the other hand, originates in a different field, namely OR/ Systems. Model-driven GDS methods were developed in response to the perceived inadequacy of traditional OR/ Systems problem solving methods for dealing with unstructured, complex problems. These problems are characterised as messy (Checkland, 1981, p. 255, drawing on Ackoff, 1974) or wicked (Bryant, 1989, p. 81-83, drawing on Rittel and Webber, 1973) or swampy (Rosenhead, 1992, p. 293, drawing on Schön, 1983). Such problems typically touch on a number of different parties, who have different and perhaps conflicting perspectives and decision criteria, and so dealing with such problems almost invariably involves working with groups. Although Dando and Bennett diagnosed the emergence of the Model-driven tradition in their 1981 paper, versions of Model-driven GDS methods such as Soft Systems Methodology, SODA, hypergame analysis and robustness analysis were already under development. Early work is described by Checkland (1981), Eden and Sims (1979), Bennett and Huxham (1982) and Rosenhead (1980a, 1980b) at the Universities of Lancaster, Bath, Sussex and London School of Economics respectively. More comprehensive histories can be found in Rosenhead (1989b) and Bryant (1989, p. 166-172).

Rather than focusing on computing systems, the Model-driven tradition focuses on the different sorts of *decision models* (again, hence the label) which may underlie a GDS methodology. The various schools within the Model-driven tradition are each associated with a particular modelling approach: Checkland (1981) work seeks to model organisations using the concept of a "soft system"; Bryant (1989) is associated with game-theoretic inspired models; Eden and Ackermann's (1998) work focuses on using cognitive or cause maps. Friend and Hickling (1994) are somewhat different from their colleagues, as they have built up a suite of modelling tools within their Strategic Choice approach, rather than concentrating their attention on a single modelling methodology.

Model-driven GDS methods, like Technology-driven GDS systems, have diffused quite widely in academia and industry: but where Technology-driven GDS systems are most likely to be found in the US, Model-driven GDS methods are most likely to be found in the UK or the Netherlands. There are active GDS research centres at Strathclyde, at Hull, and at Warwick in the UK, and at Delft, Nijmegen, Tilburg and Utrecht in the Netherlands, and at Grenoble in France, and at many other locations. Because Model-driven GDS research tends to take the form of action research, Model-driven GDS methods have been used to help with organisational problem solving from the beginning, and the research draws on experience from

innumerable studies (Checkland, 1981; Bryant, 1989; Friend and Hickling, 1997; and Eden and Ackermann, 1998, all draw extensively on the author's organisational experience).

Just as the concerns of proponents of the Technology-driven tradition give us some insight into what they take to be a key metric of their success – the diffusion of computing software - the perceived challenges facing the Model-driven researchers can give us some insight into the objectives of *that* tradition. Whereas Technology-driven researchers are typically concerned about their systems not becoming accepted by organisations, Model-driven researchers are more concerned about the transmission of their skills and tacit knowledge to potential practitioners of the methods (see especially Friend and Hickling, p. 334-335; Ledington and Donaldson, 1997). This corroborates our view that that Technology-driven researchers tend to see themselves as offering a meeting support *product*, which can be embedded in an organisation like any other information system, whereas Model-driven researchers are more likely to see themselves as offering a "problem consultation" (Bryant, 1989, Ch. 7) *service*, a vital component of which is the skill of the consultant.

3.4 Differences between the two traditions in terms of focus

To summarise the discussion thus far: we have argued that the Technology-driven and Model-driven traditions originate in different fields – IS and OR - and are responses to different needs. This explains what is for us a fundamental difference between the two traditions: the focus on the computing system, on the one hand, and on the decision model on the other. This difference in focus in turn helps explain how the two fields see the measures of their success (and hence as their main challenges): while the Technology-driven tradition seeks to diffuse its meeting support product, the Model-driven tradition seeks to provide a problem consultation service.

4. Research Philosophy and Methodology of the Technology-driven and Model-driven approaches

4.1 Introduction

We have already outlined what we see as one fundamental difference between the Technology-driven and Model-driven traditions – namely the focus on the computing system versus the focus on the decision model. Our second fundamental difference is the difference in research philosophy and methodology. Specifically, Technology-driven researchers tend to favour a positivist research philosophy and experimentation as a research method, whereas Model-driven researchers are more likely to by philosophical interpretivists and methodological action researchers (see **Table 2**).

Table 2 Differences between Technology-driven and Model-driven traditions in terms research philosophy and methodology

	Technology-driven	Model-driven
Philosophy	positivist	Interpretivist
Methodology	predominantly experimentation	universally action research

Writers on the philosophy of social science research (e.g. Burrell and Morgan, 1979; Orlikowski and Baroudi, 1991) commonly distinguish two (positivist and interpretivist) or three (positivist, interpretivist and critical) research philosophies. According to Orlikowski and Baroudi (1991):

> Positivist studies are premised on the existence of a priori fixed relationships within phenomena which are typically investigated with structured instrumentation. Such studies are primarily to test theory, in an attempt to increase predictive understanding of phenomena… Interpretive studies assume that people create and associate their own subjective and intersubjective meanings as they interact with the world around them. Interpretivist researchers thus attempt to understand phenomena through accessing the meaning that participants assign to them. [p. 5]

In this paper we shall focus on positivist and interpretivist GDS research, as we have seen no evidence of critical research studies.

4.2 Research philosophy and methodology in the Technological tradition

Writers in the Technology-driven tradition do not openly declare themselves as positivists, but the dominant style of presentation and mode of research features the "evidence of formal propositions, quantifiable measures of variables, hypothesis testing, and the drawing of inferences about a phenomenon form a sample to a stated population" which Orlikowski and Baroudi (1991, p. 5) take to be the hallmark of positivism.

This is substantiated by Pervan's (1998) review of the Technology-driven GDS literature, according to which fully 83% of empirical studies are surveys, experiments or positivist case studies (with experimental studies accounting for more than half of these empirical studies). Only 2%, however, are clearly interpretivist (the remainder, e.g. "description of specific systems" are of ambiguous status).

4.3 Research philosophy and methodology in the Model-driven tradition

The research strategy which is universally favoured in Model-driven research is action research. (Thus, Checkland, 1981; Bryant, 1989; Friend and Hickling, 1997; and Eden and Ackermann, 1998 all openly declare themselves as action researchers). Action research, at least in its Model-driven GDS form, exhibits all of Orlikowski and Baroudi's characteristics ("evidence of a non-deterministic perspective where the intent of the research was to increase understanding of the phenomenon within cultural and contextual situations; where the phenomenon of interest was examined within its natural setting and from the perspective of the participants; and where researchers did not impose their outsiders' a priori understanding on the situation" [p. 5]). It inevitably takes place within a naturalistic setting, and as the researcher is in fact engaged in the situation, the perspective is by definition that of participant, rather than an outsiders' perspective. Moreover, as action research is typically characterised as a cyclic, learning mode of investigation (Eden and Huxham, 1996), it is inevitably non-deterministic and non-a priori.

While there is no external review of the Model-driven tradition (equivalent to Pervan's, 1998, review of the Technology-driven tradition), Model-driven writers themselves tend to wear their philosophical affiliations on their sleeves. Checkland (1981, p. 277-284) for example, says that the "social reality implied by Soft Systems Methodology" is inherently multi-perspectival and non-positivist. At the same time, Eden and Ackermann's (1998) and Bryant (1989) make clear that "problem construal" (p. 48) "individual acts of interpretation" (p. 95) respectively are the basis of their methodologies. This focus on the internal world of the participants – their "perspective" in Orlikowski and Baroudi's language – gives the work of the Model-driven writers a very interpretivistic flavour.

4.4 Differences between the two traditions in terms of research philosophy and methodology

There is, therefore, a clear distinction between Technology-driven researchers, who are often positivists, of a predominantly experimental bias, and Model-driven researchers, who are much more interprevistic and inclined to action research. We believe that these two fundamental differences – the difference in focus and the difference in research philosophy - can help understand the differences in key concepts between the two traditions. In the following section we shall develop our arguments in more depth.

5. Key concepts of the Technology-driven and Model-driven approaches

5.1 Introduction

So far we have discussed the differences between the two GDS traditions in terms of focus and of research philosophy. Now we shall deal with the key concepts of the Technology-driven and Model-driven traditions, which reflect these differences. The main contrasts are shown in **Table 3.**

Table 3 Differences between Technology-driven and Model-driven traditions in terms of key concepts

	Technology-driven	**Model-driven**
Explanatory elements	group, technology, task, context	group, decision model, facilitator, client
Models of process	Computational models at the social level; Technology perception at the cognitive level	negotiation at social level; problem perception at cognitive level
Outcomes	direct evaluations of substantive outcomes	ongoing impact on the organisation

To structure our discussion of the key concepts, we have used an amended version of the Technology-driven input-process-output meta-model (see **Figure 1.**, above). We have chosen this framework for reasons of convenience: much of the Technology-driven literature is already organized in terms of this framework. However, rather than referring to "inputs", and "outputs" we shall refer to "explanatory elements" instead of inputs, and "outcomes" instead of outputs: this bluntens the edge of the underlying engineering metaphor, and makes the framework more applicable to work in the Model-driven tradition. We acknowledge that by using a framework rooted in the Technology-driven tradition to structure our

study we may subtly misrepresent the Model-driven literature: however, we view this as price worth paying, as without a common framework it would be impossible to make any systematic comparison whatsoever.

5.2 Explanatory elements

Explanatory elements in the Technology-driven tradition

To start with "explanatory elements": the commonest way of splitting up the "input factors" in the Technology-driven literature is to divide them into *group*, *technology*, *task* and *context* characteristics, as shown above in **Figure 1.** This is the strategy followed by Pinsonneault and Kraemer (1990), McLeod (1992), Benbasat and Lim (1993), Nunamaker *et al.* (1993), and Fjermestad and Hiltz (1997). "Group" and Technology" are self-explanatory. "Task" is understood to refer to task type in the sense of McGrath (1984). There is no strong positive conceptualization of "context" which is generally used as a residual class, where variables are parked when they are felt to be important but have received little systematic study (e.g. culture).

There are two variants on this model. Fjermestad and Hiltz (1997) also register a class of "intervening factors", which appear to be emergent or secondary properties of the input variables (e.g. bandwidth is intervening factor which somehow relates back to the variables in the technology category). Pinsonneault and Kraemer (1990), McLeod (1992) and McGrath and Hollingshead (1994) divide the group characteristics category into individual characteristics (e.g. ability) and properties of the group as a whole (e.g. cohesiveness).

The most commonly cited framework in the literature is Pinsonneault and Kraemer's (1990). Fjermestad and Hiltz' (1997) study gives the most comprehensive listing of variables studied.

Qualitative reviews, such as Pinsonneault and Kraemer (1990) and Fjermestad and Hiltz (1997), are useful in giving an overview of the range of variables studied within the Technology-driven research tradition. However, looking at the meta-analytic studies (McLeod, 1991; Benbasat and Lim, 1993; Dennis *et al*., 1996; Hwang, 1998) gives some insight into which variables are most *central* in this tradition. In fact, three out of four of the meta-analyses (McLeod; Benbasat and Lim; and Dennis *et al*.) have sought to answer more or less the same question: does a group with a computerised GDS system outperform a group with only manual aids? (The remaining meta-analysis, Hwang, 1998, focuses on how well GDS system users do on certain task types.) The input variable which is most crucial in this tradition, therefore, is the technological variable, manual/ computer support. (This if what validates our labeling of this tradition as "Technology-driven".)

Explanatory elements in the Model-driven tradition

The main difference between the Technology-driven and Model-driven traditions is that the technological considerations, which dominate Technology-driven GDS research, are much less prominent in Model-driven research. Eden and Ackermann (1998) and Friend and Hickling (1997) generalise lessons from practice across both computer-supported, partially computer-supported, and manual sessions: this would be unthinkable for most Technology-driven GDS researchers, whose tradition is predicated on the notion that computer-supported and manual modes of working are quite radically different.

While paying relatively little attention to the technology, Model-driven researchers tend to have a very strong sense of the differences between different sorts of decision models (Eden, 1995). A symptom of this is that how and whether different modelling tools can be used together are dominating questions in the Model-driven tradition (see for example Belton *et al.*, 1997; Mingers and Gill, 1997; or Ackermann and Belton, 1999). This debate is not in evidence in the Technology-driven tradition, which has been mixing different sorts of modelling techniques virtually since its inception – in GroupSystems, for example, users can pick and choose from a range of different Multi-Criteria and system modelling tools.

The other big difference between Technology-driven and the Model-driven traditions, relates to the roles of parties external to the group itself, which are relatively little mentioned in the Technology-driven literature. The most prominent role in the Model-driven tradition is that of the facilitator. Often, in Technology-driven research, facilitation, if it is mentioned at all, is typically a binary, yes/ no variable (see Fjermestad and Hiltz, 1997, for example). In the Model-driven core texts, much attention is given to discussing the various dimensions of facilitative style (see Ackermann., 1997; Bryant, 1989; Eden and Ackermann, 1998; and Friend and Hickling, 1997; Checkland, 1981, is an exception). Another prominent role in Model-driven research is the role of the client – the person or group to whom the facilitator is answerable. Clients are ubiquitous in the Model-driven literature, and appear in all four core texts, although for Bryant they are "commissioners" and for Friend and Hickling, they are "responsible groups".

The other typical explanatory elements in the Model-driven tradition ("group" and "task") are easier to compare to the Technology-driven literature, although the Model-driven literature tends to emphasise *stage* rather than task. (Thus, Ackermann and Eden, 1997, present a model of strategic development as a two-stage, divergent-convergent process; Friend and Hickling organise their book around four "modes" of Strategic Choice, namely, *shaping*, *designing*, *comparing* and *choosing*, p. 20). Stages differ from tasks in that they interrelated rather than stand-alone: thus a convergent phase of decision making will typically be preceded by a divergent phase, and a choosing phase will typically be preceded by a comparing phase.

Comparison of explanatory elements

In terms of explanatory elements, the most striking differences are the emphasis on technological elements of the system in the Technology-driven tradition, and the emphasis on modelling and on the roles of the facilitator and the client in the Model-driven tradition. Partly this is due to the defining difference between Technology- and Model-driven research: that the former focuses on the computer system, while the latter focuses on the decision model. But the difference in explanatory elements also reflects the difference in objective mentioned in Section 3: namely that proponents of the Technology-driven tradition are more likely to see themselves as offering a technological product, whereas Model-driven researchers are more likely to see themselves offering a service, which has a greater personal or human element: hence the emphasis on client and facilitator.

5.4 Models of process

Models of process in the Technology-driven tradition

While the model of explanatory elements as *group*, *task*, *technology* and *context* is more-or-less common to all Technology-driven researchers, there are no models of process which command universal assent in the Technology-driven literature. Models can be divided approximately into two sorts: models of *social process* and models of *cognitive process*. We shall discuss each in turn.

There is little consenus about the best model of social process within the Technology-driven literature. One model of social process is the process gain/ loss model used in the work of the Arizona school (Nunamaker *et al.*, 1993). According to this model, some sorts of behaviour (e.g. free-riding, domination) are bad, whereas others are good (e.g. "more objective evaluation"). Another model of social process comes from Pinsonneault and Kraemer (1990). They consider four aspects of social behaviour: decisional characteristics (e.g. "depth of analysis"); communication characteristics (e.g. "task-oriented communication"), interpersonal characteristics (e.g. "co-operation") and structure imposed by system (no examples given). Other writers (McLeod, 1992; Benbasat and Lim, 1993; and Hwang, 1998, Nunamaker *et al.*, 1996) mention other, slightly different aspects of social process. The overall impression is one of conceptual fragmentation, and of the absence of a single overarching theory of social process.

Other models of process are cognitive rather than social. An influential cognitive level approach is "Adaptive Structuration Theory" (Poole and DeSanctis, 1990), which draws on Giddens' (1984) theory of society, the theory of structuration. At the risk of oversimplifying a complex set of arguments, Poole and DeSanctis' key idea is that use of a computer system is determined by the perception of the system which users bring, and that these perceptions are in turn changed through use of the system.

Models of process in the Model-driven tradition

Models of process in *Model-driven* studies again have a different emphasis. We shall discuss these process models at a social and at a cognitive level.

At a social level, Model-driven researchers generally view interaction as a sort of interpretive negotiation or politicking, much after the manner of Goffman (1970). Rosenhead (1996), in his review article, remarks that Model-driven GDS methods "can facilitate negotiating a joint agenda" (p. 119). Negotiation is the "N" in *JOURNEY Making*, the strategic development methodology based on SODA (Eden and Ackermann, 1998, p. 186). Eden (1989) expands on this, remarking that:

> The manoeuvring of people along Machiavellian dimensions is relatively easy to identify, but it, in my experience, much less common than the politics that result from the wish to define reality. This latter form of politics is the essence of human life [p. 47]

For Friend and Hickling (1997), collective choice is by definition "negotiation with others which view problems and possibilities in different ways" (p. 2). According to Bryant,

> We must at the same time remember that organisations are dynamic coalitions of individuals in which there is no necessary consensus beyond that imposed by social pressures and within which each person will be seeking to re-orient the common purpose to align more closely with his or her individual expectations… This is organizational politics in action: the management of meaning. [p. 95]

And Checkland (1981) suggests that Soft Systems Methodology can help a group reach an accommodation, which "does not eliminate conflict – which is endemic in human situations – but may make corporate purposeful actions possible" (p. 83).

At a cognitive level, the emphasis in the Model-driven literature is on how problems are perceived and made sense of. Rosenhead (1996) talks about "accomodat[ing] multiple perspectives" (p. 119). The "U" in *JOURNEY making* stands for "understanding" (Eden and Ackermann, 1998). Bryant (1989) devotes an entire chapter to "experiencing problems", and Checkland (1981) advocates interpreting problems in a "loose way":

> By far the best studies have been characterised… by a readiness to collect as many perceptions of the problem as possible from a wide range of people with roles in the problem situation [p. 165]

This emphasis on problem perception contrasts with the emphasis on the perception of the computer system in the Technology-driven Adaptive Structuration Theory.

Comparison of models of process

In terms of models of process, it is worth making two points. One point is that models of social process are very fragmented in the Technology-driven tradition, whereas there appears to be a relatively strong consensus in the Model-driven tradition that negotiation is a key part of the process. Rao and Jarvenpaa (1991) take the view that this is because the Technology-driven tradition is relatively atheoretic, and so descriptions of social process have grown up in an ad hoc fashion, rather than being rooted in some pre-existent theory. We do not share this view of the Technology-driven tradition as atheoretic: however, we note Walsham's (1993, p. 4-5) view that a positivistic style of research is not well-suited to understanding the more processual aspects of information system use, and suggest that this may be one reason why models of social process seem relatively underdeveloped in the Technology-driven tradition.

The other point is that at the cognitive level, the preferred concepts of the Technology-driven tradition are centred on perceptions of technology, whereas the main concepts of the Model-driven school are based on perceptions of problems. This harks back to the core distinction between these two traditions, namely that the Technology-driven school takes as its focus the computer system, whereas the Model-driven school takes as its focus the decision model, which represents a problem situation.

5.5 Outcomes

Outcomes in the Technology-driven tradition

A key distinction in Technology-driven GDS research is the difference between *task-related* and *social* outcomes (Pinsonneault and Kraemer, 1990, use this distinction, for example). Fjermestad and Hiltz (1997) give a similar, though longer, list of outcomes, grouping "outcome factors" under five interrelated headings, *efficiency factors*, *effectiveness measures*, *satisfaction measures*, *consensus*, and *usability measures*. The meta-analyses (McLeod, 1992; Benbasat and Lim, 1993; Dennis *et al*., 1996; Hwang, 1998) mention a number of variables, which we group as quality-related variables (e.g. quality of final decision; quality of process); time-related variables (*e.g.* efficiency); and various measures of user perceptions of the substantive decision and decision process (satisfaction, confidence, consensus).

Technology-driven researchers tend to assume that the most important outcome is the substantive outcome: the "decision". The variables of interest are mostly (but not all) evaluations of this substantive outcome on various dimensions. They also tend to be measured at a point after the end of the session. Even measures of variables which relate to "the implementation of the decision" (Pinsonneault and Kraemer, 1990) are based, not on a study of the implementation process, but by a direct judgement of whether the proposed solution is "implementable".

Outcomes in the Model-driven tradition

Model-driven researchers tend to emphasise quite a different set of outcomes. There is less emphasis on the immediate, substantive outcome of a GDS session. Rather, this substantive outcome is seen as an "agenda" (Eden, 1987, p. 100) or as a "commitment package" (Friend and Hickling, 1997), which points towards future organisational action. It is this action which is the ultimate test of the effectiveness of a GDS intervention. Rosenhead suggests that the strength of a Model-driven GDS tool is that it "generates ownership of the problem formulation and its action implications" (p. 119). Eden and Ackermann propose "co-ordinated and coherent thinking and action" as the basis of organization: their methodology is intended to promote substantively coherent and politically robust change. Friend and Hickling (1997) discuss commitment to "actions", or at least to future work of some other sort, as one of the key "visible" outcomes of Strategic Choice (p. 278). Checkland (1989) suggests that the Soft Systems Methodology process is centrally about "learning your way to implementable changes".

As Checkland's quote suggests, an important mechanism by which organisational action takes place, is learning. Learning is a core notion for all Model-driven researchers. In the context of "finishing off", Bryant (1989) suggests an organisational intervention should be about:

> developing insights which will enable individuals to make sense of their personal worlds so as to act more powerfully within them. This implies a view of interventions as a stage for action research and *learning*. [p. 150, my italics]

For Friend and Hickling (1997), many of the outcomes are "invisible": a "conscious appreciation" of growth in shared perceptions and orientations, of unresolved problems, of other organisational cultures and personal styles, constraints and pressures and others, and shared ways of working (p. 278). For Eden and Ackermann (1998), the "R" in *JOURNEY Making* is reflection, and "thinking and doing things differently" is one of the outcomes managers expect from strategic development (p. 17).

Comparison of outcomes

In both traditions, the primary emphasis is on the decision which was reached. Exactly how "decision" is understood and evaluated differs between the two traditions. A significant difference is that in the Technology-driven tradition, the assumption is that this decision can be evaluated directly at a point in time, either by the users themselves or by a panel of judges; whereas in the Model-driven tradition, the focus is on the extent to which the GDS session influences both the people in the organisation on an ongoing basis, by supporting their learning, by facilitating action or change. This again reflects the underlying philosophical and methodological preferences within the two tradition. In an experimental setting, there is a clear end-point to the experiment, and the constituency who are qualified to assess the quality of the decision may be relatively clear. In an organisation, on the other hand, a decision process

will typically not have a single end-point, and may blend into implementation: and it may be much harder to know who should be the person to assess the quality of a decision.

5.6 Differences between the two traditions in terms of key concepts

Our argument in the preceding paragraphs has been that while both Technology-driven and Model-driven traditions contain much diversity, a number of general points can be made about the differences between the two traditions in terms of the key concepts. In terms of explanatory elements, Technology-driven researchers are more likely to find their attention drawn to the computer system, whereas Model-driven researchers will give more time to studying the decision model, the facilitator's behaviour, and to the client. In terms of process, Technology-driven researchers have little overarching theory of social process, and ascribe to a view of cognitive process which draws attention back to the technology; whereas Model-driven researchers have a more unified view of social process as negotiation and their view of the cognitive process of group decision making focus on group members' perception of problems rather than their perceptions of technology. And in terms of outcomes, Technology-driven researchers tend to look evaluate the decision at the close of the experiment, whereas Model-driven researchers prefer to evaluate the ongoing decision process as it rolls onward through time.

These conceptual differences, we contest, can in part be explained by the difference in focus between the proponents of the traditions. It is not so very surprising that a research tradition which stems from IS, and which aims to provide software solutions for group decision making, should stress the impact and perception of the computer system so strongly. At the same time, a tradition which stems from OR, and which aims to provide a consultancy service, should stress decision models, perceptions of problems, and the roles of the facilitator and client.

Other differences may owe more to the philosophical and methodological differences between the two traditions. The interpretivistic assumptions of the Model-driven tradition may make for a more coherent picture of social process than in the more positivistic Technology-driven tradition. In experimental research, the task on which the group is working is unlikely to have any significance for them outside the context of the experiment: hence the focus on the substantive decision in the Technology-driven tradition. In a Model-driven action research study, however, there may not be a moment at which a decision can universally be agreed to have been made: decision making blurs into implementation. Hence, it may make more sense in these circumstances to study the ongoing impact of the GDS exercise on the organisation.

6. Conclusion: a narrowing divide?

In this paper, we have presented a review of two of the main traditions with Group Decision and Negotiation, namely the Technology-driven and Model-driven GDS traditions. We have contrasted these traditions by looking, first of all, at their focus, secondly, at the underlying research philosophy, and thirdly at the key concepts of the two traditions, which we have argued stem from fundamental differences in focus and research philosophy.

Having drawn this stark contrast, we would recommend the reader to take it with a pinch of salt: throughout the 1990's the division between the Technology-driven tradition and the Model-driven tradition has become less stark. De Vreede (1997) has used a Technology-driven GDS system, GroupSystems, in a series of Model-driven-style action research projects. Bostrom *et al*. (1993) address facilitation, traditionally a Model-driven theme, in a Technology-driven context. Researchers in the Model-driven tradition have become increasingly aware that Technology-driven-style technological support opens new opportunities for process management (Ackermann, 1990; Friend and Hickling, 1997, Ch. 10).

We think this blurring of the boundaries is healthy, but for us it does not go far enough. Both traditions have a wealth of experience of Group Decision Support: but there is little sharing of lessons learned. For example, despite the concern evident in the Technology-driven school over adoption issues (Lewis *et al*., 1996; and see above, this paper), there has been no systematic attempt to draw on the rich organisational experience of the Model-driven tradition. At the same time, the concern expressed in the Model-driven literature about the transfer of facilitation skills (Friend and Hickling, 1997; Ledington and Donaldson, 1997; see above this paper) could be addressed by giving more attention to how such skills can be embedded in technology.

Common journals and conferences are of course valuable in exposing proponents of one tradition to their opposite numbers. However, too often, one puts down a journal or leaves a conference with the awareness that there are other perspectives and ways of doing things, but little real, deep understanding. A program of joint research, involving Technology-driven and Model-driven researchers working side-by-side could throw up valuable insights into how best to meet the shared aim of enabling better group decision making.

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