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THE DANCE: GETTING MANAGERS AND MINERS ON THE FLOOR TOGETHER

A case study was conducted to understand why a large Canadian financial institution had a dissatisfying experience with its data warehousing activities. The "dance" metaphor was used to describe three types of social relationships representing the data mining process.

Introduction

In today's competitive environment, businesses have become dependent on data to support intelligent strategic decision-making. An increasingly common practice in organizations is to leverage technology, specifically their data warehouse, to discover deeper insights into customer preferences and behavior (as is common in CRM applications), which in turn provides a source of competitive advantage (Wixom, 2000; Grecich, 2000). Data warehouse end-users are made up of business analysts and data miners (Haley, 1998). Business analysts perform ad hoc queries and multi-dimensional statistical analysis to support decision-making. Data miners are skilled in analyzing data in the warehouse using complex mathematical, statistical techniques, and artificial intelligence. Their goal is to find new, hidden, and unexpected patterns in data (Wixom, 2000). Although this paper technically studies both business analysts and data miners, we refer to both users as "data miners" in the study.

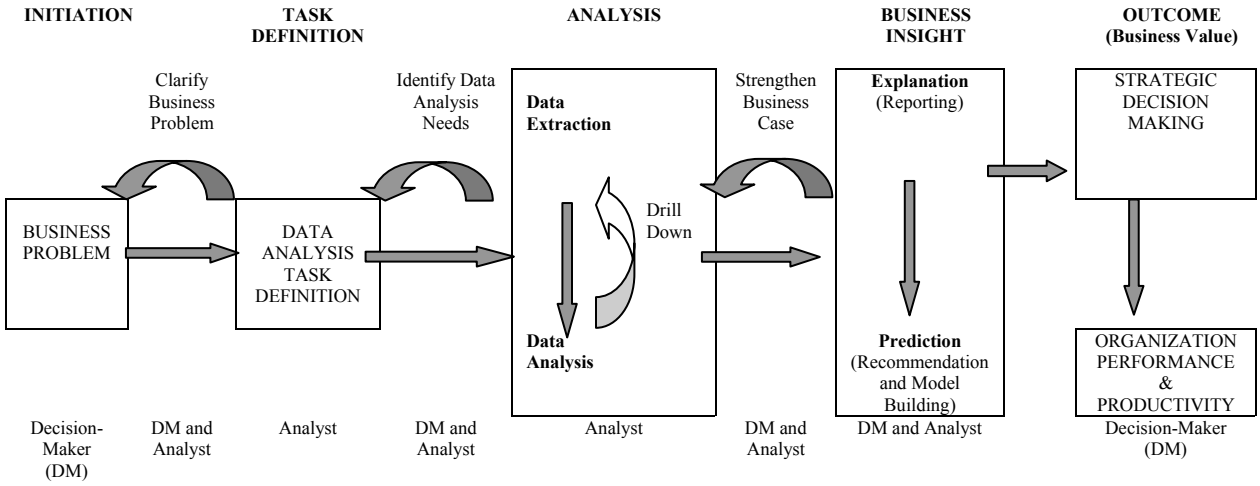
Increased technology complexity has changed the user environment (Watson, Annino et al., 2000); practitioners see managing the new user environment as one of the most prominent challenges of data warehouse implementation (Sakaguchi and Frolick, 1997). Three years following the data warehouse's implementation at a large financial institution, the situation was one where increased data warehouse usage demand from business managers was accompanied by feelings of frustration, dissatisfaction, and a high turn over rate amongst data miners. An in-depth case study was conducted to understand social interaction relationships between stakeholders; as a result, we introduce a "dance" metaphor to describe effective interactions in a complex data mining environment.

This paper is structured as follows. In the next section, the relevant literature on data warehousing is briefly introduced, along with a theoretical lens we deem appropriate. Next, the methodological approach we chose to conduct this research is discussed. Then, we present the results of our inquiry, and later discuss our findings and suggest ideas for future research.

Decision Support in a Complex Environment

Compared to a transactional database environment, the data mining process is complex as it is multifaceted and iterative; six primary stages include business problem, data exploration, data preparation, data analyses/modeling, interpretation/evaluation, and deployment (Feelders, Daniels and Holsheimer, 2000; Shearer, 2000). The Business Intelligence Value Chain (see Figure 1) is a data mining process model that describes the interaction between decision makers and data analysts throughout the data mining process (Brohman et. al., 2000). In this model, managers and data miners interact throughout the data mining process sharing cognitive and technical elements of tacit knowledge to clarify the business problem, identify data analysis needs, and strengthen the business case to support decision making.

Figure 1: The Business Intelligence Value Chain (Brohman et. al. 2000)



There are two views of social interaction relationships: one view focuses on the structure of the relationship, and the other focuses on the attributes of the people (Fiske, Haslam, and Fiske, 1991). In relationships focused on attributes of people, people may lose track of the identity (i.e., rank and expertise) of the particular person who is their partner. Conversely, in interactions focused on the structure of the relationships, the identity of the partners remains salient. Fiske's (1991) theory of social relations defines four elementary relational structures that govern the circulation of things that underlie the organization of work: communal sharing, authority ranking, equality matching, and market pricing. He suggests that people use these elementary relational models as the basis for the formation of groups, group structure, and norms.

As organizations become more dependent on data to make strategic decisions, managers are becoming more dependent on data miners to discover deep insights in data. This is a fundamental relationship shift from the data center days when managers simply made structured requests for information and data miners delivered. To effectively work together as a team, data miners need internalized behavioral routines about team structure and process (Cannon-Bowers, Salas, and Converse, 1993).

To better understand such internalized behavioral routines about team structure and process, while concealing the complexity of such routines, we suggest adopting the concept of

metaphor. The use of metaphors has proven to be a powerful tool for organizational diagnosis and to simplify the complexities of organizational life (Cleary and Packard, 1992). Metaphors may serve as a cognitive reference point for partners; metaphors aid partners in predicting the behavior or needs of other members and provide a structure for working together as a team (Gibson and Zellmer-Bruhn, 2001). Researchers in systems development have touched upon metaphors and their usefulness to systems analysis and design (Walsham, 1991). However, no previous studies were found that adopted metaphors to study systems usage. A fundamental challenge faced was to identify an appropriate metaphor to describe social interaction relationships in data mining; we deemed a "dance" metaphor to be appropriate.

Formation in dance is a fundamental characteristic that differentiates between dance styles. Formation is defined as the relationship between the dancers that defines the intention of the movement to the movers (Humphrey, 1970). Dance styles that form on a leading relationship have one dancer that moves "to" the lead of the other. Dance styles that form on an equality relationship have dancers that move "with" one another. To create the "dance" metaphor, we related the relationship between dancers to Fiske's (1991) elementary relational models to describe different routine team structures in data mining as different "dance" styles.

Methodological Approach

This case study was supported by a grounded theory research methodology (Glaser and Strauss, 1967; Strauss and Corbin, 1990). As described by Schwandt (1997), grounded theory uses a qualitative approach and techniques of induction, deduction, and verification to develop or elaborate a theory about a phenomenon. Prior to our entry in the field, we did not have any a priori (theoretically speaking) other than our general knowledge of the literature on data warehousing and data mining along with an appreciation of the situation in the decision support group at the organization (i.e., unsatisfactory data mining process, even after the data warehouse had been implemented for three years).

Data Collection and Analysis

The selected organization was one of the largest financial services providers (later referred to as the bank) in North America. At the time of the research, the data warehouse was three years old and the DSS department had grown from 6 data miners in 1997 to 30 in 1998. Sophisticated data miners (i.e., Masters degrees and above) were hired to provide in-depth data mining and decision support. As marketing managers grew more eager to draw benefits from integrated data in the data warehouse, the number of requests (both simple and complex) to the DSS department increased. DSS employees became more and more dissatisfied with these simple requests as their competence and preference were better aligned to more complex analysis.

The first author conducted 19 interviews within the bank: 11 were with data miners from the DSS departments, whereas the remaining 8 were with the managers from the Marketing department. These interviews were conducted from June 8, 2000 to June 16, 2000. All employees in Decision Support Services and Retail Card Products and Marketing (total of 29) were invited to participate. Of the 10 not considered in our study, three participated, but the recorder failed to capture an audible file of their interview. The other seven chose not to participate primarily due to holidays and busy schedules. Interviews were semi-structured in their format, with the early interviews having more general, open-ended questions, and the later interviews having questions that were more specific, but still open-ended. Interviews lasted, on average, 45-minutes minutes;

they were all tape-recorded and fully transcribed, which led to sixty-four pages (single-line) of interview material.

The analysis of data was done with the help of Atlas.ti®, a qualitative data analysis tool facilitating the coding of data. Data analysis in grounded theory is composed of three major types of coding — open, axial, and selective. *Open coding* was the process of breaking down, examining, comparing, conceptualizing, and categorizing data. Such coding was realized by comparing each incident, event, quote, and other instances gathered during the data collection for similarities and differences. From the verbatim interviews and field notes, similar textual segments were labeled and grouped to form codes. Overall, 101 codes were created. Each code was associated with one or many text segments, so that overall, the 101 codes represented 474 text segments.

Axial coding necessitated that the data be put back together in new ways by making connections between codes to form categories. This was done by using Strauss and Corbin's (1990) "paradigm model", where categories are linked through a set of relationships denoting causal conditions, phenomenon, context, strategies, and consequences[1]. The causal conditions are the events, incidents, happening that lead to the occurrence or development of a phenomenon. The context refers to the set of properties that pertain to the phenomenon. The strategies are devised to manage, handle, carry out, or respond to a phenomenon. Finally, the consequences are the outcomes of these strategies.

The phenomenon of interest, discovered within the axial coding phase, was the extent to which different types of collaborations existed, between data miners and marketing managers, in their quest for insight through data mining. A sample of the categories and codes related to the conditions, context, strategies, and consequences associated with the phenomenon are summarized in Table 1. Overall, axial coding resulted in the reclassification of data into 22 larger categories. Of the 101 initial codes, only 85 were useful in creating these categories; the remaining 16 codes either lacked sufficient textual segments to support them or were deemed irrelevant to the phenomenon of interest.

Selective coding was the process of validating the relationships among components of the model, and further refining categories that needed development. In effect, selective coding refers to the integration of all analyses conducted over the course of the research and to verification of the emerging theoretical account. With this goal in mind, we revisited under-developed analytical categories. In the current investigation, the selective coding resulted in three different interaction styles, between DSS and marketing, in their research for insight through data mining. The metaphor of dance, and more specifically dance style, was selected to describe that phenomenon; the dance metaphor resonated well with bank managers as they could easily comprehend why dyads would adopt different dance styles and steps according to different business problems.

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[1] "Intervening conditions" is another component of the model proposed by Strauss and Corbin (1990). These refer to the structural conditions that facilitate or constrain the strategies taken within a specific context. This component was removed from the model because no category of that type emerged from the axial coding.

Table 1: Codes Resulting from Axial Coding

Components of the Paradigm Model	Sample of the categories	Sample of the codes (for the first category of each component)
Conditions	- individual characteristics - reward structure - past experience - business skills etc.	- tolerance for ambiguity - need for closure - standing up for one's belief - aversion / appreciation for change
Context	- structure of the dance - stakeholders in relationship - structure of relationship etc.	- being open/close to new ideas - preference for predetermined hypothesis - scoping down a general request - preference for explorative research - letting the unexpected emerge
Strategies	- collaboration - force interaction style - education - management of the relationships etc.	- brainstorming ideas with colleagues - getting a second opinion - desire to understand other stakeholder's perspective
Consequences	- on the data mining process - on the deliverables of the mining process - on the organization - on the relationship between stakeholders etc.	- modeling perceived as easy task - technical bamboozlement - retention of information

Results

Three dance styles clearly emerged from the data: the waltz, modern dance, and break dance. Three formation characteristics differentiated dance styles: the number of partners involved, the relationship between the partners, and the extent of a pre-determined choreography framing the dance. Each dance style necessitates dancers to have certain aptitude and experience. Of course, some data miners and marketers were comfortable with multiple dance styles, in which case it was easier for them to develop successful interactions with a range of potential collaborators. Others, however, were proficient in only one dance style, which limited the extent to which they could work with a variety of colleagues in a productive way. The three dance styles are described next, followed by a description on the consequences resulting from a mismatch between dancers and dance styles.

The Waltz

Many of the familiar waltz tunes can be traced back to simple yodeling melodies of Austria. Today this peasant dance has been accepted by high society, and three-quarter rhythm is here to stay. This dance style is unique from the minuet and other court dances as the basic steps of the waltz can be learned in a relatively short time. The metaphor of the waltz was insightful in describing the first social interaction relationship. Indeed this style is a leading relationship; one dancer moves "to" the lead of the other. The elementary relational model (Fiske, 1991) of this dance style is *authority ranking*, an asymmetric linearly ordered relationship in which superiors take precedence, and subordinates respectfully defer to them. Whether it is a traveling step or a square step, leaders direct their partners sufficiently in advance so they can follow with confidence. Partners, in turn, keep relaxed so they can respond immediately to a lead. As there are many combinations in a waltz, the leader determines the steps and the follower moves "to" the lead to generate unique results. Our research showed evidence that the manager was the leader of the waltz:

[…] I had a conversation with my supervisor, and he said that ultimately marketing makes the decision. We don't have the power. We do our best, and give the decision makers our data. However the way they want to draw up the deliverable is their decision. [Grace, DSS]

I would say that marketing should be setting the strategies for the business, and we're looking to DSS to provide the support to help implement against those strategies. [Nancy, MKT]

But they take on the main responsibility […] they generate most of new ideas, and they take ownership for seeing those new ideas through to completion. I see them as driving most of that initiative. I believe that they feel acutely responsible for the financial performance of those accounts. [Molly, DSS]

The leading role taken by managers when executing a waltz was not creating resentment from the data miners. To the contrary, data miners accepted, even expected, managers to direct the dance, as data miners conceived their fundamental role as being one of support. Interestingly, data miners performing the waltz let marketing control the dance even if, from the point of view of the data miner, decisions were flawed or not supported by enough evidence:

I don't think the analysts really come up with their own ideas. Like, we're more looking to support the marketing initiatives. [Sarah, DSS]

Marketing people? It's just the way they are. Sometimes you say like, these observations are not enough to make conclusive decisions, and they don't think so. Or this report doesn't make sense… these numbers do not make too much sense, because there is not enough observations in there to make any conclusion. But if you want to use this, go forwards, then whatever… These persons, they want it the way they want it. No other way. [Grace, DSS]

The waltz dance style was choreographed according to a very clear, simple, and repetitive sequence of movements. In other words, as a data miner and a manager evolved in a waltz, they knew exactly what to expect from one another and their steps were perfectly coordinated. Such predictability in the dance allowed data miners and managers to reuse learning from previous analysis, which was sometimes beneficial, but other times restrictive due to analysis bias:

We discuss the business problem and bring in information about previous analyses, market forces. A lot of the times I will have already taken numbers that I've had before and try and come up with some approach to the problem. [Eric, MKT]

Well, I think a lot of us, because we've seen something done in the past, we have that box or mind set, where, "No, we can't do it like that because 2 years ago we did it like that and it wasn't successful" [Michael, MKT]

As the waltz requires steps to be learned in a relatively short time, the need for simplicity was achieved by dividing a given problem in its most basic components: the more complex the request for data mining was, the more important it was to partition the research endeavor is smaller, simpler, more structured pieces:

It seems analysts are searching for something structured to start with and once they get a chunk, just a chunk of it, and then they run [Nancy, MKT]

You need the direction in which way to generate insight. The data is so broad; there are so many different ways you can go. You have to start somewhere… you need to know exactly what you want to give someone so your work can influence the bottom line. [Dina, DSS]

Some analysts what the problem to be clearly defined before they start the analysis…. I ask to try to make things a little bit more specific. I would say, in terms of what sort of things would you like to see, like are you looking for, for example response rates? Are you looking for profitability? And I'd also ask how do you measure performance with a group? Do you measure it by response, or do you measure it by profitability? And that would give me a better indication of recommendation. [Marlene, DSS]

The waltz is expected to achieve a balance of efficiency and new insight. As the manager is the lead in this dance style, this type of coordination is appropriate for tasks where business knowledge represents the key to new insight.

The Modern Dance

Modern dance evolved as a direct revolt against what was perceived as the "restrictions" of more traditional dances, such as waltz. Need for leadership and step vocabulary do not confine modern dancers; this dance style is more natural. Dancers adopt techniques such as hopping, running, swaying, and skipping to express themselves. In a modern dance, individuals move "with" one another and communicate through flow of movement. Unlike the waltz, the relationship between the marketer and the data miner is one of equality. Fiske (1991) describes this elementary relationship model as *equality matching*, an egalitarian relationship in which people aim to maintain an even balance. The modern dance does not necessitate specific requirements as to the number of managers and data miners involved at a given time. We found that the relationship between data miners and managers was dynamically evolving, at times more than two dancers were involved and each individual brought a different set of expertise and talent to the dance floor. Consistent with equality matching, dancers take turns; the interaction is punctuated with different periods where managers were leading, where data miners were leading, or where there was no recognized leader.

[…] she is working with Scott, and having a great time -- because Scott is working "with" her. Again, it's a perceptual thing. He is working with you. They are playing off each other's strengths and weaknesses. [Paul, MKT]

The modern dance was only loosely choreographed, and did not welcome the structure (nor monotony) typical of the waltz. Rather, modern dancers evolved in a less structured fashion, as creativity was the main sought-after attribute for modern dancers. Flow is created from a response to fluidity and vibration stimulated by other dancers. The modern dance is artistic and creative; dancers take their time to mutually adapt to one another's imagination and response to music, which often lead to surprising results. As these modern dancers data miners put it:

There are certain tasks that, for whatever reasons, inspire a more creative and more balanced and more productive type of interaction. Whereas other ones are just very set, very structured. [Molly, DSS]

There are certain trends that I didn't expect to see, or trends that I expected to see, that weren't there. So those were somewhat surprises, and I did at that point, have to drill down and make sure that what it was showing me was actually real, and not because of other things that were coming into play at the same time. [Marlene, DSS]

Rather than confining themselves at resolving a set of smaller, specific requests, modern dancers preferred to take a more holistic view of the problems at hand, even at the cost of additional time caused by preliminary research. The goal of this type of interaction style in data mining is to break new ground through discovery of new insight. In data mining, modern dancers can work up to 6 to 8 months on a business problem that is ambiguous and strategic in nature:

I like to get the big picture […] I prefer to sit down together (data miners and business analysts) and think about how we want to appraise the problem, rather than actually go digging for an answer. [Marlene, DSS]

The Break Dance

Known to many dance historians as the first progressive dance movement to appear since the 1960s, break dancing has changed the shape of dance music across the world. This imaginative leap forward sent new artists head spinning and back spinning into the established New York art world (Hager, 1984). Break dance has energized dance with a fresh supply of symbols, myths, and values and every time it seems in danger of collapsing, it somehow bobs to the surface again, inflated by fresh ideas and with its original spirit left intact. Fiske's (1991) theory of social relations was not helpful in defining this dance style as this dance was mainly performed solo, that is, data miners conducted research activity without being formally assigned to a business manager:

You kind of work... You don't have a marketing representative […] I am not directed by anybody to do the analysis […] Sometimes, depending on what the issues are, I will go and ask a question - to marketing or some other department, but no one in particular. [Dina, DSS]

Tim and Yuri have even more time to think, because they don't even have specific projects, or modeling projects. It's whatever they want to do. But I know a lot of their work is on data, looking at the data, and trying to look for some relationships. [Ariel, DSS]

As this last quote indicates, break dancers (all from the DSS part of the organization) had much latitude in choosing the projects they worked on. Their work, rather then being specifically targeted to responding to a pressing business need articulated by marketing, was exploratory. They worked free of any routine, structure, and constraints typically associated with dance formations that require a relationship between dancers; there is no "pre-determined choreography" to their dance. Rather, break dancers had to think "outside the box" – there was no telling what they would come up with, how they would arrive to their results, and how these results would contribute to the bottom line, and when. Although a minority of data miners fit the break dance style, it was recognized by many as being a valuable kind of analysis:

These guys spend a lot of their time doing pure data research. It is unfortunate because as we getting busier, the proportion of time spent on pure exploration

has really shrunk. This is probably because we are much more efficient at making sure that we are filling our time with programs, which deliver the bottom line. And that might not be a great thing, from a longer term, point of view, because we are doing less and less of the wild and crazy, let's dig and find what we can find [Eric, MKT]

Break dancers work with the data to generate ground-breaking results and then audition these results for managers who interpret and evaluate the validity in a business context. We define the social interaction relationship in this dance as market pricing (Fiske, 1991); the interaction occurs after the data mining is complete and interactions are organized based on rational decision making values. We suggest that break dancers must be experienced, confident, and hold themselves in high esteem in order to get managers to break away from standard business models in order to identify new opportunities. Similar to the reaction of dance experts and media to break dance, managers may resist acceptance of data mining results when such results rebelled against traditional business knowledge. Our data shows that it was essential for the data mining results to be relevant and valid to business managers, as this was the only way managers would agree to "pay tribute" to the break dancers.

The issue, I think, is in the maturity and experience of the analysts. An example is someone like Yuri. Here's a guy who is around 45 or something. He has been around the block a bunch of times, but if Yuri told me that black is white, and white is black. I'll believe him, because I have confidence in dealing with him. [Paul, MKT]

Mismatch between Dancers and Dance Styles

Data miners and managers were not always able to perform the dance style they were the most comfortable with. Similarly, when a partner was required for a give dance style, that partner did not necessarily excel in that dance style. Such mismatch was common, as the assignment of data miners and business analysts to project was essentially made on a "need to" basis rather than a careful evaluation of the preference and aptitudes of data miners and manager:

Up till now, sort of an analyst looks like this… He fits in this box, and this is what they do. Even if we hire somebody that doesn't quite fit that box, we will make him fit that box, for now. There has been a lot of turnover. It happens in waves. [Sarah, DSS]

As the previous quote acknowledged, forcing someone into an unfitting dance style had adverse organizational consequences, such as a high turnover rate. Another type of consequence resulting from mismatch affected the data mining process itself: instead of being based on a common understanding of the problem at hand and how to handle it, confusion was often obscured the research process. For example, Keith, a data miner suited for break dance, described his interaction when forced into the waltz dance style:

There is a lot of confusion when we interact. I guess we're not used to talking in layman's terms, and what we take for granted as being quite obvious in statistical terms, they quite don't understand that. [Keith, DSS]

Similarly, Nancy, a marketing manager, shared her frustration when interacting with data miners that had a natural for break dance or modern dance:

And what you get a lot of the time is, because technical is the hard skill, they bamboozle the poor business people. They come up and, "You can't do that" and we think "Oh, can't we, oh ok, we can't" because we are intimidated by the technology, but that's got to stop. The reality is that, that's what happened. [Nancy, MKT]

Mismatch between dancers and dance styles led to general misunderstanding between data miners and marketers. In the best cases, such misunderstanding led to simple frustration. In the worst cases, however, such misunderstanding resulted in more harmful feelings:

I do believe though, that this lack of respect issue does exist, within, the current group… I've seen it happen with other people. [Molly, DSS]

Discussion

Results from this grounded theory research uncover that data warehousing success is influenced by the social relationships between data miners and marketers during the data mining process. We reveal three different dance styles that define social relationships between data miners and managers and conclude that when dance partners are forced into a social relationship (i.e., dance style), negative consequences ensue.

This research show that, although the implementation of a data warehouse may be considered as a technological success, the extent to which stakeholders succeed in using this analytical database environment in an efficient way greatly contributes to the *overall* success of such an endeavor. Considering that success is a multi-dimensional concept that includes more than a technological component, it is purported that successful data warehousing activities are contingent upon an appropriate relationship between the stakeholders involved in the data mining process. In other words, "dancers" must complement each other to perform the appropriate "dance". We believe it was the lack of recognition regarding the importance of social interaction management (i.e., the management of the dances) that contributed to the unsatisfactory data mining activities occurring at the financial institution.

The contribution to the practice has already been established, when the first researcher worked with the bank to implement the dance approach (i.e., to develop an approach to better assign data miners and marketers into appropriate dance styles.) Whereas the details of this implementation are beyond the scope of this paper (see Brohman et. al., 2004 for more details), it should be mentioned that this intervention resulted in several organizational benefits. Most impressive was the decrease in data miner turnover, from an average of 30% from 1998 to 2001, to 15% in 2002; a percentage well below the industry average turnover rate of 53.8% in 2001. Equally impressive was the financial benefit gained from data mining initiatives that were managed using the dance approach. For example, one break dancer worked closely with the Risk Management department to uncover patterns in data that has derived over five million dollars in savings for the bank. A designated modern dance team conducted analysis that has resulted in innovative customer treatment approaches; the outcome was increased customer retention. Overall, implementation of the dance approach to decision support has improved employee satisfaction and retention, increased data miner competence development and productivity, and better aligned decision support staff to business needs. It is evident from this case study that solving complex business problems is more successful when managers and data miners learn the appropriate dance and its steps.

A contribution of this research to academia is the extension of Fiske's theory of social interaction with concepts of formation from dance literature (Humphrey, 1970). Social action types are differentiated by the degree of engagement between the individuals, which was represented by the relationship between partners in this study. Formation literature supports the importance of the number of dancers; this literature also highlights the importance of intention of the movement to the movers. "Dancing to" is fundamentally different from "dancing with" (Humphrey, 1970). It is possible that intention of movement is similar to the pre-determined choreography described in our results, but this conclusion is premature. Extension of Fiske's theory of social interaction by integration of dance formation theory, as well as preliminary grounded theory results, provides a first step in developing a rich conceptual model to explain the data mining process.

Future Research

Future research will attempt to develop a comprehensive social interaction model of the data mining process. Results from this study identified a number of other factors that identify similarities and differences of the dance styles, such as the tempo (slow versus fast), the rhythm (simple versus complex), the flow (sustained versus suspended), the type of movement (locomotor versus on-the-spot), and others. Moreover, additional dance styles (e.g., the ballet, the samba, etc.) could potentially be uncovered as well. The link between dance style and organizational performance also represents a topic for future research. Grounded in the notion of task-technology fit (Goodhue and Thompson, 1995), we will examine how different dance styles (i.e., individual) influence performance as they change the attractiveness of data mining tasks.

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