PPD Informatics, a Division of Pharmaceutical Product Development, Inc.
(formerly Belmont Research, Inc.)

Browsing and Automatically Extracting Healthcare Data from Scattered Databases

Healthcare directives in the mid-1990s called for a reduction in cost and an improvement in the quality and efficiency of healthcare. Making these changes critically depended on convenient access to and the integration of detailed administrative, financial, and clinical data. Although sophisticated databases had been developed for each function, the lack of interoperability made it impossible to integrate data from various databases in the campaign to manage rising healthcare costs. The capability to browse and extract data from a multitude of databases would provide access to comprehensive, accurate information, while improving the overall quality of patient care and lowering costs through time savings and easily accessible resources.

The Belmont Research, Inc. Voyager project addressed the problem of data integration by creating a software tool that could be used to browse and automatically extract healthcare data from scattered databases without altering the existing systems. Because private capital was not forthcoming, Belmont turned to the Advanced Technology Program (ATP) for funding. ATP recognized the potentially large economic benefits and funded the project, which successfully developed a visual-data-retrieval and transformation system that assists healthcare providers in browsing and extracting information from scattered clinical and administrative databases. This technology was later commercialized as Table Trans™. In the process of developing Table Trans™, Belmont also developed a spin-off technology referred to as "Auto Coder," which addresses the problem of medical vocabulary coding. Belmont was acquired by Pharmaceutical Product Development, Inc. (PPD), and is marketing these products under the company name PPD Informatics.

COMPOSITE PERFORMANCE SCORE
(based on a four star rating)
* * *

Research and data for Status Report 94-04-0024 were collected during March - April 2002.

Existing Healthcare Database Capabilities Are Limited and Disparate

Prior to the Voyager project, attempts had been made to address the issues related to database integration. However, no existing medical systems could transfer, query, and mine complex data from a multitude of scattered clinical and administrative databases without requiring changes to the existing systems. Although inputting healthcare information into databases organized the information, without interoperability, an individual hospital with numerous databases lacked the required level of integration to effectively and efficiently collect and interpret all the data. Moreover, there were many challenges in integrating healthcare systems. For example, hospitals have made large investments in information systems that are often inflexible. As a result, the hospitals are hesitant to replace these systems because they perform adequately, and the cost of implementing new systems is extremely high. Furthermore, various departments within the healthcare systems often have competing priorities, and,

consequently, computer systems are often selected to meet the needs of only one group of end users.

Voyager Project Could Improve the Quality of Healthcare Information

Belmont's goal was to develop a tool that addressed interoperability among healthcare administrative, financial, and clinical data. The Voyager project would augment the healthcare information infrastructure by providing a tool that enabled healthcare providers and quality/cost monitors to browse and automatically extract data from a multitude of scattered clinical and administrative databases without requiring changes to the existing databases. Belmont's intent was fourfold: 1) design a client/server architecture that supported flexible integration of healthcare data from multiple data sources represented in various data layouts; 2) implement software that provided high performance in data extraction and transformation, as well as ease of use for users; 3) develop specialized components to support the processing of temporal data, free-text data, and medical terminology; and 4) produce an integrated prototype to demonstrate the Voyager infrastructure in the context of a sample set of healthcare databases.

At the end of the project, Belmont expected to have a tool that would incorporate browsing and automated extraction for scattered databases, free-text search capabilities, sequence-query ability, and Metathesaurus support (that is, a database of information on concepts that appear in one or more of several different controlled vocabularies and classifications used in the field of biomedicine). If Belmont was successful, they could provide the medical community with a powerful tool that would directly respond to the needs of the healthcare industry.

Belmont Identifies Need for ATP Funding

When Belmont decided to move forward with the Voyager project, they had a sound plan for developing the technology. While many tools were being developed that addressed some aspects of Belmont's goal, the company's Voyager project incorporated several components not available concurrently in a single tool. However, in 1994, market emphasis was placed on the creation of Internet applications, and investors were unwilling to fund Belmont because it did not intend to create a web application tool. Because the government and healthcare providers had not defined standards for security, accuracy, integrity, and accessibility of healthcare information via the Internet, Belmont believed that a web tool would not be practical. Moreover, because Belmont was predominantly a research-oriented company at that time, it lacked the resources to undertake the Voyager project alone. As a result, Belmont submitted a proposal to ATP for funding support and received $1.9 million for a three-year project.

Belmont's goal was to develop a tool that addressed interoperability among healthcare administrative, financial, and clinical data.

With financial support from ATP, the company expanded their resources and overcame their research obstacles. Belmont's Jeremy Poole stated, "Without ATP funding, a development group of our size would not have proceeded with such a large and complex project."

Voyager's Potential for Broad-Based Benefits

The Belmont tool would enable interoperability of proprietary systems without requiring changes to existing systems. This would promote interoperability and encourage collaborative efforts within healthcare institutions, resulting in improved efficiency and quality of healthcare, while reducing overhead costs and enhancing the effectiveness of databases already in place. In addition, the healthcare facilities' improved internal operations would raise the quality of patients' care by potentially reducing medical errors.

"Without ATP funding, a development group of our size would not have proceeded with such a large and complex project."
-Belmont's Jeremy Poole

If the technology proved successful, it would enable a broad range of opportunities in healthcare and other markets, such as manufacturing and financial services. These markets tend to have difficulty developing

quality-improvement programs and creating new applications that integrate administrative and financial information.

Collaborator Support Crucial in Achieving Technical Goals

In order to bring together the right combination of information technology and healthcare expertise to successfully deploy the Voyager project, Belmont collaborated with Children's Hospital and Beth Israel Hospital in Boston, Lexical Technology (currently known as Apelon, Inc.), and the University of Massachusetts. The work of Children's Hospital on database integration would serve as the starting point for defining a query language and protocol to be used with Voyager client software.

Belmont was a member of the Center for Intelligent Information Retrieval at the University of Massachusetts (a consortium for the development and application of information retrieval) and had a relationship with Applied Computing Systems Institute of Massachusetts, Inc. This gave Belmont access to these groups' technology and expertise in developing free-text searches that would allow the automatic screening of words or phrases that appear in available databases. Belmont was quite familiar with efforts in time-oriented data management and intended to develop technologies for time-oriented clinical data visualization to be used in the Voyager project. Belmont also collaborated with Lexical Technology to overcome difficulties of clinical data representation that were complicated by the fact that clinical information systems tended to use different conventions and vocabularies, especially with medical coding.

Belmont Succeeds in Developing Voyager

Belmont successfully developed prototypes for two data management tools. The first tool has a visual-data-retrieval and transformation system that allows users to conduct complex database retrievals, derivations, and transformations. The system helps users unlock information by allowing them to specify sophisticated transformations step by step, browse data and meta data, and visualize complex transformation logic. The second tool, Auto Coder, addresses the problem of medical vocabulary coding. It has the capability to support the intelligent translation of clinical data representations. With Auto Coder, Belmont made substantial progress in translating clinical data representations and in developing a visual environment for designing and running autocoding algorithms.

Belmont's two main performance goals for the Voyager project were to demonstrate usefulness and to demonstrate scalability and robustness. The usefulness of the Voyager technology was demonstrated in 1997 when the U.S. Food and Drug Administration used a beta version of Voyager to verify the life-threatening consequences of using the fenfluramine and phentermine diet drugs in combination. Furthermore, Voyager's robustness was proven when Belmont used the technology to convert a client's data from one medical-problem-reporting software package to the BBN/ClinTRACE adverse-event-reporting application. Belmont not only completed the task, but the team estimated that they were able to convert the data in approximately half the time that would have been required without the Voyager technology.

In early 1997, Belmont launched a parallel project to commercialize the technology developed during the Voyager project. Table Trans™, the commercialized version of the Voyager technology, incorporated the visual programming interface and was intended to support database transformation, database integration, and complex database query creation and management.

Belmont Encounters Obstacles to Commercialization

Belmont felt they could commercialize Table Trans™ more effectively by aligning themselves with a larger company. In 1997, Pharmaceutical Product Development, Inc. (PPD) acquired Belmont (now PPD Informatics) for an undisclosed amount. The Voyager technology was a major part of Belmont's attraction. The new partnership arrangement, Belmont management believed, would allow them to significantly expand their commercialization efforts while at the same time giving them the freedom to continue development of healthcare software solutions.

The Voyager technology also led IBM to form a strategic partnership with Belmont. Belmont began

negotiations with an operating unit of IBM to become the exclusive distributor of the Table Trans™ software in the United States and Europe. Under this arrangement, Table Trans™ would be integrated into the IBM Healthcare product line and IBM sales and technical staff would be trained to support the sale and application of the technology. IBM was also interested in using the Table Trans™ technology in other data-intensive industries such as sales tracking, market analysis, and data warehousing. Unfortunately, the IBM partnership did not prove as successful as Belmont had initially hoped, because the company encountered difficulty incorporating Table Trans™ into their suite of tools.

As a result, Belmont decided to refocus its attention on supporting clinical trials data. Although this technology has proven valuable, it was still a challenge to sell it within the pharmaceutical industry. Therefore, Belmont concentrated on consulting opportunities, with the Table Trans™ software as a part of their service offerings. This method allowed companies to obtain the benefits of the software, but to have Belmont support the technology. Belmont continues to sell the tool separately, yet they focus on offering it through consulting services. The company's current customers who use Table Trans™ have noted that the software expedites the migration of data, minimizing the need for costly and time-consuming programming.

In July 2001, PPD Informatics released Table Trans™ version 2.1. The new features of Table Trans™ enable users to configure the software to their specific requirements for security, user access, and auditing in order to comply with Federal regulations issued in 21 Code of Federal Regulations (CFR) Part 11.

DSstar, a leading publication for the data mining, data warehousing, and business intelligence communities, has written an article on Table Trans™ version 2.1 titled, "PPD Informatics' Table Trans 2.1 Provides Advanced Security."

Conclusion

When Belmont was unable to secure external funding, the ATP award allowed the company to develop an innovative product for the healthcare industry. ATP's support helped the small research firm design a system that created significant interest in the healthcare informatics market. The company's successful development of Table Trans™ led to Belmont's acquisition by PPD, which enabled Belmont to obtain the market position they needed to commercialize their product and to penetrate an established customer base.

PROJECT HIGHLIGHTS
PPD Informatics, a Division of Pharmaceutical Product Development, Inc. (formerly Belmont Research, Inc.)

Project Title: Browsing and Automatically Extracting Healthcare Data from Scattered Databases

Project: To enable healthcare providers and quality/cost monitors to browse and to extract data automatically from many scattered clinical and administrative databases, without requiring changes to the existing databases.

Duration: 01/01/1995-12/31/1997
ATP Number: 94-04-0024

Funding (in thousands):

ATP Final Cost	$1,978	77%
Participant Final Cost	603	23%
Total	$2,581	

Accomplishments: Belmont Research successfully developed prototypes of two healthcare data management tools that are being commercialized in the clinical data industry. ATP funding allowed Belmont to create a faster, yet more reliable, tool for clinical data migration. The first product, Table Trans™, is a visual-data-retrieval and transformation system that allows users to carry out complex database retrievals, derivations, and database integration. The spin-off tool, Auto Coder, is a set of automated and interactive components for classifying and coding clinical data to address the problem of medical vocabulary coding.

Commercialization Status: Belmont chose to be acquired by PPD so that it could commercialize Table Trans™ more effectively. PPD Informatics continues to market both Table Trans™ and Auto Coder to the clinical research industry; however, the company has decided to focus on offering the tool mainly through their consulting services. PPD Informatics continues to enhance Table Trans™ to meet the unique access control requirements defined by Federal, state, and local regulations, as well as industry standards. In July 2001, PPD Informatics released Table Trans™ version 2.1. The new features of Table Trans™ enable users to configure the software to their specific requirements for security, user access, and auditing in order to comply with Federal regulations issued in 21 Code of Federal Regulations (CFR) Part 11.

Outlook: PPD Informatics continues to support enhancements to Table Trans™. The healthcare infrastructure technology developed with the help of ATP funding has received considerable interest. For example, DSstar, a leading publication for the data mining, data warehousing, and business intelligence communities, has written an article on Table Trans™ version 2.1 titled, "PPD Informatics' Table Trans 2.1 Provides Advanced Security." With the support of its parent company PPD, PPD Informatics will continue to make inroads in the healthcare informatics industry.

Composite Performance Score: * * *

Number of Employees: 15 employees at project start, 35 as of April 2002

Focused Program: Information Infrastructure for Healthcare, 1994

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