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Abstract

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Keywords

Technology Transfer, Dialectic, Organizational Sensemaking, and Metastructure

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Dialectical Inquiry: A Structured Qualitative Research Method

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This paper presents Dialectical Inquiry (DI) as a structured qualitative research method for studying participant models of organizational processes. The method is applied to rich secondary anecdotal data on technology transfer, gathered by subject-matter experts in a large firm. DI assumes that the imposition of a dialectical structure will produce emergent theories in tacit use by organizational actors. As such, it serves as a meta-structure for grounded research. Three competing models were discovered in the data. Each model was analyzed in the context of other models to reveal governing assumptions and counter assumptions. It is demonstrated that each model grasps essential truths, but is necessarily incomplete, and would fail due to internal contradictions. The internal and external validity of the results were tested in a manner consistent with qualitative research. Key Words: Technology Transfer, Dialectic, Organizational Sensemaking, and Metastructure

Introduction

The purpose of this paper is to present and exemplify Dialectical Inquiry (DI) as a useful structured qualitative research method for studying organizational sense making processes as they are understood by participants. The paper will develop DI as a research method and link it to other qualitative methodologies. The particular research setting and challenges will be described. In this particular case, the challenge was to understand internal processes of technology transfer. Subject matter experts in the organization conducted interviews and experienced great difficulty interpreting their data. The research challenge was to "make sense" of this secondary data (McNabb, 2004).

The research process will be described and exemplified with data from the case. The findings will be presented as they emerged in the research process within an imposed dialectical framework. At critical points, we will pause to reflect upon the method. Tests of internal and external validity are presented as well as conclusions from the research. It is hoped that the relationship between emerging findings, the imposed dialectical framework, and the process will demonstrate the advantages of DI as a qualitative research method.

The first author was engaged in executing the research. The second author reviewed the research, contributed the literature review, and structured much of the paper. He was not directly involved with the company research process. He had the foresight to insist that the work be published.

Organizational Sense Making

Organizational sense making presents a challenge to the researcher. Gareth Morgan (1986) has classified the multiple models, metaphors, and constructs we impose on organizational phenomena in our efforts to gain valid scientific understandings. Taken together, our models and theories are inconsistent, incommensurate, and paradoxical. They seek to answer the question, "How are we to understand, as scientists, organizational phenomena?" A related question is to ask how organizational actors understand the same phenomena. Kaplan (1964) argues that we must distinguish between the meaning of an act to the actor and it's meaning to scientists taking that act as subject matter. We presume that those understandings are similar, but that is only a presumption. "Observational data have no more validity than attaches to that presumption" (Kaplan, 139). That suggests that the relationship between our models and theories, and those in use by organizational actors, are problematic. We should not impose our constructs as valid representations of the understandings of organizational actors.

Managerial understandings about organizational functioning must make sense, even if such functioning appears unreasonable and irrational at times. There must be "method to the madness." Ethnomethodology (Garfinkel, 1968, pp.16-17) assumes as much, referring to "the availability…of common sense knowledge of...society" or to "the grasp of what were…adequate methods for dealing with…matters." Sensibility, thus, implies theory building. There must be a model, or models, that grant structure to experience, and reduce equivocality by distilling events into recognizable patterns. Discovery of such theories implies a grounded theory perspective (Glaser & Strauss, 1967) as opposed to the imposition of rational academic models.

Purposeful actors whose actions are guided by their own particular understandings of the processes in which they participate constitute organizations. If we assume that actors have choices, *their* categories and meanings become necessary, complementary elements in a valid representation of those processes. Furthermore, those processes "make sense" to participants. They represent a more or less coherent representation of how their organizations function. However, most of this knowledge and understanding is tacit, communicated in anecdotes, narratives, and stories (Wilkins, 1989). It should be clear that the discovery and explication of tacit knowledge necessarily calls for qualitative research methods.

The research opportunity sets up a strategic choice for the researcher. We can review the literature, accepted constructs and theories, and the various instruments available to measure and verify aspects of these models and theories. In effect, we would be imposing the understandings of researchers on to the experiences of organizational actors. Alternatively, we can assume that organizational actors are competent in their work, that is, that their successful functioning indicates effective theories of action. In that case, we cannot impose our constructs or instruments. We must search the qualitative content of narrations and interviews to discover meanings and theories-in-use. The constructs, to be measured, are not yet available. The assumption of purposefulness and competence requires, at this stage of the research, qualitative methods.

The Development of Dialectical Inquiry

Our development of Dialectical Inquiry as a method of qualitative research derives from the work of C. West Churchman (1971), as further developed by R. O. Mason (1969). In his book, *The Design of Inquiring Systems*, Churchman compares several competing scientific approaches to testing the truth content of statements including those of Locke, Leibniz, Kant, and Hegel. The purpose was a philosophical analysis of a practical question, "Could a computer determine whether there was life on Mars?"

The dialectic assumes that a thesis and its antithesis can be developed to explain any set of facts and data. This is a strong epistemological assumption. Conflicting models can emerge from facts and data, and both models have valid claims to truth. The conflicts derive from differing interpretative assumptions actors apply to facts and data (Churchman, 1971; Mason, 1969). Paul Feyerabend (1968) applies these principles to science, arguing that the relationship between theory and data is incestuous; theory defines what will be called data, and data, in turn, verifies the theory. Theories should be tested against radically antithetical theories. The point of the dialectic is to posit antithetical theories and models as a method of elucidating the assumptions underpinning those theories and models.

Richard Mason (1969) used dialectical modeling to support decision making for a firm faced with two antithetical strategic plans for its future. There has been an extensive debate on its utility in support of effective decision-making (Cosier, 1981; Mitroff & Mason, 1981; Mitroff & Mason, 1982) in the pages of the *Academy of Management Review*. Given that our focus is on discovery, not decision-making, the benefits with respect to decision processes are not a concern.

The dialectic is clearly a qualitative research method. Its focus is on the content and meaning of models and theories in use. As will be demonstrated in this research, the number of subjects evoking particular models of technology transfer is irrelevant to discovering their meaning. Indeed, one subject richly described all three models that emerged from the research. The significance of each model is its utility in understanding the alternative models.

The Logic of Dialectical Discovery

The focus on discovery forces us to abandon some of the assumptions noted in the above discussion. We cannot assume the availability of competing models; they must emerge from the data. Nor can we arbitrarily limit the number of competing models to two. In principle, there are no limits to the number of potential models. Nevertheless, Dialectical Inquiry does impose a structure on the qualitative research process.

DI imposes a meta-theoretical framework on the research process. It parallels the efforts of others to better structure grounded theory methods, and reduces the "magical moments" that are needed to bridge between emergent theories and data (Carlson & McCaslin, 2003). DI makes the ontological assumption that organizational actors can operate on the basis of multiple implicit models. While the dialectic implies two models, grounded research principles suggest that we do not limit the number of models in use. That becomes an empirical question. Furthermore, DI assumes that such models, upon

analysis, will prove to be in conflict. This does not mean that decisions and processes are necessarily inconsistent or incoherent. Given that these models are tacit, organizational actors will be unaware of inconsistencies. Rather, the DI framework requires that emergent models be distilled so that underlying assumptions, counter assumptions, and contradictions become evident.

The meta-theoretical framework imposed by DI is not about the content of managerial models, but their structure taken as a set. The point is that by juxtaposing tacit models within an imposed structure, their content and meaning will become evident. The logic of DI is an example of Sheffield's (2004) notion of a philosophic method. A philosophical perspective is utilized explicitly to frame inquiry.

These distinctions might be better grasped metaphorically. Imagine organizing processes as a shared *fabric cognitive map* of understandings overlaid in a multiplicity of patterns. As organizational history accumulates and evolves, much of that understanding becomes tacit. The map appears as a dense mass of meanings created by the folding over, under, and into of understandings and interpretations, a wadded ball without beginning or end. The logic of processes becomes obscure. Processes appear to work even if they are poorly understood. Rules of thumb evolve to guide actions encoded in anecdotes, stories, and myths (Wilkins, 1989). These may be understood as "scripts" (Gioia & Manz, 1985). According to Lord and Kernan (1987), scripts are the cognitive knowledge structures that are held in people's memory. In this sense, scripts describe the sequencing of events in conventional or familiar situations.

Scripts work whether they are well understood or not. Moreover, there is no requirement that scripts be consistent. In the case studied, this was the situation that confronted expert managers when they interviewed colleagues across their company. Anecdotal data revealed no apparent logic or pattern. There was nowhere to grasp the *fabric* in the ball; the *map* could not be read.

DI can be used to identify and make explicit models that stretch out the *fabric map* and expose both patterns and interpretations. Imagine each model as a stake stretching its corner of the fabric, exposing part of the *map*. To achieve this stretching, each model must be distilled to an extreme formulation (i.e., to the point where it becomes almost dysfunctional). Practical scripts are composites of these extreme models. Thus, inconsistent models can become the basis for what appears as coherent purposeful action.

The Method of Dialectical Inquiry

The logical structure imposed by DI requires the researcher to identify competing models and explore them in depth. It must be emphasized that these models must emerge from respondents. They should not be controlled by the questions of the interviewer or by categories suggested by the interviewers. In this particular research, the interviewers were themselves unaware of technology transfer models. They asked respondents to explain how technology transfer worked from their experience. The results were anecdotes, narratives, and a variety of assertions. The record of these interviews was the data that we analyzed.

The method was to identify particular themes that seemed to be recurring across interviews. For example, someone claimed that you do not transfer technology. You get the expert. The theme is people. A second theme was about information. Once identified, it becomes possible to document the many instances when a theme is expressed across the interviews. Following the identification of common themes, each was defined as a model that excluded the others.

Conceptual clarity allows the researcher to expose the assumptions that drive the model. Each model incorporates ontological assumptions about organizational functioning. Exclusive models suggest conflicting assumptions and counter assumptions, all of which expose the tacit understandings of how each model "works." If we assume that each model represents some organizational truth and that they are in conflict, it follows that each is incomplete with respect to the truths of competing models. Forcing each model to its extreme stretches the *fabric cognitive map,* making it intelligible.

It must be noted that the identified models are subject to whatever biases interviewers, interviewees, and researchers bring to bear. Alternative sets of models, in dialectical relationships, could also be postulated. We can assume that each model can be a basis for finer distinctions, and the exposure of other models collapsed under a single model. DI provides an initial map that is useful to practitioners and a point of departure for further research.

Our purposes in this research, then, were to apply Dialectical Inquiry as a method of discovery of explicit models shared among competent professionals and managers in organizations, and to demonstrate the efficacy of DI as a qualitative research methodology. The methodological hypothesis is: The imposition of a dialectical structure will distill emergent theories in use by organizational actors that validly represent their tacit understandings.

Discovery versus Imposition

Discovery and imposition suggest conflicting modes of inquiry. The first implies "inquiry from the inside," while the second implies *a priori* categories. (Evered & Lewis, 1981). Glaser and Strauss (1967) suggest that theory should emerge from data. In this research we decided, *a priori*, that a dialectical pattern would be discovered in the interview data. Such believing should result in seeing what researchers expect (Weick, 1979). Nevertheless, this application of DI seeks to bridge the conflict between these approaches.

The *content* of organizational enactments of technology transfer is emergent (i.e., the product of interview data), while the *form* in which they are interpreted is dialectical. In essence, we are saying that while content may not be predictable, the relationship between various scripts, their conflicts, and contradictions are predictable. This imposition of dialectic order may be understood both epistemologically and ontologically. The former assumes that the dialectic structures our ways of knowing the world. The latter assumes that the world is necessarily dialectical and paradoxical.

The Research Setting

ABC is a large aerospace firm with significant resources invested in research and development (R&D), and general dissatisfaction with the effectiveness of technology transfer (or *infusion* as they called it)[1] between R&D units and project groups. An Engineering Management Quality Improvement Team (Management Team or interviewing team), made up of high-level engineers and engineering managers, was chartered by the company to investigate the poor rate of technology infusion. "Why isn't technology infusion more effective" was their concern. The problems appeared to span the entire company and appeared generic to the industry, given many years of public discussion of the issues.

The Management Team interviewed 55 top engineering managers across the company in many geographical locations. Interviewees understood the charter of the Management Team. Individual team members asked interviewees to reflect upon their years of managerial experience, and explain how technology transfer works at ABC. Technology transfer obviously made sense to respondents, no matter how ineffective it was. Yet, the Management Team could not draw useful general conclusions from their highly anecdotal data. The Management Team's report provided a rich and complex picture of technology transfer across the firm. Interviews between competent professionals with shared, but tacit, understandings did not yield a coherent model of technology transfer.

This is a strange outcome for a group of experienced managers in dialog with expert colleagues. The norms of rationality and the presumption of logic should preclude such outcomes. It was to be expected that when managers assume the roles of practitioner-researchers, studying their own organizational processes, they would impose order on the data in a process of socially constructing a reasonable reality (Berger & Luckmann, 1967). Chenail and Maione (1997) raise the question of how practitioner-researchers conceptualize and "evaluate their qualitative research projects in light of their already knowing too much …without being totally overwhelmed by it." Clearly, the ABC Management Team was overwhelmed by the data they collected.

The ABC Management Team, subsequently, turned to the first author for help in "making sense of the data." The challenge for the researcher was to *explain* to the team what they already knew. In other words, to discover patterns and meanings within the anecdotal data they had collected. At no point were the researchers in contact with any of the interviewees. Given that the researcher was not part of the interview process, the authors did not determine the conditions of the Management Team's research. Given that the interviews were conducted between employees of a single firm, it is doubtful that any human subject protections were in place. Indeed, the identities of all of the interviewees were part of the published interview record.

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[1] Technology transfer and infusion may be differentiated as processes between organizations and within organizations respectively. For this discussion, both are assigned a common label - technology transfer.

Technology Transfer

Perhaps the outcome should not be surprising. The management of technology has become an area of increasing concern for government and industry, and an emerging domain of academic research. The rate of development and implementation of new technologies is seen as an indicator of industry competitiveness in international markets (Root, 1990), and the performance of research and development organizations is considered critical to competitive success (President's Commission on Industrial Competitiveness, 1985; Wheelwright, 1985). Considerable government resources are being devoted to R&D to support both defense and commercial technological development. Of particular concern have been the processes of technology transfer (Ancona & Caldwell, 1990; Galbraith, Merrill, & Campbell, 1991).

A characteristic of much research on the processes of technology transfer has been to take technology for granted, while studying organizational variables as determinants of the success or failure of technology transfer efforts. O'Connor, Parsons, Liden, and Herold (1990) suggest that "technology will readily cross boundaries," while human resources practices are not easily transferable. Wilkof (1991) develops a socio-technical analysis of a technological innovation that focuses almost entirely on organizational, social, and cultural factors. In a later paper O'Connor, Parsons and Liden (1992) argue for greater attention to attitudinal and behavioral responses to new technologies. The technology management literature is replete with many models of technology transfer (Ettlie, 1988; March & Sproull, 1990; Rubenstein, 1992), developed as extensions of more or less rational models of organizational processes. There is a tendency to impose academic models upon the phenomena, even at this necessarily preliminary stage of inquiry (Tornatzky, 1992).

New technologies are equivocal, poorly understood (Weick, 1990), and necessarily incomplete (Berniker, 1991). Arguing they are transferable, but for organizational constraints, assumes away their uncertainties and shifts the focus towards attitudes, beliefs, and culture. Several questions are confounded in current research efforts on technology transfer. For example, "Are the issues technological, organizational, resistance to change, motivational, or cultural?" This study suggests that even when there are strong organizational and individual motives for the adoption and implementation of new technologies, and when such technology transfers are intra-organizational among units within the same organization who enjoy proximity, technology transfer can be problematic.

The Process of Dialectical Inquiry

The focus of the research is on the underdeveloped "technology of technology transfer," to use Tornatsky's (1992) perceptive term. Our research purpose was to develop models of technology transfer grounded in the experience of ABC's managers (i.e., make their "technology of technology transfer" explicit). This process involved four distinct steps, each of which is discussed below.

Step 1: Identifying Scripts and Models

Making sense of printed interview notes is necessarily a creative endeavor. The reconstructed logic of the dialectical presentation does not mirror sense-making as it unfolds. The research process required several readings for immersion, familiarity, and note taking. Script search commenced with the fourth reading to seek strong exclusive images that might typify models.

We should differentiate three terms to make the research process more transparent. We see "themes" as a common thread of ideas that suggests a script. A script is a cognitive knowledge structure about how processes work in organizations (Lord & Kernan, 1987). Since scripts are poorly understood, we differentiate them from a "model." The model is characterized by logical coherence (i.e., an understanding of how it works). Thus, the research process is to seek themes in the interview data, infer from these themes a shared script, and develop the implicit model by examining its underlying assumptions. Given that the framework is dialectical, we expect each of these models to contradict the others.

Themes are first identified by a strong unequivocal assertion in the interview notes that purports to exclude alternative assertions. For example, "The best way to transfer technology is to transfer people." Among the many lesser assertions and anecdotes, this assertion stands out as a potential theme. It suggests a strong script (Lord & Kernan, 1987). Taking this theme as a potential theme, the interviews were again reviewed seeking to find further similar statements. It quickly became apparent that many managers shared this view of technology transfer. People spoke of it in many ways. For examples, "People you know," "old boy contacts," "technology exists as good people," and "transfer of technology is essentially the transfer of people." The evidence of this theme could fill pages with quotes from the interviews. It was, by far, the most frequent of the technology transfer models discussed by the interviewed managers. This model, or script, was tentatively labeled the "people-mover model".

Once the first script had been verified with a plethora of quotations from the interviews, a similar search was conducted for a second model. The dialectic framework was used as a heuristic. Specifically, we sought a strong assertion that, in some way, excluded the first script. Did any interviewee deny the first theme? Again, a strong assertion triggered recognition of a potential second theme, "We need directives to force projects to… document…" Note that the subject is information. People are not mentioned, signaling an alternative theme. This theme was initially narrowly labeled the "documentation model". However, further review of the interviews suggested a more inclusive label, the "*communication model,"* to include references to documentation, symposia, seminars, bulletins, databases, etc… The references to this model, less frequent than the "people-mover model" took many forms. Examples include, "We need more corporate memory," "more communication," "projects should be briefed," and "total lack of documentation." There were also many references to journals, updates, briefings, meetings, seminars, symposia, and the need for databases. This clearly qualified as an important and frequent theme in the interviews.

The third model proved more elusive. The most frequent references were to the first two models. Furthermore, while DI implies at least two models, there is no requirement for more to emerge. Statements, that implicitly denied both these models,

yielded two more "scripts." Examine the following statement: "For a technology to be ABC on-the-shelf, ABC must put it on the shelf." There is no mention of people, communication, or documentation. A different theme is signaled here. We tentatively labeled this third theme the "on-the-shelf model."

The discovery of the "on-the-shelf model" required some reflection about the first two models. The first model was emphatically about people, while the second was clearly about information. The third had to relate to some other domain. It took some imagination to parse a set of quotes that seemed to suggest a similar script. Paraphrased, the following are examples.

- Program requirements call for the utilization of a proven concept… implies the availability of appropriate specifications, allowables and design manual information . . .
- Not enough data exists to assure low risk.
- Risk avoidance [guides selection].
- Allowables did not exist.
- A need exists for rigorous and objective classification of the maturity of a technology.

The term "allowables" is retained because it signaled the concerns of the engineers. "Allowables" refers to the design limits of a new technology. To jump ahead, they are about the conditions where the new technology will NOT work.

This script clearly, refers to aspects of the technology itself and not to experts or the means used to convey knowledge to others. Conceptually, each of these scripts is quite different. One is about people, the second is about information, and the third is about the technology. The last quote captured the essence of the model. It was about the maturity of the technology. It should be noted that the first author's engineering background allowed him to discover the script suggested by this last group of quotations. This third model was relabeled as the "maturity of technology model" to reflect its content more explicitly.

Step 2: Defining the Models

The next step in the process was for the researcher to invent definitions of each model. The model is not a scientific construct. It is a theory-in-use (Argyris & Schon, 1978) by organizational members. While evidence will be offered that it may be generalizable to other organizations, it is not connected to academic organizational theories. The purpose of these definitions was to provide a basis for developing a set of assumptions that explicate each model. The definitions provide tentative formal meaning to the metaphorical labels that derived from the subjective analysis and coding of the interview data.

The process of defining each model is iterative. A definition based on the interview data is ventured and its assumptions are made explicit. These assumptions are tested against the definitions and assumptions of competing models. Each definition is honed so that it is consistent with its own assumptions and opposed to those of competing models. This creates a dialectic structure where each model anchors an extreme position.

This structure, anchored by extreme conflicting models, creates a framework of understanding within which the interviewing team could make sense of their findings.

We must emphasize that this structure represents a framework for thought, not action. Practical actors draw from all of these models without understanding their explicit content. The research goal was to make that content explicit, so that actors could more intelligently deal with the challenges of technology transfer.

We begin with model definitions that emerged from the process.

A. The people-mover model

> Technology transfer occurs when a person expert in an advanced technology is assigned to a program and produces outcomes in that program that utilize that technology.

B. The communication model

> Technology transfer is essentially a communication process affected through the documentation of research and development and dissemination through the media of documents, databases, seminars and presentations.

The definition developed for the maturity of technology model demonstrates the iterative nature of the process. We cannot simply label and define a model. We must test it against the other models and for consistency with the interview data. We, first, ventured the following definition,

C. The maturity of technology model – Tentative definition

> Technology transfer takes place when results, data, and specifications are sufficiently complete to allow a designer to apply the technology and such applications have occurred.

Is it about the technology or the designer? If the R&D experts are the designers, the model collapses into the people-mover model. The dialectic requires a sharper differentiation. The definition did not carefully relate to the maturity of the technology. A second definition proved more explicit. The notion of maturity is anchored to the ability to utilize the technology. Even this definition is somewhat problematic because of the overlap with the communication model. However, as a basis for testing assumptions and counter-assumptions, it proved adequate.

C2 The maturity of technology model

> Technology transfer takes place when a technology is mature and sufficiently complete knowledge has been communicated to designers and engineers to utilize that technology practically and effectively.

A possible fourth model

A fourth script hinted at in the data argued that technologies are purchased from suppliers, and thereby developed for engineers and designers. Typical of the type of assertion indicative of this script was "It is more prudent to put risk for technology infusion on the shoulders of suppliers." The problem with this model is that technology refers to knowledge that can be used predictably. Given this recognition, suppliers do not transfer technology: They simply provide hardware or related supplies. They may learn a new technology in producing their products, but their knowledge remains with them. This model was rarely mentioned in the interviews. Given the charter of the interviewers and the specific focus on technology transfer within the company, this model was not explored.

Upon further reflection, exploration of this model might have yielded interesting results. Some managers appear to be too risk averse to engage the challenges of technology development and transfer. That suggests that another barrier to technology transfer is risk avoidance. It would have been difficult, given the paucity of responses, to explore this model. Moreover, the focus of the interviewing team may have suppressed the expression of risk avoidance. It may have been very significant, but that could not be inferred from the interview data.

Step 3: Assumptions and Counter Assumptions

The meaning of each model is further clarified by inferring the assumptions underpinning each model. In this qualitative methodology, researchers maintain relative freedom in developing their taxonomy from the interview data. The models become the objects of further conceptual inquiry. In seeking assumptions, researchers escape the limitations of the anecdotal data.

This is, therefore, a creative and iterative process. The assumptions of each model are tested against competing models to reveal counter assumptions. These, in turn, force further clarification of the original assumptions. The purpose is to make salient the differences between models and sharply distinguish between them. Our interpretations of the assumptions and counter assumptions are displayed in Figures 1, 2, and 3. It should be clear that these lists are not exhaustive.

Figure 1. The people-mover model: Assumptions and counter assumptions.

The People-Mover Model - Definition

Technology transfer occurs when a person expert in an advanced technology is assigned to a program and produces outcomes in that program that utilize that technology

Assumptions

People-Mover Model	Communications Model	Maturity of Technology Model
Assumptions	Counter Assumptions	Counter Assumptions
Technology is knowledge in the mind of an expert	Technology is the transfer of knowledge not people.	Designers cannot use an immature technology.
Advanced technologies cannot be transferred by other means.	Advanced technologies can be documented sufficiently for application.	Advanced technologies may not be mature enough for application.
Technology transfer means producing components for projects.	Transfer is evidenced by documentation, not time spent on a project.	Expert learning is not equivalent to applications by designers.

Figure 2. The communications model: Assumptions and counter assumptions.

The Communication Model - Definition

Technology transfer is essentially a communication process affected through the documentation of research and dissemination through the media of documents, data bases, seminars, and presentations.

Assumptions

Communication Model	People-Mover Model	Maturity of Technology Model
Assumptions	Counter Assumptions	Counter Assumptions
Technology at any level of development can be transferred.	Researchers must apply a technology to document it for others.	Immaturity makes a technology unusable for designers.
Designers and engineers will apply technical information gained through information dissemination.	Without researcher expertise, designers will not sufficiently understand that information.	Technology transfer is a learning process accomplished by application of a technology.

Figure 3. The maturity of technology model: Assumptions and counter assumptions.

The Maturity of Technology Model - Definition

Technology transfer takes place when a technology is mature and sufficiently complete knowledge has been communicated to designers and engineers to utilize that technology practically and effectively.

Assumptions

Maturity of Technology Model	People-Mover Model	Communications Model
Assumptions	Counter Assumptions	Counter Assumptions
The core limitation is the maturity of the technology	State-of-the-art technology is not transferable to the untalented.	Where is the "shelf" if not in the documentation?
A mature technology can be learned by a competent designer	Too much of a new technology remains intuitive to the expert.	Too little of the technology will have been documented.
Application will be evident to designers.	Application will be more evident to researchers	Evidence of applicability needs to be documented
Designers will pull them from the "shelf	Only old technologies are "on-the-shelf."	How does a mature technology become known as "on-the-shelf?"

Step 4. Identify and Define Contradictions

This process forces each model into its extreme interpretation further illuminating differences. Conflicting models suggest that effective technological transfer is necessarily a paradoxical process (Cameron, 1986). This suggests a hypothesis that goes beyond current DI practice.

> Given that each model has relevance and validity, and given that they are in conflict, then, necessarily, each model is limited and incomplete. It follows that each model is self-contradictory if pushed to an extreme.

If each model grasps an essential truth, and each is in conflict with the others, then each model is necessarily incomplete. It follows that attempting to apply any of these models, while ignoring the others, will lead to failure.

So clarified, the models developed through the DI process can better serve as a basis for parsing discussions on such broad concepts as technology transfer. More important, pushing each technology transfer model to the point of self-contradiction unambiguously establishes its meaning. This appears to liberate it from a host of other organizational variables creating a basis for generalizing each model to other organizational settings. We would expect all aerospace firms engaged in research to face similar technology transfer challenges. Research interpretations of contradictions inherent in each of the three models developed from DI analysis of the interview data follow.

People-mover model contradiction

Clearly, experts moved to projects to develop applications increase their knowledge of a new technology, but do they transfer that knowledge to others? More likely, it remains with the expert. Thus, this model can collapse into a supplier model. Experts return to research facilities, and only project hardware and software remain after them. The interviews provided ample evidence for this outcome, for example, "We do not manage to capture our past knowledge and experience" and "Old boy' contacts . . . will present difficulties when we lose older people." In short, without a mechanism for teaching and learning, technology will not be transferred.

The contradiction, then, of the people-mover model is: Simply employing the expert to solve a specific problem may assure that he or she learns more about a technology. Without provision for teaching and learning, the technology will not be available to others.

The communications model contradiction

The contradiction relates to the content of the knowledge required for effective technology transfer and to learning processes. Advanced technologies are necessarily incomplete and untried. We may know how they work. Without application, we are unlikely to know their design limits (i.e., the conditions when they will not work).

Thus, it is what is unknown about an immature technology that may be more important than the known. The contradiction inherent in the *communication model is:* The expectation that researchers can document and communicate what they do not know.

The maturity of technology model contradiction

The primary contradiction is the process of putting a technology on-the-shelf. An immature technology must be applied to develop the design parameters and limitations of its utilization. The maturity of technology model requires exactly this information as a precondition for such applications. In effect, the model calls for technologies to be transferred before they will be applied; to "bootstrap" themselves.

Therefore, the contradiction inherent in the maturity of technology model is: An immature technology must be applied to develop its design parameters and limitations. Yet, the model requires exactly such information as a condition for such applications.

The Requirements for Effective Technology Transfer

The three models suggest particular requirements for the successful transfer of technology from research and development to utilization in practical designs.

- Experts knowledgeable in the technology must work with designers and engineers.

It is clear that too much of the knowledge in new technologies is implicit and untested for, to be utilized without expert direction and experience.

- The new technology must be tested to establish its design limitations.

The process of utilization creates the conditions for testing a new technology and discovering its design limits. Experts will learn from both designers and testing of new designs. Until design limits are verified, the new technology will be considered immature and problematic.

- The process of application and testing must be sufficiently documented for the technology to be useable for other designers.

It is not sufficient to successfully utilize a new technology in a particular application. It is necessary to document the design, the variables, and the nature of the tests. The technology will not have been transferred unless there is sufficient documentation to attest to its maturity and inform its utilization.

In effect, a technology will have been transferred when project engineers have mastered it well enough to teach it to others and do so, it is well enough documented so that others can learn it, and it has been applied and tested sufficiently for its limitations to be understood.

Methodological Reflections

Recognition of each of these tentative models was triggered by strong negative constraints on technology transfer. "We do not transfer technology, we get the expert." "They don't document." "It must be on the shelf." "We don't transfer technology, we purchase hardware." While the models seem self-evident from the data, they are, nevertheless, the interpretations of the researcher, not the subjects. "The laws of science may thus be *descriptions* of how the world looks… or *prescriptions* for how to look at the world. We really have no way of knowing which" (Weinberg, 1975, p. 203). The dialectic was imposed on the data as a prescription for discovery. To be valid as descriptions of technology transfer, their validity had to be tested.

With the framework complete and appearing to encompass all of the interview data, and the cognitive maps implicit in the data stretched, to reveal competing perspectives, all of the data and analysis (enriched by many quotations from the management team interview notes) were presented to the management team, who had conducted the interviews. The presentation took over four hours and proceeded in exactly the order presented here. Much time was devoted to exemplifying the models and their assumptions with interview data. Given that the researchers' interpretive processes moved them well beyond the interview data, it was necessary to test the validity of their models and assumptions.

Reality Checks – Internal Validity

Once assumptions, counter assumptions, and contradictions are explicit, it is important to perform reality checks on the findings. Argyris and Schon (1978) have argued that subjects should test valid information. Weick (1989) sets some criteria for the validation of theories that are as appropriate for manager's theories as those of scientists. The foremost criterion is "plausibility." This is especially important if the object of inquiry is sense-making enactments. Aubusson (2002) also argues that interpretations should be checked with those who have direct knowledge of the phenomena.

At the end of the presentation, two questions were asked of the management team. The first was a test of internal validity, "Do the findings conform to your experience of the practices of technology transfer in ABC and do they constitute a reasonable interpretation of the interview data?"

The management team, of course, had conducted all of the interviews. They had access to all the company data, and constituted a panel of experts on technology transfer in the organization. The management team's response was remarkably positive. It was asserted that the models represented the interviews well, albeit with different labels and images. Indeed, one member expressed his relief that someone had finally made sense of their findings. Furthermore, the management team found the models *interesting* and *believable*, two other criteria set by Weick.

The following question was a test of *internal* validity, "How consistent were the results in representing the interview data?" Given the rich debates on the validity of qualitative findings (Winter, 2000), it is important to define what the researchers meant by validity. DI, in this research, was employed as a method of *discovery*, not measurement. Internal validity, in this case, meets the criteria suggested by Winter, in so far as it represents the meanings and experiences of individuals, and a group of knowledgeable professionals. The three models of technology transfer were an interesting, useful, believable, representation of the data gathered by a team of subject matter experts. It made sense to them.

Internal validity does not imply an exclusive frame of reference. It is certainly possible that a set of alternative models might also demonstrate their validity and provide other insights into the complexities of technology transfer.

Reality Checks – External Validity

A more important test is external validity. Winter (2000) argues that external validity is not usually important to qualitative researchers. "Qualitative findings are best generalizable to the development of theories and not wider populations." We disagree; external validity, as we define it, proved to be very important in this research. Given the characterization of technology transfer, in terms of ideal types of models, the models may be generalizable across many organizations. That is, the challenges represented by these models may be inherent in the field of advanced technological development, independent of particular organizations and their practices. They may be formulated differently if examined from a different perspective, but they cannot be avoided.

Distilled to their essentials and stripped of the accretions of particular organizational cultures and practices, ideal models should be valid for all large organizations faced with the challenges of technology transfer. It was important to test this conclusion leading to a second question. "Can any aerospace organizations of similar size and complexity escape the implications of the three models derived from the analysis?"

The management team had rich industry experience, and had interacted with colleagues across the industry for many years. They were asked to reflect on whether these models were not inherent in the technology transfer enterprise, a valid characterization of technology transfer processes across many different firms.

Note what is and is not implied by the question. The question does not suggest that other organizations conduct technology transfer efforts in a way similar to ABC. It does not specify particular practices. It asks whether the practices or understandings of other firms could be mapped on the basis of these models.

Again, the management team concluded that the proposed models were valid. In their experience, and on the basis of their many contacts in the industry, they saw these models as reflecting industry wide issues. The models appeared "generic," although many other such models might have been developed.

External validity has particular organizational relevance. If the models are "generic," they are not a function of personalities, local organizational cultures, structures, or management styles. Recall that these are the variables in most research on technology transfer. Most of the models discussed in the literature were developed as extensions of theories and models of organizational processes (Ettlie, 1988; March & Sproull, 1990; Rubenstein, 1992). Generic models should lead us to question much of this quantitative research on technology transfer.

The recognition of generic challenges and models of technology transfer change the discourse within the organization. The issues are not leadership, personalities, culture, or organizational structure. They are inherent in the endeavor. Even if every unit is effective and competent, these challenges will remain. That creates an opportunity to collaborate across units rather than fight about responsibility for failure, and enables the organization to transcend disruptive conflict at least with respect to technology transfer issues.

Synthesis

Further reflection on the findings lead to a synthetic model for technology transfer that incorporates the requirements of each model elicited by DI. An effective process may be defined as:

> Technology transfer is a process where advanced and immature technologies, developed and understood by experts, become tested and documented bodies of knowledge accessible and usable by designers who have gained the competence to apply them effectively.

This process requires much more than meets the eye. Experts must be given opportunities to test out new technologies in practical applications. Those efforts must exceed the requirements of particular projects to discover the full range of design "allowables" and limitations. Parallel with this evolution of the technology, adequate documentation must take place to preserve knowledge gains. In addition, designers must be associated with the process in ways that allow them to gain competence as the practicality of the technology unfolds. A key aspect of the process is the shift in focus from knowledge to application, from experiment to product, and from research to design.

The project concluded with a proposal for a technology transfer team organization, as an extension of a project team, charged with the dual goals of producing an item of required hardware and effecting technology transfer to the wider ABC organization. By linking the two goals, we can overcome a glaring deficiency of present technology transfer practice. Technology transfer appeared in the interviews as an incidental outcome of the regular work of researchers, designers, and managers (i.e., a goal to be achieved at no extra cost). The proposal recognized that technology transfer demanded specific efforts.

ABC identified three projects involving technology transfer in a variety of aerospace operations. The authors could not be involved in these projects for security reasons. In addition to completing their projects, the teams were charged with transferring the new technology utilizing the synthetic model defined above. As is often the case in complex R&D endeavors, two of the team projects were terminated for reasons independent of the technology transfer agenda. The third team, according to a report, completed its work and was able to successfully transfer a new technology. That is, the project engineers were able to continue to apply the new technology on further projects.

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Conclusions and Implications

Our conclusions address two levels of concern, the research outcomes and Dialectical Inquiry as a qualitative research method. The research effort was successful. We were able to "explain" the management team's interview data to them. We provided them with a classification framework with which to understand and evaluate the many organizational proposals to change, improve, and codify technology transfer processes across the organization. That was the management team's charter and the ultimate purpose of our research.

The issues did not go away as this was a widely dispersed, complex, aerospace company with research efforts distributed across the company. There were always proposals, programs, and other managerial and administrative efforts to improve technology transfer. The members of this Engineering Management Quality Improvement Team were able to classify such initiatives in terms of these models, and foresee their limitations and challenges. Given the classified nature of their projects, the researchers were not able to discover how widely the research results were disseminated. In an interview with one manager many years after the research, the results were still remembered and found useful in his management role.

Confronted with rich, anecdotal, "thick descriptions" (Geertz, 1973) constituted by multiple, implicit, frames used by organizational actors (Goffman, 1974), Dialectical Inquiry proved to be a useful qualitative method. It achieved one of the purposes of

ethnomethodology (Garfinkel, 1968), by making explicit the theories-in-use of a set of organizational actors. While the method imposes a structure to these theories, their content is distilled from the descriptions of respondents. We believe that our tests for validity are particularly appropriate for qualitative research. We took Kaplan's (1964) admonition seriously that our data must be tested against the understandings of organizational actors. Organizational subject matter experts who were, competent technologists, validated our interpretations. External validity, which we saw as the generalizability of the findings, not the method, across the domain of technology development and transfer, was tested with the same group and validated. Clearly, more testing of the models would be necessary to increase confidence in both internal and external validity.

We have not demonstrated the efficacy of DI in a wide range of settings. The research represents a special case among social and organizational settings. The work of the team was well specified. The focus was not on organizational interactions, but a particular process. While technology transfer is a complex endeavor, it is not "wickedly structured." Wickedly structured problems are those where there is no agreement on goals or means (Mason & Mitroff, 1981). There is agreement on the goals of technology transfer. DI should work well even when dealing with wickedly structured situations. However, its efficacy in a wide range of applications remains to be demonstrated.

We have demonstrated that the imposition of a dialectical form to qualitative inquiry deepens understanding of multiple perspectives. By allowing for concurrent competing perspectives, we can refine each perspective, its constructs and meanings, and the relationships between perspectives without blurring and over-generalizing their content; that is a source of validity. It raises important issues for quantitative methods.

- Why do we assume that single constructs, however reliable, accurate, and repeatable their measurement may be, can characterize complex social universes?
- Why do we believe that theories constituted by sets of such constructs can adequately encompass a complex organizational or social universe?

In addition, Dialectical Inquiry suggests a similar set of questions for qualitative researchers.

- Is the world to be researched constituted by multiple, paradoxical, competing processes?
- Are participant perceptions, in that world, constituted by multiple, antithetical understandings?
- If so, what methods of qualitative research can capture this world?

Among the interviewees at ABC was a manager who clearly articulated all three models of technology transfer without any appreciation of their inconsistencies. He was a competent, rational actor capable of effective action in a complex, poorly understood world. There are many like him. After all, technology transfer has been going on successfully for millennia.

References

Ancona, D. B., & Caldwell, D. (1990). Beyond boundary spanning: Managing external dependence in product development teams. *Journal of High Technology Management Research, 1*(2), 119-135.

Argyris, C., & Schön, D. A. (1978). *Theory in practice: Increasing professional effectiveness.* San Francisco: Jossey-Bass.

Aubusson, P. (2002). Using metaphor to make sense and build theory in qualitative analysis. *The Qualitative Report, 7*(4). Retrieved June 13, 2005, from http://www.nova.edu/ssss/QR/QR7-1/aubusson.html

Berger, P. L., & Luckmann, T. (1967). *The social construction of reality*. Garden City, NJ: Doubleday, Anchor Books.

Berniker, E. (1991). Models of technology transfer (A dialectical case study). In D. F. Kocaoglu, K. Niwa, & K. Brockhoff (Eds.), *Technology management: The new international language* (pp. 499-502). New York: Institute of Electrical and Electronics Engineers.

Cameron, K. S. (1986). Effectiveness as paradox: Consensus and conflict in conceptions of organizational effectiveness. *Management Science, 32*(5), 539-553.

Carlson, N. M., & McCaslin, M. (2003). Meta-inquiry: An approach to interview success. *The Qualitative Report*, *8*(4), 549-569. Retrieved June 13, 2005, from http://www.nova.edu/ssss/QR/QR8-4/carlson.pdf

Chenail, R. J., & Maione, P. (1997). Sensemaking in clinical qualitative research. *The Qualitative Report, 3*(1). Retrieved June 22, 2005, from http://www.nova.edu/ssss/QR/QR3-1/sense/html

Churchman, C. W. (1971). *The design of inquiring systems.* New York: Basic Books.

Cosier, R. (1981). The dialectic in strategic planning: A case of premature acceptance? *Academy of Management Review, 6*(3), 643-648.

Ettlie, J. E. (1988). *Taking charge of manufacturing.* San Francisco: Jossey-Bass.

Evered, R., & Lewis, M. R. (1981). Alternative perspectives in organizational sciences: "Inquiry from the inside" and "inquiry from the outside." *Academy of Management Review, 6*(3), 385-395.

Feyerabend, P. K. (1968). How to be a good empiricist—A plea for tolerance in matters epistemological. In P. A. Nidditch (Ed.), *The philosophy of science* (pp.12-39). London: Oxford University Press.

Galbraith, C., Merrill, G., & Campbell, K. (1991). The vertical transfer of technological know-how in the Navy research and development community. *Journal of High Technology Management Research, 2*(1), 15-33.

Garfinkel, H. (1968). The origins of the term "Ethnomethodology." In R. Turner (Ed.), *Ethnomethodology* (pp. 15-18). Middlesex, England: Penguin.

Geertz, C. (1973). *The interpretation of cultures.* New York: Basic Books.

Gioia, D. A., & Manz, C. C. (1985). Linking cognition and behavior: A script processing interpretation of vicarious learning. *Academy of Management Review*, *10*(3), 527-539.

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded research: Strategies for qualitative research.* Hawthorne, NY: Aldine.

Goffman, E. (1974). *Frame analysis*. New York: Harper Colophon.

Kaplan, A. (1964). *The conduct of inquiry*. San Francisco: Chandler.

Lord, R. G., & Kernan, M. C. (1987). Scripts as determinants of purposeful behavior in organizations. *Academy of Management Review*, *12*(2), 265-277.

March, J. G., & Sproull, L. S. (1990). Technology, management, and competitive advantage. In Paul S. Goodman, Lee S. Sproull, & Associates. (Eds.), *Technology and organizations* (pp. 144-173). San Francisco: Jossey-Bass.

Mason, R. O. (1969). A dialectical approach to strategic planning. *Management Science*, *15*(8), B403-B414.

Mason, R. O., & Mitroff, I. I. (1981). *Challenging strategic planning assumptions: Theory, cases, and techniques*. New York: Wiley.

McNabb, D. E. (2004). *Research methods for political science*. New York: M. E. Sharpe.

Mitroff, I. I., & Mason, R. O. (1981). The metaphysics of policy and planning: A rejoinder to Cosier's "the dialectic in strategic planning." *Academy of Management Review, 6*(1), 649-652.

Mitroff, I. I., & Mason, R. O. (1982). Business policy and metaphysics: Some philosophical considerations. *Academy of Management Review, 7*(3), 361-371.

Morgan, G. (1986). *Images of organization.* Beverly Hills, CA: Sage.

O'Connor, E. J., Parsons, C. K., & Liden, R. C. (1992). Responses to new technology: A model for future research. *Journal of High Technology Management Research, 3*(1), 111-124.

O'Connor, E. J., Parsons, C. K., Liden, R. C., & Herold, D. M. (1990). Implementing new technology: Management issues and opportunities. *Journal of High Technology Management Research, 1*(1), 69-89.

President's Commission on Industrial Competitiveness. (1985). *Global competition: The new reality.* Washington, DC: U.S. Government Printing Office.

Root, F. (1990). U.S. high technology industry and international competitiveness. *Journal of High Technology Management Research, 1*(1), 91-102.

Rubenstein, A. H. (1992). Research opportunities in the study of entrepreneurship in the large firm: A propositional inventory. *Journal of High Technology Management Research, 1*(3), 83-110.

Sheffield, E. (2004). Beyond abstraction: Philosophy as a practical qualitative research method. *The Qualitative Report, 9*(4), 760-769. Retrieved June 26, 2005, from http://www.nova.edu/ssss/QR/QR9-4/sheffield.pdf

Tornatsky, L. G. (1992). Tools for living in interesting times. *Journal of Technology Transfer, 7*(1), 5–7.

Weick, K. (1979). *The social psychology of organizing* (2nd ed.). Reading, MA: Addison-Wesley.

Weick, K. (1989). Theory construction as disciplined imagination. *Academy of Management Review, 14*(4), 516-531.

Weick, K. (1990). Technology as equivoque: Sense-making in new technologies. In P. S. Goodman & L. S. Sproulls (Eds.), *Technology and organizations* (pp. 1-44). San Francisco: Jossey-Bass.

Weinberg, G. M. (1975). *An introduction to general systems thinking*. Boston: Wiley Interscience.

Wheelwright, S. C. (1985). *Product development and manufacturing start-up.* New York: Booz-Allen Hamilton.

Wilkins, A. (1989). *Developing corporate character*. San Francisco: Jossey-Bass.

Wilkof, M. V. (1991). A socio-technical analysis of an attempted innovation: The clash of cultures. *Journal of High Technology Management Research, 2*(1), 99-112.

Winter, G. (2000). A comparative discussion of the notion of "validity" in qualitative and quantitative research. *The Qualitative Report* [On-line serial], *4*(3/4). Retrieved July 22, 2005, from http://www.nova.edu/ssss/QR/QR4-3/winter.html

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