

3M Moves to a Customer Focus Using a Global Data Warehouse

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Introduction

In 1995, 3M Chairman and CEO L. D. DeSimone along with his top management team recognized that the focus of 3M had to change. For nearly 100 years, 3M manufactured products to make life easier, safer, healthier, and more productive for people in nearly 200 countries. In the excitement of creating innovative products, however, 3M was ignoring its customer relationships.

Until that point, 3M was organized into 50 autonomous, product-centric divisions, each with its own IT group, its own strategy, products, and markets. Innovation was the driving force of 3M's decentralized organization, and each division focused on selling its own unique suite of products, which resulted in 15.7 billion in sales in U.S. and abroad in 1999.

Unfortunately this approach confused customers who often had to interact with a host of 3M divisions to meet a wide range of needs. Under DeSimone's leadership, 3M was restructured into seven market segments: Industrial, Transportation, Health Care, Graphics and Safety, Consumer and Office, Electro and Communications, and Specialty Material. Each segment was charged with serving customers better and efficiently meeting their needs.

Changing a large Fortune 100¹ company like 3M is not easy. It requires shifts in mindsets, work processes, and the information that is needed to run the business. To address the latter need, 3M began a significant initiative to create a data warehouse called Global Enterprise Data Warehouse (GEDW). Before the GEDW, aggregate information was available only on division or country specific monthly reports at a fairly high level of aggregation. With GEDW, thousands of 3M employees now have real-time access to accurate, global, detailed information about sales, orders, customers, and products down to the SKU level of detail. The GEDW also underlies new web-based customer services that are dynamically generated based on warehouse information.

GEDW has created a number of benefits for 3M, the most important being the capability to understand 3M's customer relationships by providing a customer-centric view of the business. The data warehouse has enabled 3M personnel and processes to become more customer-focused, and it serves as the foundation for Customer Relationship Management (CRM) initiatives throughout the organization.

This case study describes 3M and the business and systems drivers for the global data warehouse. Next, the development of GEDW and its architecture are described. The case

¹ Fortune ranked 3M 110th in the 2000 Fortune 500 ranking.

concludes with benefits of the data warehouse and the lessons that 3M has learned along the way.

Company Background

Minnesota Mining and Manufacturing (3M) is a \$15.7 billion manufacturer with 70,000 employees selling 50,000 products that comprise 500,000 SKUs. The products are diverse, ranging from office supplies and industrial supplies to healthcare products and telecommunications and electronics components. 3M is a global company, with operations in more than 60 countries, manufacturing in 41 countries, research in 29 countries, and sales in 200 countries (52 percent of sales come from outside the U.S.). 3M strives to be the preferred supplier to its channel partners (e.g., K-Mart, Target, Office Depot) and customers, and focuses on customer loyalty, supply chain excellence, and new product innovation.

Until 1995, 3M's divisions were autonomous. Because of a major emphasis on product innovation throughout their history (30 percent of 3M's sales each year come from products introduced within the previous four years), 3M divisions were good at sharing research and development knowledge throughout the corporation. However, there was little sharing of information about customers and markets across divisions. Most divisions also had their own IT group and decision support strategy. Before the recent reorganization, there were 25 IT groups supporting the divisions, and 60 IT groups supporting non-U.S. countries.

Several times in recent years 3M reorganized the middle layer between divisions and top management; however, these business groups were focused around technologies. In 1995, top management at 3M realized that the company needed to become more customer and market focused and that to do so would require dramatic changes in corporate culture and information systems. At this time, 3M grouped its divisions into six market centers, and 3000 IT personnel were shifted from their division and country IT groups into the market centers, with only small IT staffs of up to three people left at divisions.

The Business and Technical Drivers behind the Warehousing Initiative

The need for GEDW became clear when the move to market centers was announced. The GEDW business drivers included what we call CRM today: the need to understand customers and what they buy globally; and the need for global pricing, sales, and customer information.

Ron Mitch, the Assistant Chairman of the Board, was a key driver of the move to market centers. Mitch complained that he was tearing his hair out because when he visited key customers, IS could not tell him what the customers bought from 3M – he had to ask the customers! There were 30 data marts across the company, but they were all organized differently, developed by different groups for different purposes. How could 3M increase customer penetration when it could not identify sales by customer? How could 3M track global pricing to prevent 3M from competing against itself when pricing information was split between business unit specific systems? As Mitch reorganized the company around

market centers, it became clear that the existing information systems could not provide the information needed to support the new focus.

During this time, Al Messerli, a veteran IS manager who managed the advanced IS technologies group, began a crusade to move from decentralized decision support systems to a single global data warehouse supporting 3M's decision support needs. Messerli argued that a data warehouse would be the only way to generate the necessary data to support the new market focus. Specifically, 3M needed global direct and indirect customer sales, the ability to track product pricing globally, customer and market profitability, demand planning, and new product tracking. Current systems could not provide this information.

In addition, if the GEDW were installed, all of the division-specific decision support platforms and their antiquated systems could be removed, for a savings of many millions of dollars. All reporting and decision support applications could be driven from a single, consistent source of data.

Messerli and his group began a major effort to sell the concept of the Global Enterprise Data Warehouse from the CIO to the top of the organization, and out to the Division VPs. Eventually the dual arguments of access to global data and reduced costs for decision support succeeded. By mid-1996, Messerli's group was given funding and corporate approval for Phase 1, and they started implementing GEDW for the U.S. sales data.

The Global Enterprise Data Warehouse

Getting Business Support

Three parallel efforts laid the groundwork for GEDW. The first effort involved selling the concept to top and division management. To succeed at this, 3M needed a champion with broad business knowledge, an understanding of the role of data within key business processes, and knowledge of organizational politics. Most database administrators cannot connect at that level; however, Messerli had credibility with high-level business folks because of his long tenure at 3M and his proven ability to deliver valuable systems to the business. Messerli began selling the idea up the chain of command to senior management, even creating videos of quotes from executives who supported the idea. However, the sector vice president to which IT reported insisted that before the Operating Committee would approve the GEDW, Messerli must gain approval from the fifty divisions.

This was a significant and time consuming challenge. However, Messerli had been at 3M for 30 years, and he understood that there was a balance of power between the divisions and the country subsidiaries. The division VPs were hungry for global data so they could be more effective in managing globally. According to Messerli, "I knew what the business unit people wanted." Messerli spent a year selling the Divisions on GEDW.

That yearlong detour likely was a key to the success of GEDW. It created two important outcomes. First, getting division VPs on board gave the GEDW effort strong buy-in.

Second, the process showed that sharing data on a global scale would require a non-trivial shift in corporate culture around data ownership. 3M had a culture of sharing information about product technologies, but this had not been the case with information about markets and customers. For example, if there was a breakthrough with a new customer, there was no mechanism of sharing this information with other divisions. Similarly, there was no process to share contact information. Before GEDW could be implemented, it would require corporate approval to share sales, profitability, margin, service, inventory, customer, and product data across the business units. This decision to share information ultimately was supported by the CEO and the Senior VPs (i.e., the highest level of sponsorship).

Benchmarking

The second process that moved the GEDW project forward was benchmarking the data warehouse technology platform. Messerli's group spent several million dollars benchmarking five different platforms and databases. This was critical because the financial justification for the warehouse included replacing existing decision support applications. If the intended technology could not support the load and replace the old systems, the team could not justify the expense.

Messerli's group provided benchmark tests to the vendors: the hardware had to be \$2M or less, configured any way the vendor desired; 3M would provide the data to fill what would normally be considered a fairly small data warehouse database (i.e., 200 gigs); and the systems would have to respond to specific queries. The process included (1) load the database and see how long it takes, (2) run the queries and see how long it takes, and (3) scale up the number of users from 1 to 200. 3M benchmarked five different platforms, and most crashed as the number of users increased. NCR's Teradata was the only platform that completed the entire benchmark test.

Gathering Requirements

The third effort in moving forward with GEDW was developing an understanding of the business needs and systems requirements for the data warehouse. Messerli's group interviewed 250 mid-level managers to set priorities and specify requirements, working from the general down to specific subject areas and detailed data.

Understanding the business *and* the data was critical in developing the requirements and specifying the data definitions for the data warehouse. Although a separate global data standards group at 3M had been working on global definitions for some time, Messerli found that their data definitions were useless. For example, the data definitions for the global order subject area were based on the way orders were handled in the U.S. system. This was less advanced than the European order model and made it almost impossible to link the pieces of an order back together once it was processed.

The problem was that the people who wrote the data definitions were low-level employees who had little understanding of the order fulfillment process and how the data was used. Messerli assembled a team of people who had strong business knowledge and knowledge of the IS applications. The team also included people who understood the

global and U.S. businesses. "If you are going to build a global solution you have to have global participation."

Messerli's team built the data model and the data standards according to what was needed for the future 3M organization, not according to what was currently done. "We went for what we should have, not what exists already." This meant that often there was not an exact match between the existing systems and the data model for the GEDW; however, the effort positioned the GEDW for meeting long-term needs. Now that GEDW data standards exist, 3M finds that when new operational systems are designed, the GEDW data standards are used as the basis for data within the new systems. The data management team spent more than 20 people years standardizing data globally. They created more than a thousand tables and three thousand data elements.

Developing GEDW

3M built the GEDW with minimal help from outside consultants, relying on a strong core of IT and business personnel who had an excellent understanding of the business and its data. Messerli controlled the project within 3M, doing project management and design, and installing and managing the data warehouse platform. He was skeptical about the ability of system integration consultants to add value, but he noted that they did receive helpful knowledge transfer from the platform vendor, NCR. Managing the platform within the project team was important, Messerli felt, to ensure the effort got off the ground. Once the platform was in place, it was transferred to the 3M IT infrastructure group.

Interestingly, the strongest resistance to the GEDW came from the IT groups who were losing control of their data. Although the IT personnel from the old Division IT groups had been centralized into market centers, they still had to cooperate with the GEDW project to shift decision support applications away from the legacy platforms. Often, the IT personnel were resistant to change, even though the savings from making this shift were significant and the data was of higher quality. The GEDW project team pushed the IT folks hard to switch over, and at the same time they sold the warehouse to marketers, sales representatives, business unit analysts, and functional managers.

Cost savings was an important selling point. For example, in one division there was a \$2 million savings by moving off of legacy systems. A GEDW analyst explained, "[Some IT folks] weren't looking at the overall picture. They were just looking at here and now. They do data loads and queries against this old horrible data from the 70s that is very inefficient, and the programs are horrible. And, it is costing a lot of money to maintain it." The data charges and the computer time for loading and accessing data were about \$180,000, and the cost of several people hired to maintain the applications was another \$400,000. Savings totaled several million dollars over a year and half.

A big issue in switching to GEDW was that GEDW reports often did not match existing reports. Initially, users reacted by criticizing the GEDW information, but the GEDW team responded by showing users the reasons for discrepancies. Now the GEDW team is able to take the stance that the GEDW data is right and the legacy applications are wrong.

After a year of development, the project team has moved from selling the warehouse, to feeling secure in its existence, to facing almost too much demand for new projects because users want so much from the warehouse.

The Phase 1 GEDW (U.S. sales data only) was deployed in April 1997. In 1998, the team justified Phase 2 by rolling out the business intelligence portion to the rest of the world (except North America and Europe). By that time, the need to share information with channel partners (85 percent of 3M's business is with office distributors, industrial wholesalers, and healthcare distributors), the public, and customers was obvious. The Internet was emerging, and customers were demanding more and better product information. Also, it was clear that 3M needed POS information from its channel partners to understand the end customers.

In 1999, the project team began Phase 3, which was implementing e-business supported by the GEDW. Phase 3 included putting multi-media product information on the web and dynamically generating web pages based on GEDW content. This application was called Data Express, and it was used to push product information to channel partners who traditionally have had poor information about 3M products. Data Express pushes current, accurate, quality data into the channel partners websites and makes catalogs and marketing literature available on-line. This has moved the marketing groups at 3M towards a data manager/data trustee focus and saved millions of dollars a year in publishing costs.

The Warehouse Architecture

GEDW is deployed as a 3-tier architecture that includes database servers, application servers, and user desktop browsers. The database technology is NCR's Teradata RDBMS and WorldMark massively parallel processing (MPP) servers. The primary database server consists of twenty 5150 nodes with eighty 200 mhz processors and eight 4800 nodes with thirty-two 550 mhz processors. A secondary database server is a 6-node MPP 5100 with 24 Pentium 200 mhz processors. The system has a total of 10.3 TB NCR/LSI Raid storage, across two different physical platforms. Though each platform has five terabytes of storage, the current warehouse is one terabyte. MPP architecture provides the linear scalability required to support the growth of data and users for internal and external access.

High availability is essential for this mission critical system. It has 7x24, 99.9 percent availability for global business intelligence and external public access. Continuous "follow-the-sun" loading is accomplished with ping pong loading processes and replication of the critical application access layer and data to two physical platforms in two buildings. The ping pong loading process assures that one machine is always available for queries. Data is loaded into a highly normalized foundation data layer organized by subject areas (e.g., product, customer, order, GL). Above that sits an application access layer (e.g., meta data from the toolset; a de-normalized star schema database; etc.). The team makes upgrades to this weekly without affecting applications running off of the warehouse.

Primary access to the database engine is provided via a high speed, ATM network infrastructure. MVS and VM mainframe systems are direct connected to the data warehouse with multiple, high speed ESCON channels. On a daily basis, Teradata software utilities use these channels to extract, transform, and load source data into the warehouse. Data is also sourced from NT and UNIX operational systems.

A variety of NT and UNIX application servers are used to access the Teradata RDBMS. The primary application tool set for internal business intelligence is Computer Associate's MyEureka! suite (formerly DecisionSuite, WebOLAP, and IQ), which facilitates high performance and mass deployment of analysis, query, enterprise reporting and portal capabilities. The primary tool set for dynamic web publishing of multimedia product information from the GEDW on 3M.com and extranet sites is ATG's Dynamo.

Use of standard Microsoft or Netscape browsers on user desktops minimizes maintenance and support. The GEDW homepage provides a common interface to all GEDW capabilities, and this is supplemented by personalized portals for many users, which simplify access to the reports, queries, or analysis applications that they commonly use.

The GEDW includes data for every 3M order, shipment, customer, and product. Direct sales, indirect sales (POS), price, gross margin, service metrics, demand, forecasts, inventory, supply plans, procurement, vendor, and financial data are all included. In addition to 3M legacy systems, a key source of data is Dun & Bradstreet WorldBase, which contains 50+ million company sites for understanding customer organizations. For disparate legacy systems that cannot be easily linked directly into the GEDW (primarily non-U.S. systems), the "Green Book" provides a convenient way to facilitate data feeds. This is a standard format for information on shipments, orders, invoice, product, and customer data.

Ultimately the GEDW team compromised on forcing all data into a set of completely standardized global tables. They now allow local users to put some of their own local tables in the warehouse to better meet local needs. The GEDW staff reviews requests for these local tables to confirm that they do not fit within the global data model. In addition, local temporary files of a limited size are allowed with no supervision of the GEDW project team.

GEDW and the Global CRM Architecture

Although there are quite a few applications focused on developing and supporting customer relationships with 3M, many of these have been driven by local business needs and local perspectives, in keeping with the long time innovative and autonomous culture of 3M. While there continues to be a significant focus on local management, it is now clear that customers, markets, and the competitive business environment are converging on the need for global decision support and global CRM. "That's where we have to be!" said one CRM manager. To support this global CRM capability, 3M is in the process of implementing a packaged CRM application from Siebel Systems.

Though there is currently no direct link between GEDW and the Siebel Systems CRM package, GEDW figures prominently in 3M's long term architecture for CRM. The GEDW will be the source for additional data not contained in Siebel. This data will be drawn upon as necessary by the Siebel CRM package. Thus the GEDW will provide two important capabilities in the overall CRM architecture.

First, it will be the decision support tool for the corporation. GEDW is the storage area for data (an absolute necessity) and the source for analysis tools. It provides not only sales reporting, but also sophisticated analytical tools. Decision support is obviously critical to the management of products, markets, and customer relationships. GEDW provides better information than the old local decision support platforms because it provides more information. In addition, it has much more powerful decision support tools. Where before the typical product of an information request was a paper report, now it is possible for management to take an initial result and follow up with drill down analysis or other related analyses.

Secondly, GEDW is seen as providing the mechanism for integrating transaction processing across multiple (previously separate) systems, including the Siebel CRM package. GEDW is a single source for a wide variety of information pertinent to a given transaction, and accessing that information requires only a single interface.

The GEDW Today

Since its inception in 1996 through mid-2000, 3M has made a \$30 million capital investment in the GEDW, including hardware, software and major applications. Ongoing maintenance costs (e.g., hardware, operating system, database management system), analysis software, query and reporting tools, and portal software total \$2.6 million per year.

The current data warehousing team includes data management, common applications development, digital media, and e-business. The total team has 40 full-time 3M employees and 40 professional services people in St Paul. More than 100 IT, business unit, and subsidiary users globally create queries, analysis, and reports. GEDW initiatives are ongoing, and additional users and applications are continually added. A GEDW Steering Committee oversees ongoing GEDW efforts. The group includes IT managers and directors from the market centers and functional area representatives.

An important role of the GEDW project team is to encourage users to take advantage of the capabilities of the warehouse. Every month the group demonstrates an interesting application or shares examples of the benefits from using the systems.

Training has been focused on the use of the applications – what the applications can do, how to use them, how to navigate, and the benefits. The GEDW team is now shifting from application training to more general global data warehouse training. The latter training includes information about the warehouse, the data within the warehouse, and the various ways to access information. Last year the project team trained 400 IT and business people on GEDW.

Applications and Use of Warehouse Data

GEDW can handle hundreds of concurrent users, and as of June 2000, there were over 10,000 employee and channel partner users, in addition to public access via 3M.com. By the end of 2000, there will be 20,000 registered, secured users and millions of public users. By the end of 2001, there will be 30,000 registered, secured users, and daily access of public information is expected to reach 15 million database hits.

Employees, customers, distributors, suppliers, and the public worldwide can access one centralized information source via the Internet, intranet, or extranet with a web browser. Users view data by product, customer, market, channel, site, account, geographic area, organizational unit or time dimensions, at any level of detail from total 3M to the individual SKU level. There is a collection of fixed hierarchies included in the reporting schemes, but business units can build specific ones for specific needs.

Business intelligence content is pushed to desktops or pulled on demand with interactive drill-down to detail. There are alerts, which notify users of reports or exceptions. Users get information when they need it, in a personalized format meaningful to them via their personal portal.

Some specific GEDW applications include:

- **"One Face, One Voice" Digitization:** a corporate process to digitize and load all product information - images, text, structured data, video, and other data types - into the GEDW.
- **GEDW DataExpress:** Quality of product data for channel partners is now greatly enhanced by the ability to push digital information about products to channel partners. In the past, 3M channel partners have had incomplete, inaccurate, inconsistent, and often obsolete product information. The GEDW DataExpress application assures current and accurate daily, weekly, or monthly updates, automatically triggered by any content change for any range of selected products. The information is transmitted in formats that include EDI, proprietary formats, or URLs, which enable direct real-time links from a channel partner website to the GEDW.
- **Products on the Web! (PoW!):** dynamically produces web pages on demand. It enables employees, channel partners, customers and the public to navigate 3M product information, drilling down via market, product line, product family, product and item (SKU) to get the information needed to buy. The GEDW is the focal point in 3M's new global electronic commerce architecture, providing an integrated shopping and buying experience for channel partners and customers, and making it easier to do business with the manufacturer.
- **D&B WorldBase:** data that is used to match 3M customer account records from all 3M subsidiaries globally to provide visibility of customer hierarchies and accurate summarization of customer data, and thus a complete picture of global customers not previously available. Accurate global sales, profitability, and price reporting is now

possible for multinational customers, eliminating unsuccessful manual attempts to do this.

The Benefits of the Warehousing Initiative

The GEDW has achieved a variety of quantitative and qualitative. The warehouse was justified based on:

- IT savings from eliminating dozens of independent data marts;
- re-engineering sales reporting processes and reducing the people resources required to report sales and reward sales forces;
- value of understanding customers and markets across all 3M business units globally;
- improving sales force and customer service productivity;
- reducing 3M and channel partner cost of providing product information to customers (marketing communications cost);
- speeding the product commercialization process; and
- improving growth and profits by increasing customer satisfaction;

Based on these and other hard benefits, the GEDW return on investment is 56 percent, substantially exceeding 3M's investment threshold.

Since the investment in the GEDW has been quite sufficiently justified by the cost savings from phasing out the decentralized decision support platforms, the GEDW group has not focused on developing a concerted and complete assessment of the value of the business benefits. However, during the summer of 2000, the GEDW group sponsored a contest for business units to report quantifiable savings or business benefits, with hundred dollar prizes going to the most compelling entries. From the entries in the contest, and from additional anecdotal evidence, the following picture emerges of the ways in which GEDW is helping the business develop customer relationships.

Customer Service:

Prior to GEDW, when customers would call about electronics parts, the service representative would search through a 900 page report to find them. Now they search the web-enabled GEDW, and they are off the phone with a happy customer in much less time. In addition, in the past when customers inquired about order status, customer reps had to copy information from paper reports, put it into spread sheets, and send it out to the customer. Now that information flows through to the customer on the web, without any involvement from the customer rep.

Sales Force Automation:

Sales representatives are paid to manage their territories; however, they used to receive information from monthly reports, including a sales report and a rebate report. Because of problems and complexity in the rebate system, the reports often did not match. In order to reconcile the various reports and make sure they were getting proper credit for their sales, reps typically spent about 5 hours a month manually checking multiple paper reports. Now all the reports are based on the

GEDW, and all of them always match. The reduction in reconciliation time is estimated to result in a \$2 million dollar savings in just one business unit, and extended corporate wide should be approximately \$20 million a year.

In addition, since the reports are daily and on-line, sales representatives have begun to monitor how close their customers are to qualifying for rebates based on current orders, and to work with those customers who are very near to qualifying. They point out what additional orders are needed to get the rebate, and often get the additional sales.

Quality Control:

3M recently decided that it would no longer produce Scotch-Guard. Its long half-life was considered a potential product liability problem even though there had been no indication of trouble. 3M needed to know the buyers of Scotch-Guard and alert them to the fact that the product was being discontinued. The GEDW provided this information.

Cross-Selling:

Some groups now analyze sales data to recognize when a customer buys one product from 3M without buying related products from them. The analysis identifies sales opportunities for the related products.

Understand the End Customer:

In the past, POS data from channel partners has not been gathered in a centralized or standard way. Now the obvious resting place for the POS data is the warehouse. There is movement towards a coordinated effort to assemble all the POS data on the warehouse for the analysis of the end customer.

Sales Tracking and Analysis:

Because the tax department was able to easily to identify shipments outside of the U.S. that 3M should not be paying taxes on, they saved \$5 million last year.

Lessons Learned

There are a number of lessons that 3M has learned during its years of developing GEDW. In this section, some of the company's most important learnings are presented.

Selling the warehouse to the organization takes more than DBMS skills and experience. If you do not have business credibility at high levels, you will need to partner with someone who does. Key people who are located throughout the organizational hierarchy, especially at high levels, will be critical to move the company from a traditional way of thinking to a focus on customer relationships.

Designing a data warehouse requires very good people who understand the data *and* the business. Data models and data definitions designed by people who do not meet this requirement will be useless or counterproductive. An IT/business hybrid also is the best

kind of person to design the ware to support the future business as opposed to the old way of doing things.

A substantial savings can be achieved by creating a single, well-managed platform that serves as the single source of data for reporting and decision support. Typically, decentralized organizations have a wide array of legacy systems that have high maintenance costs associated with them. Eliminating these systems reduces costs while improving the access to consistent, high quality information throughout the organization.

Do not underestimate the resistance to change. IT personnel can be the hardest to convert to new systems strategies. A combination of tangible cost savings and benefits and support from business users likely will be necessary to drive IT personnel to a centralized data warehouse strategy.

Do an extensive benchmark. If your data warehouse size or end user base is large, it is critical to benchmark a variety of technology platforms before choosing a vendor partner. Otherwise you may discover when it is too late that your hardware cannot scale to meet future growth.

Conclusions

A large organization can change direction as well as an ocean liner moving at full-speed on the open seas. You can expect great shudders, confusion, and tremendous pull in the wrong direction. As companies focus increasingly on customer relationships, they cannot underestimate the systems changes that will need to occur to support new information requirements. Often, a data warehouse is the way to meet those needs, and 3M illustrates the effort of a large Fortune 100 company who experienced a successful warehouse implementation.

The 3M case offers hope for large companies that have operated under a decentralized structure and now need to gain a comprehensive view of their customers. It shows the importance of first creating a robust data infrastructure and laying the groundwork that can support customer relationship management in the future. The definition of CRM continues to evolve, but 3M considers its infrastructure good enough to keep pace with change.