

Highmark Inc.

**An Enterprise Data Warehouse Solution from Teradata
Creates a Unified Foundation for Competitive Success at
Highmark**

I. Executive Summary

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As one of the largest health insurance companies in the country, Highmark Inc. understands the pressures of serving its customer base, stabilizing costs, and preventing fraud. The \$8.1 billion non-profit company, headquartered in Pittsburgh, needed to find ways to understand its cost drivers better so that it could hold the line on premium increases – thereby retaining customers, enhancing its competitive position, and protecting its financial strength.

The organization has a long history of finding innovative ways to use information technology (IT) to support its operations and report on basic business trends. Years earlier, the company created Health Care Informatics Research and Analysis (Informatics), a group of scientists dedicated to leading-edge research and analysis on health care and insurance issues. Its claims processing operations and financial organization were state-of-the-art, among the best in the industry. Supporting these Highmark departments was a powerful IT infrastructure, including three data warehouses used to track claims information through traditional finance and analytical processes:

- > Adjudicated Claims Experience (ACE) stores adjudicated claims information from the former Pennsylvania Blue Shield part of the organization in addition to other claims. Used primarily to support finance operations and account reporting, this warehouse has run on a Teradata® solution for 13 years.

- > Highmark Information Warehouse (HIW) stores information about adjudicated claims, client and member detail and summary data. Used primarily to provide sophisticated business intelligence to the company's analytics group, this warehouse runs on a Teradata solution.
- > Historical Finance Data Repository (HFDR) stores financial data for adjudicated claims, earned income and cash in addition to summary client and member data. Used for financial reporting, it runs on an Oracle solution.

However, because these three warehouses were created to support the business needs of individual organizations, the queries run through them often produced different, sometimes conflicting, results. The same claims data was frequently stored in each warehouse, creating redundancies and consuming corporate IT resources. In addition, the claims data used for analysis was too dated to produce the type of meaningful results the company needed to make decisions that would enable it to stay ahead of the competition.

These three data warehouses clearly were not the most effective way for Highmark to enhance corporate performance. In 2002, Highmark's Informatics group partnered with its Information Services Group (ISG) and Finance department to plan a new solution: an integrated enterprise data warehouse (EDW) that could share information among those three user communities. In unifying the business information in one high-powered solution,

Building on a foundation of several successful Teradata warehouse solutions, Highmark is beginning the phased implementation of a 12-node, 7.7TB enterprise data warehouse.

Highmark expects the EDW to deliver the analytical capabilities and research results that will provide new business insight and a single view of the Highmark organization – thereby supporting better, faster decisions.

The first phase of the new EDW, called Medical Experience Subject Area (MESA), is being implemented by Highmark in four phases on a 12-node, 7.7 terabyte (TB) Teradata solution comprised of coexisting 525X and 5380 nodes. Using an extract, transform, and load (ETL) tool from Informatica, Highmark is in the process of populating MESA with claims data. The new warehouse will ultimately store all claim and claim-like (capitation, rebates, etc.) information from initial submission to final payout in addition to the General Ledger and Claims Billing transaction lifecycles. Ultimately, MESA will become an active data warehouse (ADW). When this is complete, updated information will trickle into the EDW on close to a real-time basis, which will allow Highmark to make better, faster decisions based on data that is merely hours old.

Highmark's plans for MESA are based on the company's successful experience building its previous data warehouse solution, the Highmark Information Warehouse (HIW). This data warehouse, which was also built on a Teradata warehouse solution, has already delivered valuable, quantifiable business benefits and is supporting new business processes that were previously impossible. For example, new, in-depth analyses are enabling the company to understand its business and the marketplace better. Fraud detection capabilities are improving, with Highmark recovering more than \$9 million in fraudulent payments in 2003 alone – roughly four times the amount recovered in the year before the Teradata systems were implemented. Predictive analysis processes will prevent three times that amount from ever being paid out on fraudulent claims.

The solution is also helping Highmark to provide better service to its members as well as to the companies that procure members' health insurance coverage. Medical management of members' chronic conditions is becoming more proactive – which protects members' health, enhances their workplace productivity, reduces medical expenses, and controls premiums for the coming year. Highmark has used the system to expand profitably into new lines of business. For example, Highmark now offers managed-care Medicare programs for senior citizens.

While many other insurers failed with similar endeavors, the data has helped the company make the product profitable, despite the fact that the product is offered in Allegheny County, whose population of seniors is the second highest in the country. Highmark has also used the HIW system to pursue new business opportunities in areas such as provider network management services and consulting.

Yet, for Highmark to continue achieving its current and future business objectives, HIW could only be a first step. Highmark needed an enterprise view of operations – one supported by technology that reaches across the three corporate data warehouses. MESA, the project currently under way, will help Highmark build enterprise business applications and deliver an enterprise-wide view of the organization. As the benefits of MESA and the solution become widely known throughout the organization, the MESA support team within Highmark envisions even greater opportunities to use the Teradata solution to help the company succeed. “The solution has been a big benefit to Highmark already,” says Tom Tabor, Highmark's chief information officer. “I know that Highmark will benefit from it well into the future.”

II. Succeeding in a Challenging Market

The medical insurance industry faces challenges more complex than ever before. Burgeoning customer demand for medical services and an aging population conspire to drive costs ever higher, just as consumers and the government organize to oppose the increasing cost of health care premiums to employers and individuals. For insurers, providing optimal service at reasonable costs is the only way to maintain or improve customer satisfaction and, thus, to ensure profitability and competitiveness. Achieving this balance requires an active search for new ways to manage costs, enhance productivity, prevent fraud, and expose new revenue-generating opportunities.

Highmark Inc., headquartered in Pittsburgh, Pennsylvania, is acutely aware of these challenges and solutions. With 4.4 million members in Pennsylvania, Highmark is the largest health insurance company in the state and one of the largest health insurers in the United States. Created in 1996 by the consolidation of Pennsylvania Blue Shield (now known as Highmark Blue Shield) and Blue Cross of Western Pennsylvania (now Highmark Blue Cross Blue Shield), the company serves the 29 counties in the western half of the state, 21 counties in central Pennsylvania, and the Lehigh Valley. It also provides services in conjunction with Blue Cross plans in northeastern and southeastern parts of the state.

An independent licensee of the Blue Cross and Blue Shield Association, Highmark

Highmark's mission: To provide access to affordable, quality health care, enabling individuals to live longer, healthier lives.

underwrites various indemnity and managed-care health insurance products, as well as Medicare supplemental products. The \$8.1 billion non-profit company also provides Medicare (Parts A and B) services, such as claims processing, customer service, and provider relation functions. Highmark also handles national accounts, administering self-insured groups, performing third-party administration, arranging network access, and providing claims processing services for other Blue Cross and Blue Shield plans. In addition to health insurance, the company also provides specialty products such as dental, vision, life, and casualty insurance.

With operations in Pittsburgh and Camp Hill, Pennsylvania, Highmark employs more than 11,000 people. The company's mission, to provide "access to affordable, quality health care, enabling individuals to live longer, healthier lives," is matched only by its vision. Highmark aspires to be "the leading customer-focused health insurer..., addressing the health care needs of individuals while maintaining our financial strength."

Meeting this goal – while facing the complexities of today's health insurance industry – is perhaps the company's primary business challenge. The rising cost

of providing health care services to an aging population and consumer demand to hold the line on premium increases are squeezing insurers like Highmark. Increasing government and regulatory mandates add operational cost, as do required information technology investments. Because the market in which Highmark operates is pressured by increasing local and national competition, customers have far more choice in health care plans.

Three Warehouses, No Clear Answers

Highmark processes 400,000 claims and 36,000 phone calls each day. These customer contacts generated huge volumes of customer and provider transactions, many of them related to claims processing. The claims information was stored in three distinct warehouses, which were each used to support an affiliated organization:

- > **Adjudicated Claims Experience (ACE):** This Teradata warehouse solution supports claims account reporting for a subset of Highmark products. It is used by operations to support claims processing operational reporting, and testing.
- > **Highmark Information Warehouse (HIW):** This Teradata warehouse solution stores information about

finalized claims – those that have been approved and paid. It tracks payments, types of medical services, clinical indicators, inpatient admissions, and services paid for adjudicated claims. It is used primarily to support the company’s Informatics analytics group.

- > **Historical Finance Data Repository (HFDR):** This Oracle solution focuses on the monetary aspects of a medical service. The data content is primarily cost/numerics as opposed to clinical or operational. It is used for financial reporting by Highmark’s Finance department.

Using three discrete warehouses posed several problems for Highmark. The HIW and HFDR warehouses provide Highmark with retrospective analysis of claims information because there is a delay of 30 to 60 days from the time of initial claim entry through finalization, payment, and customer invoicing. Because these warehouses store only historical data from

finalized claims, they provide no proactive data analysis, information mining capabilities, or visibility into claims or customer trends using fresh data.

In addition, using three warehouses to track information and perform decision support often created conflicting answers to the same query. “Because there were different interpretations of the data, different data definitions, different timings and cycles, and different data sources selected, users often came up with different answers to the same question,” says Sue Jones, director of business information applications. “None of the answers was incorrect, but from an enterprise perspective, it made it difficult to present a single view of the business. We all need to be singing from that same book: the Ledger needs to be booking the same thing that Billing is invoicing, and that needs to be the same thing that people are reporting – from an operational, tactical, and strategic perspective,” she adds.

On the finance side, numerous corporate systems used the claims information, but none could be synchronized with others. A PeopleSoft General Ledger system was distinct from a newly built customer rating system, and neither was integrated with the claims billing system. “We have different engines all being fed with claims from different sources at different points in time,” says Don Dabkowski, director of finance information management. “So even though there is only one place to get a particular adjudicated claim, that claim flows downstream to different places and different platforms.”

For the Informatics group, the existing system offered no in-depth analysis of Highmark customers or their relationship with various medical providers. Without this information, the company was stymied in its efforts to effectively monitor patient care, proactively address chronic conditions, or work more closely with medical providers.

Moreover, the sheer volume of work created a situation where the Informatics analysts struggled to get out of “firefighting” mode. “The mission of the Informatics group was to be a leading-edge organization within Highmark providing more real-time information and solutions,” says Richard Pro, vice president of Informatics. “But it was difficult for us to do that in the environment in which we operated.”

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– Sue Jones, director of business information applications, Highmark Inc.

Vision For Change

To succeed in the health insurance market, Highmark realized that the old ways of doing business had to give way to a new vision. The goal: Highmark needed to become a more customer-focused organization – one that could address the market’s very real business challenges while enhancing consumer satisfaction and improving profitability.

Company executives recognized that Highmark needed to use data warehouse systems to enhance customer service and reduce costs by providing unprecedented visibility into its claims processing operations and to discover new views of its customers. Leading this vision for change were Darren Macioce, then vice president of Informatics and now senior vice president of customer and analytic operations; Tom Tabor, CIO; and Jones. The three began discussing a strategic initiative to build an enterprise data warehouse (EDW) that would store all claims-related information, as well as data about customers. This EDW could be used by ISG and Informatics to support new understanding of the business.

At the same time, Highmark’s finance organization was also considering its data warehouse options. The HFDR warehouse that supported the group included the same dated claims informa-

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tion and offered no links to the rest of the organization. “We needed to build a central repository that could store both operational and analytical data and use the claims to feed the needs of everyone in finance,” says Dabkowski.

By summer 2002, Macioce’s team began working with Dabkowski and Nan DeTurk, senior vice president of finance. “We used our requirement for an integrated infrastructure to create a list of 10 issues that the finance department wanted to address,” says Dabkowski. “Then we married that with the list from Informatics and ISG. When we synchronized those lists, it became clear that this was a project we should do together.” Instead of creating multiple data warehouses to support the different corporate departments, the group began evaluating the cost and value of creating one EDW that would ultimately serve the entire Highmark enterprise.

The plan was to combine three existing corporate information systems into an integrated EDW. The first subject area to

be completed was Medical Experience (e.g. Claims), hence the project name of MESA (Medical Experience Subject Area). Using powerful business analysis and reporting tools, Highmark would be able to further its understanding of medical trends, spot fraudulent claims, and perform predictive analysis. When combined with information about Highmark’s millions of customers, the warehouse would one day support proactive patient care and customer service. In all, MESA would help Highmark cut costs and enhance customer satisfaction, improving the company’s overall competitive position.

“We’ll have one source to find the information we need,” envisions Tabor, the CIO. “Today, when someone asks for the membership count, we go to three different sources, and we don’t necessarily know how current the information is. When we know the information is timely and accurate, and when we can provide it confidently to our customers, the organization will benefit immensely.”

Creating an Enterprise Team

In summer 2002, the finance and IT groups presented their findings to Highmark management, which quickly agreed that a cross-enterprise EDW made financial sense. “Intuitively, the ROI was a given, because the existing infrastructure was so complex that the improvement would clearly be significant,” adds Dabkowski. No specific ROI justification was required, because the potential value of infrastructure simplification, streamlined processes, and a single source of claims-related information were obvious to those who considered the benefits MESA could bring to Highmark.

The company formed a steering committee to keep the MESA project on track over the many months that it was in process. Co-chairs were Jones from ISG and Dabkowski from finance. Other participants included Macioce; Tabor and Kathy Colwell from ISG; Bill Cashion, Highmark’s chief actuary; and DeTurk.

In addition, the company created a cross-functional project team that drew representatives from not just ISG and finance, but from other areas of the organization as well. Project managers

included Dabkowski and Jones; Jack Emes and John Newell from Informatics; and Craig Colbert, an employee of PwC Consulting (a company later acquired by IBM), as the overall project manager to handle administrative details.

“Having the commitment from both finance and Informatics – and building a project organization from that – has helped us get the right resources at the right time,” says Jones. “Many people from the business side are performing what are typically ISG functions. As part of the process, these people are generating functional designs, participating on the quality assurance team, creating and executing test cases, doing analysis, and participating in the design sessions. Because of this participation, this has been one of our easiest projects, even though there are many people involved.”

A Phased Plan for Success

The MESA team made two initial technology selections to support the solution. First was a decision support tool from Informatica designed to extract, transform, and load (ETL) data into the EDW. Second was a data warehouse solution from Teradata.

Highmark already had extensive experience with Teradata solutions (see Section III), which simplified the evaluation process. Highmark partnered with several analysts, including META Group and Gartner, and hired Accenture for a short consulting engagement. “It was a skinny-down evaluation,” says Jones, “a confirmation that the experiences we had already had with Teradata would hold true in an enterprise-wide system.” When the evaluation was complete, Highmark selected a two terabyte (TB), four-node Teradata 5250 solution.

Highmark began rolling out MESA in phases over a multi-year timeframe (See Figure 1). MESA Release 1 included submitted claims data from Highmark members (and host business) in the western and central parts of Pennsylvania. It also included the rollout of supporting subject areas such as client, member, and provider to facilitate PMPM (per member/per month) analysis. The intent was to provide only core data to facilitate medical experience analysis. Phase II includes the addition of adjudicated claims and specific disbursement sources. Phase III includes General Ledger closed loop processes. (MESA feeds the ledger and the ledger returns posting information to MESA.)

Phase IV includes the remaining disbursement sources, Claims Billing closed loop processes, history conversions from the appropriate legacy warehouses, and other cumulative events such as the creation of ACG. Over time, additional subject areas (expanded client and member, new subject areas such as revenue/premium, etc.) will be added to the warehouse, and data analysis capabilities will be expanded to additional users.

The phased approach was designed to help Highmark reach specific, value-producing milestones; each goal achieved will serve as a foundation for the following phase. It also is helping the MESA team create business benefits that the remainder of the organization can see. "If we had waited to go live until the entire EDW was complete, I don't believe we could have convinced management of the scope and size of the project," says Tabor. "This way, we have been able to show incremental benefit, a return on the dollars that have been spent, and a path to the additional value still to come."

Prototype: Claims Sources – completed September 2003

- > Analysis and requirements phase where system requirements were assessed and integration was considered

Release 1.1: Submission Flow – began March 2004, completed May 2004

- > All submission claim sources
- > Limited member, client, provider supporting subject area data

Release 1.2: Adjudication Flow – completed December 2004

- > All adjudication claim sources and related disbursement life cycle events
- > Claim lifecycle integration (adjudication and disbursement)
- > Direct data interface from General Ledger

Release 1.3: General Ledger and HFDR Interfaces (HFDR supports the Claims Billing closed loop), Aggregations (targeted to begin production implementation ~four months after Release 1.2)

Seven Ledger Interfaces complete Q3/Q4 (2004). Three are remaining. Claims Billing process still in design.

- > Populate downstream systems such as General Ledger and Billing
- > Direct data interfaces to HFDR for Medical Experience data
- > Claim lifecycle integration (General Ledger posting and billing events)

Release 1.4: Cumulative Events and Remaining Disbursements (targeted to begin production implementation – staggered implementation starting three months after Release 1.2)

- > Versioning of data-driven clinical enhancements
- > Conversion of historical data from Highmark Information Warehouse (HIW)
- > Full claim lifecycle integration (including disbursement events)

Figure 1. Highmark Project MESA Milestones

III. Partnering with Teradata for Long-Term Value

The MESA project is not the first partnership between Highmark and Teradata. Certain Highmark data warehouses, such as ACE and HIW, have successfully run on Teradata systems for as long as 13 years.

In 2001, however, Highmark's Health Care Informatics Research and Analysis group (Informatics) needed help from Teradata. The group had been struggling with performance on an IBM mainframe. "Our decision support cycles – the period between when an analyst first submits a query and when an answer is received – were down to only one or two per day because system response time was so bad," says Bob Lentz, manager of the Informatics Systems Engineering group. New work schedules were instituted to accommodate the problem – some analysts came in early, while others worked late into the night. Finally the company introduced a four-day, 12-hour per day workweek for analysts, an unpopular schedule that began to impact employee morale.

Another problem was that Highmark analysts wanted to run increasingly complex queries. Executives were asking more difficult questions, and the Informatics group was trying to understand more intricate trends within the business and the industry. "In order to turn these queries around in the mainframe environment, with competition from production jobs, these queries became overnight jobs,"

Mainframe charges were slashed from \$411,000 per month to \$18,000 per month.

explains Richard Pro, vice president of Health Care Informatics Research and Analysis. "So if you made a mistake, if anything went wrong, it meant coming in the next day to find the job had not run successfully, fixing what went wrong, and submitting it again the next night. We couldn't get the turnaround needed to make the queries valuable."

Moreover, analysts had almost no opportunity to drill down for additional information when new questions arose. Conducting what-if analyses under these conditions was nearly impossible. "Our old system had the content, but not the performance," explains Macioce. "Creativity was negatively impacted, because you had only so much time to develop the analytics and interpret the results. Most of your time was spent waiting for the job to run."

Terry Crislip, the Teradata account executive for Highmark, offered to perform a benchmark to show how Teradata could improve the company's processing speeds. The entire Highmark data warehouse – with approximately 300 GB of raw data – was loaded on a Teradata system. Informatics analysts provided seven of what Lentz remembers as "the biggest, baddest,

worst queries" as well as numerous common query requests. When the queries ran, Lentz and his team were sure there was a mistake. "When we saw the queries running 10, 12, and 20 times faster than on our IBM system," he says, "it was quite an eye-opening experience."

Shortly after seeing those results, Highmark decided to make a change. With help from Teradata Professional Services, Highmark moved its data warehouses from the five-year old IBM DB2-based system to a Teradata 5250 four-node system – in just 60 days. The benefits reaped from this transition were rapid and dramatic. Mainframe charges were slashed from \$411,000 per month to \$18,000 per month. As much as one terabyte of mainframe space once dedicated to analysis was relinquished to the Highmark mainframe, and the 1.5 TB of storage used by the Informatics group was also freed. "What Teradata brings to the table is a scalability solution," says Mark Romasco, senior decision support consultant for Health Care Informatics Research and Analysis. "You spread the data out on multiple processors, and you're going to get your results more quickly. It's very impressive technology."

Perhaps more important, the new system allowed Highmark analysts to expose more valuable business information within the data warehouse. As analysts began using the system over the following six months, Highmark estimates that query performance improved by 300% to 700% – even while the queries became more complex. In addition, analytic cycles were shortened, allowing analysts to dig deeper into the data to answer new questions and further explore existing issues. “What we were able to do in terms of pushing forward our knowledge of the business through this analysis was really amazing,” says Pro.

Romasco, the data analyst, typically handles the company’s most difficult analysis tasks on subjects such as membership, types of claims, and enrollment. With the Teradata warehouse, Romasco slashed processing time for these jobs. “I’m usually the one looking for an answer across 100 million rows,” he says. “Processes that once

took three or four days to run on the old systems I now run in a couple of hours.”

Using the new Teradata system enabled Highmark to empower its analysts by delivering the right information at the right time. Having the tools available enabled the company to enhance and expand the corporate knowledge base; it also expanded Highmark’s ability to collaborate with internal and external partners. “Since we moved to Teradata, we can get jobs through faster, we can put back the creativity, we can allow the predictive modeling and the data mining,” says Macioce. “We had all these skills in the Informatics group, we just couldn’t leverage them before.”

Today, Highmark’s Informatics group uses a Teradata 525x/5380 solution – which was recently upgraded to 12 nodes – to spot trends, perform analysis, and ask questions of the database in ways that were unforeseen even a few years ago. Analysis is not limited to power users, which means that more Highmark employees are able to use the system to expose valuable information. Lentz says that these users are not as experienced in posing queries, but the Teradata solution can handle it. “We keep adding more data and loading the system with all kinds of queries, but somehow the Teradata solution handles it all,” says Lentz. “Our Teradata solution is like the phone system: it just always works.”

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– Darren Macioce, senior vice president of customer and analytic operations, Highmark Inc.

IV. MESA Today

Although MESA is not yet complete, the system components are in place and beginning to accept data. The system consists of coexisting 525X and 5380 nodes, for a total of 12 nodes. It runs version 5.0.1 of Teradata, with plans to upgrade soon to version 5.0.3. The system can accommodate 7.7 TB of data, of which only 2.5 is currently being used.

At this time, MESA includes 100+ production tables, which are the core tables that the system accesses for primary information. Information is loaded into those tables using the Informatica Power Center ETL tool. Also included are nearly 280 code tables, which describe codes used in the various medical forms. In addition, worktables are being developed to support the coding environment; for example, these tables will help prepare the data extracted from Highmark's IMS databases. All tables use third normal form, which allows flexibility and extensibility to accommodate the rapidly changing environment and business needs. Additional logical, physical and virtual structures (aggregations, marts, multidimensional, etc.) are being evaluated as the rollout to the customer base continues.

Highmark has more than 500 concurrent users on the Teradata system. Two full-time database administrators support the system. According to Tony Howe, database administrator for Highmark, the existing Teradata system did not require full-time DBA support until the migration to MESA began. One of the DBAs was hired to support the growing data volumes antici-

pated for MESA and the need for more frequent backups. (By contrast, Highmark has 10 full-time DBAs to support the IBM DB2 system and 16 DBAs to support its Oracle environment, in which the HFDR warehouse resides.)

The new Teradata system has helped Howe focus more on supporting performance and tuning, rather than on maintaining tables. "DB2 takes a lot of performance and tuning effort to make things run quickly," he says. "In DB2, if you don't use an index, it's not going to run very fast. In Teradata, we don't worry about that."

When the company was using three separate warehouses, Highmark custom-developed code to help extract, transform, and load data into the warehouses as needed. But to load enterprise-wide data into the new MESA system, Highmark needed a more powerful ETL tool set. The company selected Informatica to work with Teradata's TPump loading utility.

Continuing Progress

Highmark has extracted and archived all 2004 submission, adjudication and disbursement MESA source data to accommodate their phased implementation approach. The project team and their stakeholders will determine (on a source by source basis) which archived data should be processed and backfilled and which data should be replaced with HIW history data.

In the second phase, Release 1.2, approximately 15 adjudication sources and adjudicated claims (those ready for payment) were introduced into MESA.

This phase, helps Highmark track and monitor the subsequent claims process flow. The third phase, Release 1.3, in which downstream systems such as General Ledger will be populated with the data, is in various states of design and implementation. The fourth phase, Release 1.4, will bring in cumulative events and remaining disbursements.

While these phases are in progress, Highmark is developing a plan to continuously update the warehouse in a steady trickle, creating a near-real-time data flow in what will ultimately be considered an active data warehouse (ADW). Having the information updated frequently will give Highmark access to the most current data around the clock – thereby allowing executives to make better, faster decisions. Plus, Informatics will make it possible to intervene much earlier by readily identifying candidates for individual case management, health-and-wellness programs, disease management programs and the like. These advances will further facilitate Highmark's mission to "provide access to affordable, quality health care enabling individuals to live longer, healthier lives."

Some of the data sources will be updated several times a day, while others will generate new information weekly or even bi-monthly. "We're looking at the data loads and trying to determine how to make this work best," says Jones. "We may use a multi-source filing process that lets us batch a group of claims and send them through one Informatica work flow.

At this point, we're moving cautiously; we don't want to let everything just rip through the corporate scheduler."

In addition, the company has begun to conduct a post-implementation review in which users from Informatics and the actuarial area will begin assessing submitted claims in the company's production environment. The assessment is designed to ensure that the data these users need is produced in a way that is most useful. "We want to know that the diagnosis codes or the revenue codes are in the right place and that the users can get to the data," says Dabkowski.

As users become more familiar with the system, Dabkowski expects the MESA team to discover new ways to use the technology to enable the business. "It seems to me that any report a user could produce now on adjudicated claims could also be run on submitted claims with interesting results," he says. "For example, an analyst could learn from these claims what types of claims are coming in, and whether that pattern deviates from the norm. Clinical assessments could be made, too. Did we receive a significant number of cardiac claims from one policyholder or practice? From those analyses, we can start taking action."

Looking Forward

Highmark is still working out certain future MESA support issues. According to Jones, the Executive Steering Committee has agreed that MESA requires a formal, dedicated support unit that includes both ISG and business representatives. "What

Highmark's MESA Data Governance Council

From MESA's beginning, Highmark recognized that maintaining control over the data that would be fed into the EDW was essential to the value of such a large and critical corporate resource. Highmark formed a MESA data governance council and staffed it with high-level representatives with the clout to make and execute the council's decisions.

The data governance council convenes regularly to discuss issues such as data ownership and data stewardship. "For example, we're helping people to understand that if there's a data quality issue, the source system should fix it," says Dabkowski. "We don't want people fixing it downstream in multiple different places. And for data that is used by multiple organizations, we want to determine the best way to collect it once and then disseminate it through the data warehouse."

we haven't done yet is to figure out how to do this," she says. "Should we set up a separate organization? Would we keep the ISG and business organizations separate and have people report to both their original organizations and the new support unit? We're still working out the physical structure of that."

From a systems point of view, MESA will ultimately become the single source of Highmark's data warehouse efforts, and the other warehouses will be retired. Since all adjudicated claims are being loaded to MESA, Highmark is now in a position to stop populating the HIW warehouse. This is expected to occur sometime in 2005. Dabkowski says that HIW will continue to be used as the source for historical information from December 2003 backward, so that users can do year-over-year analysis. The company will maintain four years of historical data on adjudicated claims. By

late 2005, however, Highmark expects that users of HIW will have had enough time to become comfortable using MESA.

In mid 2005, Highmark will introduce a data interface from MESA to the HFDR warehouse. This interface will allow MESA to feed the data elements from adjudicated claims that HFDR requires. When complete, all users will acquire data from the same claims without having to re-create the source interfaces to systems such as Billing and Rating. Ultimately, though, even the HFDR users will switch over to MESA.

The MESA team is still discussing what the scope of work will include in 2005. One option is to build out additional subject areas. Another possibility is to bring in claims business from Highmark subsidiaries such as Highmark Life and Casualty, UCCI, or Davis Vision.

V. EDW Benefits from HIW to MESA

Although the phased rollout of MESA will be complete sometime in 2005, Highmark is already deriving valuable results from its current Teradata Warehouse systems. The business benefits from these solutions – especially those delivered by HIW – will serve as the foundation for what the company hopes to accomplish with MESA.

One of the most important benefits is the insight delivered into Highmark's business operations. "Teradata has provided Informatics with the opportunity to do the types of analyses that are highly valuable to Highmark," says Pro. "It's enabled us to gain insights into how our business is working, how the marketplace is working, that we couldn't have seen otherwise."

The new system is also helping the Informatics group perform the more complex types of analyses that its leaders always wanted to do. "What if we could get the majority of our members with heart disease to change their way of life?" asks Mark Romasco, senior decision support consultant for Informatics. "What would happen to our utilization costs if they exercised and went to see their cardiologist once a year? We also ask business questions, like what would happen if we increased our deductible by \$10? What would that do to our market share? The analysis that we do supports any question that anyone in the corporation can come up with."

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– Richard Pro, vice president of Informatics, Highmark Inc.

Information turnaround times are also improving. In one case, a Highmark employee testifying on behalf of the company in a court case called the Informatics group during a lunch break with a related question. An analyst was able to use the system to produce the information before the employee went back on the stand. Before the new system, that information would have taken at least two days to retrieve. With the new data warehouse, the employee had the information in minutes, and Highmark won a multimillion-dollar court case. "That kind of turnaround – with the flexibility and timeliness of the information – gives us new business confidence," says Tabor.

The Teradata solution is also making positive changes in Highmark's ability to get the information it needs. Gone are the days when obtaining an answer to a difficult question required multiple internal handoffs among systems and departments. "The warehouse folks from IT did a lot of data cleansing, running reports, validating them, going back and

forth, trying to figure out what was kicked out of the system and what needed to be verified and fixed," says Tabor. "That's all gone now."

The solution has also improved communication between Informatics and other Highmark departments. "Some groups did not fully grasp the potential impact of the solution," says Pro. "So we often performed the analyses and let people see the results. When they want to know how we came up with the answers, we sell them on the new methodologies and try to educate them on the types of analyses we offer. In return, we've learned more about the different business units and what they need."

This cooperation – combined with the coming integrated EDW – is helping Highmark build a single view of its business operations. "It's extremely important for us to have that common book of business, that common definition and the integration between the data used for analytics, tactical day-to-day decisions, and that connection to the Ledger and

Billing and any other downstream functions,” says Sue Jones. “When that is available, any person looking at a claim line can see when that line went to the ledger, who sent it, and all kinds of information about the reconciliation between the ledger and the actual detailed information. Even though it’s summarized in the ledger, we have a direct link to the detailed information. When a customer holds an invoice in her hand, there should be a direct tie to the information we have. That’s a fairly significant advantage – from an operational, customer satisfaction, and audit perspective.”

Stopping Fraud, Predicting Future Needs

The HIW data warehouse has helped Highmark enhance its fraud detection capabilities. The insurance industry estimates that 3% to 10% of every dollar paid out is potentially fraudulent. With Highmark bringing in \$8 billion in annual revenues, even a 1% reduction in fraud would be a tremendous savings. The Informatics group is using the new system to help its special investigations unit discover fraudulent claims and payments by streamlining what was a resource-intensive manual data mining process into a faster, more automated effort. In addition, the Informatics group is building intelligent software that will look for patterns that can identify previously unseen fraud schemes.

- > \$9 million recovered through fraud detection
- > More than \$25 million in fraudulent payments prevented through predictive analysis
- > More complex analytical analyses supported
- > Information turnaround times and ability to obtain needed information improved
- > Transition to single EDW, clearing the way for a single view of business operations
- > More accurate prediction of future member expenses and required reserves
- > Business confidence increased due to rapid turnaround, increased flexibility, and responsiveness of data

Table 1. Benefits Generated from Highmark’s Data Warehouse Systems

“We wanted to help them use some of our data mining tools to cut through the mountains of data we had and put more focused information on their desktops,” says Pro. “Then they can pick up with the follow-through investigation, which is where their expertise lies.” Last year, the special investigations unit recovered more than \$9 million, which was roughly a fourfold increase in the amount of recovered fraud dollars – real hard dollar savings.

Yet recovering funds fraudulently paid out is a very costly operation. To further improve its bottom line, Highmark is also using the system to develop predictive analysis processes that prevent fraudulent claims from ever being paid. “The amount we can prevent from being paid erroneously is three times higher than the

money we can recover,” says Pro, “so that is an enormous savings.”

As the tools and processes become refined, Highmark is able to spot even smaller dollar amounts, creating greater savings. “The statistical models we use consume a lot of resources,” says Pro. “It’s our environment and the performance we get from the system that make it practical for us to be able to build models like this and try to move to a new generation of special investigations unit activity.” Once MESA is live and frequently loading fresh data, Highmark will be able to use the system even more proactively. The solution will be able to spot patterns that indicate fraudulent claims, preventing these claims from ever reaching the adjudication stage and saving the company even more money.

“We need the best possible prediction of customer expenses in order to stay financially viable and competitively strong.”

– Richard Pro, vice president of Informatics, Highmark Inc.

Informatics is also using the system for other types of predictive analysis – especially in understanding insurance industry trends that can help keep Highmark financially strong.

For example, the system can help Highmark predict required cash reserves more accurately. Insurers need to set aside a certain amount of funds to pay out reimbursements for each month’s medical care. Setting aside the right amount requires the company to be able to accurately predict what its payouts may be. If Highmark can predict its future risk and set aside the appropriate amount to cover costs – not less, and not substantially more – excess funds can be removed from the reserve and invested in investments that bear higher interest. Having more timely and precise information about potential claims and associated reimbursements can reduce the monthly fluctuation in reserve levels and lead to

better decision-making. “If we’re able to estimate our current liabilities better, we can invest more aggressively, which will provide better returns and help us hold down our premiums,” says Pro.

“It’s a very competitive environment,” he adds. “We need the best possible prediction of customer expenses in order to stay financially viable and competitively strong. In order to do that, we need to rate our customers appropriately, stabilize premiums, and make the premiums predictable to customers from year to year. Internally, we need to handle activities that help us ensure our financial stability, such as actuarial tasks like reserving the calculation of premiums. And we need to be able to predict where those dollars are going over at least the next 12 months.” With the more current data that MESA will provide, it will be simpler for Highmark to ensure these tasks are handled optimally throughout the enterprise.

Delivering Value to Members and Customers

As MESA grows and the systems demonstrate clear, ongoing value, Highmark is expanding its use to new organizational operations. From a medical management perspective, the company wants to identify individuals who are at high risk for chronic conditions, such as heart disease or diabetes. That information can be used to work proactively with care management vendors and internal staff to help members manage their disease.

For example, the HIW is already being used to identify members with chronic conditions who are eligible for condition management programs. That information is passed to a Highmark vendor that coordinates the customer communication – calling the customer, mailing reminders, and performing interventions designed to keep the member healthy. The data warehouse allows analysts to perform decision tree analysis that helps differentiate between members with false-positive diagnoses of a chronic condition and those who truly need assistance. “In our initial work, we identified about 35,000 people as potentially diabetic,” says Pro. “With the more powerful analysis capabilities, we know that about a quarter of those were false positives.” With the correct members

properly identified, Highmark can direct resources more effectively and ensure that those people who need care actually receive it.

“It’s a win-win situation,” says Pro. “If we succeed, the member lives a better quality of life. His health remains stable, and he misses less work, which is less lost productivity to the employer. There is less expense generated by the member from a treatment perspective, which means there is less money rolling into the pool that’s used to determine next year’s premium. So to the extent that we can help members stay healthier, we benefit from being able to better control the premiums we need to ask for the following year.”

Having this decision support information readily available is helping Highmark improve its ability to service customers. Employer sponsors and large groups that provide insurance routinely ask for data about their claims terms and spending. As MESA becomes operational, it will help answer this call. “Our customers want to know where their health care dollars are going,” says Tabor. “With MESA, we’re able to start giving them more information in a more timely way.”

Expanding Highmark Services

Highmark is using the availability of detailed, high-quality data to expand into new lines of business. For example, the company is using the data to support a managed-care product for senior citizens. Although many health insurers initially

- > More rapid and accurate identification of members with chronic conditions
- > Better service and value for dollars spent by employers and other group insurance providers
- > Additional revenue from new lines of business, such as managed care programs for senior citizens, provider network management services, and consulting opportunities
- > More timely analysis of key trends

offered such products, which are funded in coordination with the federal government’s Medicare program, the majority have withdrawn from the market because the products are difficult to make financially viable. Highmark’s Medicare Plus product, Security Blue, is offered in Allegheny County, where the population of senior citizens is the second highest in the country. With no shortage of eligible members, the Security Blue product team used Informatics and the Teradata solution to generate risk analysis information. That information helped them to understand the customer base and to manage their care within the fiscal restraints of the federal funding. The result was a financially successful product.

Other Informatics services that have expanded with the use of the data warehouse solution include provider network management in the central Pennsylvania region, as well as analysis and reporting capabilities for the sales and support of large national customers. Highmark is

Table 2. Benefits Expected from Highmark’s EDW System

moving to a self-service model that will enable these large customers to query data in the warehouse and create reports that will give them better visibility into their own risks and liabilities. In addition, the group will offer consultative services that will use data from MESA.

A related consulting opportunity is one in which Highmark is beginning to provide European insurers with advice on successfully establishing a data warehouse and using it to their best advantage. Several companies have already met with Highmark officials to discuss how the warehouse can be used to support their analytical needs. Some smaller health insurance companies within the United States have also talked with Highmark about using the Informatics services to better understand their markets.

Clearly, Teradata Warehouse solutions have helped Highmark keep pace with the changing business environment and the evolving demands for data analysis. For

example, after the terrorist attacks of 9/11, Highmark saw an increase in the number of people who went to their doctors for basic checkups. A recent local outbreak of hepatitis led to a surge of hepatitis testing. “We can look at our claims based on local and national events,” says Mark Romasco. “It’s important to Highmark to know those things. With the market becoming more competitive, the need is even greater. You need data now – not tomorrow – to be able to make decisions.” Once MESA is up and running, Highmark will be able to perform analysis that identifies trends as they are happening.

Lessons Learned

A project the size and scope of MESA gives organizations such as Highmark an opportunity to reflect on lessons learned – even before the project is complete.

Creating the cross-functional MESA team resulted in new levels of communication among different Highmark departments. “When we set up the team structure,” says Dabkowski, “there was some skepticism

that it would work. Having four or five peers in a group with an outside arbiter was something new. But we moved ahead as one cohesive unit, and we definitely have produced a better work product because of it.”

The mixed group also helped the team determine priorities and responsibilities. “In the past, it was very difficult for us to get widespread participation in a project like this because people didn’t want the responsibility of signing off on some function that other people would be using,” says Jones. “By having cross-enterprise representation on the MESA team, we’ve been able to get people to agree on what should be in the system, and on common definitions from a MESA perspective. It’s not perfect, but we’re making progress.”

In addition, building the MESA system is helping users across the enterprise understand the interrelatedness of the claims processes and data and the need for data integrity. “One of our challenges has been

to help users see that if they are working on a claim and they manually make a change, that it impacts data integrity downstream,” says Dabkowski. “When the information comes in wrong, the financial equation doesn’t balance.”

Initial plans called for Highmark to implement MESA in one “big bang” within 12 months, but it quickly became obvious that a phased approach would be necessary. The project was subsequently divided into four phases. Yet from a project management perspective, Dabkowski says that carving the MESA project into even smaller phases might have been more effective. Learning new technology and taking the time to do the project the right way – understanding user requirements and thoroughly scoping out functional design before development – contributed to the delays. “Having smaller pieces may have made the project more manageable and efficient,” he says. “It also may have helped us manage the perception that we were behind schedule.”

VI. Highmark's Continuing Data Warehouse Growth

The continued success of the MESA rollout is encouraging Highmark to consider additional data warehousing opportunities. For example, with Macioce's promotion to senior vice president of customer and analytic operations, the potential for MESA and the data warehouse system is becoming better known on the operations side of Highmark.

"Like FedEx, which uses its technology to track packages and to develop applications that help the business succeed, Highmark could do more with this," he says. "What we're trying to do with the active data warehouse is to capture information more in real-time, closer to the event, and closer to the member's receiving a service. We can create event-based decision-making using automated decision-making algorithms that monitor the data. And when something happens – when Mrs. Jones gets discharged from the local hospital for a diabetes complication, for example – the routing in our system can trigger a transaction to a business unit to call Mrs. Jones and get her enrolled in our condition management program or connect her with a health coach."

Macioce says that the active data warehouse will allow Highmark to create patient activity indexes that spot unusual member activity. For example, if a member sees a cardiologist three times in two weeks after never having seen one, the system can flag the patient as needing health education or intervention programs and

"There's a huge opportunity here to integrate the active data warehouse with our business operations, for the benefit of the whole company."

– Darren Macioce, senior vice president of customer and analytic operations, Highmark Inc.

send a trigger to the appropriate Highmark provider organization. Keeping members healthy – and working productively – will help prove Highmark's value to the employers who procure the health insurance. "That's what they're paying for – they want their employees living healthier, working productively," he says, "and that's the value we need to provide. That gives us an opportunity, especially in a market that is growing ever more competitive."

MESA can also support Highmark's need to provide consumers with in-depth treatment and medical information. "As the burden of making decisions falls more and more to members, our challenge is to provide better information," says Macioce. "When presented with a diagnosis, most consumers don't know what their options are. If their knee hurts, do they need knee replacement, arthroscopic surgery, or six weeks of physical therapy? When they're charged with contributing to that decision and living with it, they're going to demand more information. The sooner and more fully we can give it to them, the better. There's a huge opportunity here to

integrate the active data warehouse with our business operations, for the benefit of the whole company."

One potential future application that Macioce supports is a customer relationship management initiative. Instead of generating literature on issues such as condition management and retention after a customer calls Highmark, Macioce wants the campaigns to be proactively initiated based on information stored in the active data warehouse. For example, if a member is diagnosed with diabetes, MESA should immediately send him Highmark materials designed to explain the disease and its management. "We need to get out there and start dealing with these issues before the phone rings," he says.

In addition, Highmark may use the data warehouse to spot trends in the call center inquiry data, using that as an early warning device for the company's business operations. "When you see a spike or a deep valley that's outside of the statistical data, you know something is going on," says Macioce. "The members didn't get

“In this case, it has not been a struggle at all to prove value.”

– Tom Tabor, CIO, Highmark, Inc.

their ID card, they had a co-pay problem, there’s a benefit issue, or something is going on with that account. Instead of waiting for hundreds of members to call us, we can proactively dig into the operations data to identify the problem and solve it before it’s out of control.”

It may even be possible to use MESA as a personal health information system for consumers, according to Lowell Starling, vice president of infrastructure management. “We have an incredible amount of information here about diagnoses and treatment,” he says. “If we packaged it properly so that users could gain access through our Web site, there is the potential for people to use the database to answer their questions, investigate how common a disease is, what its treatment options are, and how successful those treatments have been in practice. That’s a service that consumers could use.”

“Teradata has been an excellent platform and it’s served us well,” he adds. “But I continue to look for how we can do more with less. Processing claims accurately and quickly is almost a commodity service. We need to think in terms of what value is added in terms of information and content, and I think this is where analytical platforms like Teradata will play an increasingly important role.”

Seeing the system getting used – and having demand for even greater use – is a rewarding experience for everyone involved with the data warehouse systems. “It’s been a big benefit to the organization,” says Tabor, “and it’s been a long time coming. I know that Highmark will benefit from it well into the future.”

The Value of MESA

Although Highmark’s MESA initiative is not yet complete, team members are certain that the project will continue to contribute to the company’s success. “We’re really at the midpoint of our story,” says Macioce, “but the identification of hard dollar savings will become easier after MESA is complete – especially on the operations side. If there is a problem with how we’re paying a claim, or how the system coded benefits or set up pricing algorithms, and I can identify it or stop it before it happens – before the payment gets made – we have a real opportunity. There are opportunities that the active data warehouse will give us, if only we can change our mindset about how to use the information. We must move from being a reactive business model, because our data was retrospective, to proactive decision-making.”

Interestingly, Highmark does not consider itself to be a “bleeding edge” adopter of technology. Yet the MESA system clearly

positions the company as one of the industry’s most innovative health insurers. “Operationalizing data warehouses is something that’s been done in industries such as manufacturing and airlines,” says Terry Crislip, the Teradata account executive for Highmark. “But within the insurance industry, Highmark is a leader in this type of technology. While other companies are still batch updating once a week or once a month, Highmark has been innovative in its architecture of MESA.”

Tabor, the CIO, agrees. “When you look at the size of the organization, the tool sets, the mainframe environment, and the scope of the data we deal with, what we’re doing here is pretty impressive,” he says. “When it’s all said and done, none of our competitors are doing better.”

Yet, with all of the change that has already taken place and what is still to come, Tabor views MESA and the technology that supports it as a means of empowering Highmark to meet its business goals. “The IT group gets a significant part of the corporation’s overall administration budget,” he acknowledges. “As a result, we have to provide value. With this system, we can turn the information over to the Informatics group, and they can take ownership, often without any help from IT. And that’s our goal: to provide information to the business to make decisions. In this case, it has not been a struggle at all to prove value.”

Appendix

MESA Technology Considerations

Highmark's MESA project has many technology components. Following are selected issues and concerns that factored into Highmark's effort to create the MESA EDW.

System information

The Highmark data warehouse system includes several coexisting Teradata 525X and 5380 nodes.

- > Total capacity: 7.7 TB with 2.5 TB current loaded
- > Data structure: Third normal form

Data sources

In total, eight Submission data sources will initially feed the data warehouse. Fifteen Adjudication sources will follow. The company plans to store four years of historical data in the EDW environment. In addition, there are flat files from Highmark mainframes, VSAM files, Oracle databases, IBM and DB2 databases, and Microsoft Excel spreadsheets. The warehouse utilizes third-party direct data, information such as diagnoses and procedure information, from corporate sources to ensure consistency within the organization. Third-party pharmacy provider and network information from the prescription vendor are also utilized in the warehouse. Finally, miscellaneous data, such as all ZIP

codes and county codes, are purchased by the corporation and made available within the warehouse environment.

Supplemental data in the warehouse

At the beginning of 2005, the EDW includes data about all claims (Inpatient, Outpatient, Professional, Durable Medical Equipment, Drug, and more) and claims-like transactions that are necessary to make sense of the claims data. This information includes certain data from the member subject area, as well as client and provider information.

Source of records

Mission-critical systems at Highmark include customer Claims Billing and the General Ledger systems. Other systems that will use the data warehouse as a source of records include Revenue and Settlement applications for both group customers and providers, Provider Incentive and Profiling applications, Performance Measurement applications, and many others.

Data loading

Highmark uses Teradata TPump, the continuous-update load utility, to help spread data volumes more uniformly throughout the workday. Teradata TPump is a highly parallel utility designed to move data continuously from data sources into Teradata tables without locking the affected table. TPump works with the

Informatica Power Center ETL tool.

"We knew that Informatica processed the data quickly, so we wanted to take advantage of that with TPump," says Jones.

"Also, we knew that near real-time data loading was where we wanted to be, so we decided to start there from the beginning."

Workload management techniques

Formal standardized monitoring of the EDW is not yet required, due to Highmark's large system capacity compared to current data accumulation. However, the company is monitoring warehouse conversion as well as load performance and query performance. Resulting data will be the basis for making recommendations on more formal monitoring tools and processes that will be needed once the data warehouse is fully loaded.

Query tuning

Very little tuning is required at this time. Some queries occasionally require rewriting. No join or aggregate join indexes are used, but some secondary indexes are.

Reporting

Many Highmark users rely on Cognos Impromptu to generate reports from the data warehouse. More technically oriented users, such as analysts in the Informatics group, often write many of their own SQL queries and prefer to generate their own reports and datasets.

Archival

The data warehouse is archived once a week with a full backup. This methodology will not accommodate the new EDW model so efforts are under way to design and implement a more timely backup process. Highmark has so far run two disaster recovery drills and is continuing to fine-tune its strategy as the ultimate data volume is calculated.

Capacity planning

Highmark has a formal capacity planning program in place. The company considers mechanical statistics – such as how much data is added to the warehouse per day, week, or month, and how much data is removed. From there, business estimates are made regarding enrollment fluctuations and new business with other health

insurance providers and other business partners. Other considerations include historical statistics, such as the average number of claims per year per user, and ad hoc additions, such as an existing product line that needs to be added to the warehouse.

Security

Highmark is currently experimenting with role-based security provided by Teradata.

Data warehousing team

The team consists of 45 people, including:

- > Business analysts, who handle requirements gathering, functional design, testing, analysis, customer service, and end-user migration
- > Systems analysts, who perform technical design, coding and unit testing

MESA project team structure

The project team includes approximately 100 people, including database administrators, systems analysts, customers, and support team members. The technical ETL development staff handle: global components and reusable code; Informatica transport loads; extract archiving (responsible for getting sources and balancing initiated and preparing archive copies). The remaining teams are a quality assurance team; a business ETL team that maps sources to generate data; and a business integration group that oversees user migration, end-user access, metadata, data governance, and training.