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## Executive Summary

*In the mid-1990s, Cardinal Health's Medical Products and Services business implemented SAP R/3, and built an accompanying data warehouse to handle business reporting. Since that time, use of the data warehouse has diffused widely across the enterprise and has evolved into an advanced business intelligence (BI) capability that the business professionals use regularly to solve problems and to take advantage of opportunities. Besides the data warehouse, the key components of this advanced BI environment are Cardinal Health's data infrastructure (its enterprise-wide data model, limited set of tools, and robust support environment) and its information culture (its data-driven decision style, business-led IT decision-making, dense social networks, and pull reporting structure). This article describes this advanced BI environment, how Cardinal Health evolved it, and how others might do the same.<sup>2</sup>*

## BUSINESS INTELLIGENCE IS EVOLVING

Most organizations have made substantial investments in information technology (IT) over the past decade to reconfigure their business and technology architectures in order to enhance their operating capabilities, enrich their employees' information environment, and enable events that take place in one part of the enterprise to be visible across the extended enterprise.<sup>3</sup> While most firms have generally introduced new technologies successfully, their users often have not taken full advantage of all the features: "evidence strongly suggests that organizations underutilize the

functional potential of the majority of this mass of installed IT applications: users employ quite narrow feature breadths, operate at low levels of feature use, and rarely initiate technology- or task-related extensions of the available features."<sup>4</sup>

One active IT investment arena has involved data warehousing.<sup>5</sup> An increasingly common motive for implementing data warehouses is to improve a firm's business intelligence (BI), that is, the accumulated knowledge about itself, its operations, and, to a lesser extent, its immediate business environment, e.g., suppliers, customers, and competitors.<sup>6</sup> While BI solu-

<sup>1</sup> Jack Rockart was the accepting Senior Editor for this article.

<sup>2</sup> This study was supported by the University of Oklahoma Center for MIS Studies. A previous version was presented at the 2004 SIM Academic Workshop in Washington, D.C., December 10, 2004.

<sup>3</sup> For exemplars, see Anderson-Lehman, R., Watson, H. J., Wixom, B., and Hoffer, J. A., "Continental Airlines Flies High with Real-Time Business Intelligence," *MISQ Executive* (3:4), 2004, pp. 163-176; Lee, H., Farhoomand, A., and Ho, P., "Innovation through Supply Chain Reconfiguration," *MISQ Executive* (3:3), 2004, pp. 131-142; Loebbecke, C., "Modernizing Retailing Worldwide at the Point of Sale," *MISQ Executive* (3:4), 2004, pp. 177-187; Rockart, J., "Information: Let's Get It Right," *MISQ Executive* (3:3), 2004, pp. 143-150.

<sup>4</sup> Jaspersen, J., Carter, P. E., and Zmud, R. W., "Post-Adoptive Behaviors Associated with IT-enabled Work Systems," *MIS Quarterly* (29:2), 2005, pp. 525-557.

<sup>5</sup> Data warehousing refers to the family of technologies associated with creating repositories of cleansed, formatted, and well-integrated data, and enabling business professionals to access and analyze that data to produce routine and ad hoc reports.

<sup>6</sup> Business intelligence involves collecting data, analyzing the data to detect patterns and meanings within the data, extracting information from these analyses, and turning this information into actionable knowledge. With advanced technologies (data warehouses, enterprise systems, sophisticated analytical tools, etc.), the volume and breadth of data available for analysis is growing rapidly in most organizations.

tions can take a variety of forms, three environments are most common:<sup>7</sup>

1. **A shared service made available to users across an enterprise.** This consists of a central BI capability that includes a single data warehouse, analytical tools, and a professional BI staff skilled in accessing the data and using the tools. Generally, users work through this BI staff to satisfy their BI needs.
2. **Targeted data marts, which are focused data warehouses built to meet the BI needs of a specialized user group** (e.g., market research analysts, supply chain professionals, etc.). After receiving appropriate training, these user groups are typically able to satisfy their BI needs themselves using their data mart.
3. **Menu-driven reporting systems, which enable the firm's business professionals to access a data warehouse to produce standard reports and to initiate simple queries.** When such reporting systems are targeted at a firm's executives, they are typically referred to as executive information systems.

However, we have observed a broader approach to BI, which, though still quite rare, could well become its next phase. In this approach, an enhanced data infrastructure is combined with an information culture so that business professionals can regularly access the data warehouse, in collaboration with others, to create business solutions to relatively unique problems and opportunities. We call this approach "advanced business intelligence." We view advanced BI as involving two key components:

1. **A data infrastructure,** which includes the data warehouse, an enterprise-wide data model, data access and analysis tools, and a support infrastructure. Together, these components provide universal access to a common set of data by all business professionals.
2. **An information culture,** where business professionals are expected to justify their decisions and plans through "hard" data and to proactively meet their own BI needs.

This article examines **Cardinal Health's efforts in the 1990s to evolve such an advanced BI environment**, it describes how that environment is being used, and it offers recommendations on how to build such a capability.

<sup>7</sup> Gardner, S. R., "Building the Data Warehouse," *Communications of the ACM* (41:9), September 1998, pp. 52-60.

## CARDINAL HEALTH'S MEDICAL PRODUCTS AND SERVICES BUSINESS

Cardinal Health is a global provider of integrated solutions for the healthcare industry. The company's businesses distribute and manufacture pharmaceutical and medical products, and offer a range of services that **improve customers' clinical and financial performance.** The subject of this study is Cardinal Health's medical products and services business, which includes the largest U.S. manufacturer and distributor of medical, surgical, and laboratory products and services used by healthcare providers. This group of businesses manufactures products such as surgical instruments, drapes, gowns, and gloves. And, its supply-chain arm distributes medical, surgical, and laboratory supplies from over 2,600 manufacturers to nearly 80,000 sites of care.

This segment of Cardinal Health had a rich and successful heritage, beginning with the 1922 founding of American Hospital Supply Corporation (AHSC). In the 1980s, AHSC gained a reputation as an early IT innovator and one of the few companies to gain competitive advantage from its use of IT. Its ASAP system revolutionized supplies distribution to hospitals.<sup>8</sup> In 1985, AHSC was acquired by competitor Baxter International, and then spun off by Baxter in 1996 as Allegiance Corporation. Allegiance was acquired by Cardinal Health in 1999 and formed the core of Cardinal Health's medical products and services business.

This heritage has three direct influences on the organizational environment of the medical products and services business. First, most executives and senior managers, as well as many employees, have long tenures. Thus, its business strategy is sales and marketing oriented and its decision-making is financially and analytically oriented, that is, data driven. Second, its culture is highly receptive to IT-enabled business innovation. Third, due to the long employee tenures, personal networks are dense and rich. People across the firm tend to trust each other because they either know each other or know *about* each other.

Despite this lengthy heritage, there is little evidence of an entrenched bureaucracy. Allegiance was essentially "reborn" when it was spun off from Baxter International in 1996. At that time, the healthcare industry was undergoing dramatic market changes: powerful group purchasing organizations emerged and margins narrowed. As a result, sales compensation structures changed. After the spin off, Allegiance Corporation

<sup>8</sup> Harvard Business School Case #9-186-005, "American Hospital Supply Corp. (A): The ASAP System," HBS Case Services, Boston, Mass., 1985 (revised 4/1986).

became a very lean organization to ensure the company's survival. Thus, the stage was set for rather dramatic organizational change initiatives that, in more normal times, might have been resisted.

In addition, Allegiance's IT decision-making processes were noteworthy, as were the IT organization's role and structure. IT decisions were largely driven by senior executives and line managers, all of whom recognized the important role of IT and the need to continue to invest in and innovate with IT. The IT organization's role, thus, was to facilitate and support line management in making these IT-related decisions. Information, IT assets, and IT professionals were seen as key business resources that needed to be applied regularly and well. IT operating expenses were charged back to operating units, largely on an overhead basis, and accepted as a normal cost of business. IT capital investment was treated like any other capital investment – it was financially driven. However, the IT organization was provided with investment funds to enrich the IT infrastructure. (These investments were also justified, in the same manner as with any other capital investment.) Through careful management of these funds, monies were available for “seed-ing” IT experiments and prototyping systems.

Most of the IT professionals also have long tenures with the company, especially those in senior positions. As a result, the IT organization as a whole has a deep understanding of the business and its business processes. The IT professionals are located both at an enterprise level (focused on enterprise-wide IT activities) and within business units. In fact, most business functions are technologically supported by both co-located IT professionals and an IT-savvy set of business analysts. These business analysts serve as the primary day-to-day internal IT consultants to a unit's business professionals. The co-located IT professionals, on the other hand, are mainly charged with handling a unit's major technology initiatives and resolving technology-intensive operational and use issues.

## THE SAP R/3 AND DATA WAREHOUSE INITIATIVES

In 1995 (just prior to the Baxter spin-off), Baxter senior management decided to implement SAP R/3® to accomplish three objectives: resolve Y2K issues, replace outdated legacy systems (multiple databases with similar but unsynchronized data, inferior user interfaces, unconnected systems, etc.), and decommission some 20 end user computing systems (which were effective within single business units but created huge information challenges across units). Planning for the SAP implementation and its associated busi-

ness process reengineering efforts occurred during 1995 and 1996. The \$64 million SAP implementation took place in 1997 and 1998. Figure 1 shows the goals of this initiative, which provided the foundation for Cardinal Health's current advanced BI capabilities.

### Figure 1: SAP / Data Warehouse Project Goals

- Create a single source for all data.
- Achieve a high responsiveness with business transactions.
- Improve quality & currentness of data.
- Switch reporting mindset from push to pull.
- Reduce business reliance on IT.
- Lower IT operations (hardware, software, people) costs.

### Using the Data Warehouse as a “Reporting System”

During the planning, management made the decision to use a data warehouse, rather than the SAP reporting system, for all reporting. At that time, SAP did not have a data warehouse product. Management based its decision on three main factors:

- The many stories in the business press about ERP failures gave management a strong incentive to simplify the SAP implementation as much as possible.
- Management was concerned that SAP could not handle the expected high transaction processing volumes. At the time, this installation was the largest single instance of SAP. Separating transaction processing and business reporting would improve transaction processing responsiveness and would also protect the operational systems (which change infrequently but are expensive to change) from the reporting systems (which change frequently and are less expensive to change).
- Finance management was not satisfied with the report generation tool in SAP at that time. They believed it was inferior to the McCormick & Dodge report writer that the finance function was then using.

Thus, management decided to build a data warehouse using purchased software components where possible.

Figure 2 provides an overview of this solution. As shown, it included three client interfaces to serve people in three very different roles. The first was a hierarchically-structured, menu-driven tool for the sales force. The second was a Web-based front-end for customers and suppliers. Both of these interfaces were quite restrictive, but very intuitive and, hence, easy to use. These two interfaces were targeted at client segments where on-going investments in training and support would probably not pay off. The third interface – built around the Business Objects® tool set – was for all other employees. Once trained, employees could use Business Objects to make either simple or sophisticated queries of the data warehouse. Business Objects was powerful enough to support both.

<b>Figure 2: Data Warehouse Design</b>	
<b>Component</b>	<b>Description</b>
Database	<ul style="list-style-type: none"> <li>• Oracle</li> </ul>
Interface	<ul style="list-style-type: none"> <li>• Homegrown</li> </ul>
Client Tool Set	<ul style="list-style-type: none"> <li>• SAP single table inquiry tool</li> <li>• Business Objects tool set</li> <li>• Download capability into Microsoft Access, SAS, and Excel</li> </ul>
Client Interface	<ul style="list-style-type: none"> <li>• Hierarchically structured (for sales force)</li> <li>• Web-based front-ends (for customers and suppliers)</li> <li>• Business Objects tool set (for most employees)</li> </ul>
Data Universes	Sales history, invoice, inventory, purchase order, rebate, pricing, accounts receivable, accounts payable, financial, fixed assets, human resources

### **Reengineering the Reporting System**

As part of the overall business process reengineering effort that accompanied the SAP implementation, Cardinal Health formed teams of business analysts, users, and IT staff to create a uniform, simplified reporting structure across the firm. The IT members of these teams had previously been involved in end user computing, so they were adept at working with end users and understood their reporting needs. These teams spent most of their time first listening to business users, and then designing a minimal set of master report templates, which the company called “static”

templates. Largely by saying, “No!” these teams produced a simple reporting structure that met most individuals’ reporting needs – and eliminated thousands of former reports.

The results were (1) a set of stable, repeatedly used Business Objects templates (the static templates), and (2) an ad hoc reporting capability, whereby a user could modify an existing Business Objects template or build a new one to access data in the warehouse. The business units, not the IT organization, “owned” the master static templates. The “new” templates were stored locally and retrieved with refreshed contents. However, individual users could not modify the master static templates without following the company’s formal modification process.

The new static and ad-hoc reporting structure changed Cardinal Health’s reporting from a “push” system to a “pull” system. The IT organization no longer needed to create and send reports to individuals. Instead, employees accessed the information they needed, either by executing an existing template, by modifying and then executing the modified template, or by creating and then executing a new template.

### **Data Warehouse Marketing and Training**

Up to 50% of the data warehouse implementation effort was spent communicating with employees about the data warehouse, and then training them how to use it. Thousands of employees attended a 2½ day basic class (to obtain their Business Objects ID). They could also attend annual update classes and more advanced classes on specific areas. A five-person Business Objects support group provided the training, handled general support, and maintained a Web site that communicates “news” about the data warehouse.

### **Creating Finance Super Users**

The finance function originally housed all the data warehouse “finance super users.” These users were financial analysts with three to four years of experience, who were chosen by the directors of finance to receive intensive training on the warehouse. They became the data warehouse experts, and made the most sophisticated use of it. The role “financial super user,” was, in fact, formally defined, but it was not a formal job assignment. These analysts held regular assignments as well. But they met regularly, their supervisor gave them the time to perform their super user role, and their annual evaluation included their performance in this role.

Due to the importance of financial data across Cardinal Health, each “finance location” (headquarters, division, and office) was required to have both a finance super user and a backup super user. Thus, finance

“seeded” the entire enterprise with “finance super users.” The initial result was some 60 finance super users throughout the company, each of whom could exploit the data warehouse for their local business unit by carrying out sophisticated analyses themselves, and by helping co-workers understand the data, access and execute static reporting templates, and modify and create ad hoc reporting templates. These super users are viewed by other employees as their unit’s data warehouse experts.

Over time, the composition of these sophisticated data warehouse users has changed. While the first ones were chosen by supervisors, as they moved on to new assignments, they selected and mentored their replacements. The result has been an ever-enlarging community of highly knowledgeable data warehouse users.

### ***Turning Ownership of Data and Report Templates Over to the Business Units***

The business units historically “owned” the data in the data warehouse, but not maintenance of the data or the reporting systems. Why? Because the IT group, rather than the business units, had the expertise to modify the data and the reporting structures. However, that has now changed due to the dispersion of the data warehouse expertise. IT is still responsible for populating the data warehouse cube structure, but the business units now have the abilities and tools to handle both data and template maintenance. So, they now “own” both of these maintenance functions.

### ***Turning Off the End User Computing Systems***

As data moved into the data warehouse, the end user computing systems were depopulated, and the data and reports became accessible only through the data warehouse. This change forced the business users to embrace the data warehouse – it became the only game in town. As a consequence, the newly developed data and templates enforced the “pull” reporting structure, and also became the common business language.

### ***Evolving the Data Warehouse***

From the start, business and IT professionals viewed the data warehouse as an evolving entity, not a one-time event. They realized it would be ever-changing to continually increase its functionality and scalability. As a consequence, the processes for improving and extending the data warehouse have become an accepted part of organizational life, and employees across the enterprise participate in them.

With these capabilities in hand, and widespread, Cardinal Health has moved beyond traditional uses of data warehouses and into advanced business intelligence.

## **FIVE ADVANCED BUSINESS INTELLIGENCE PROJECTS AT CARDINAL HEALTH**

Cardinal Health’s advanced BI capabilities are exercised through the on-the-fly formation of teams of people who have the expertise and capabilities to resolve a problem or exploit an opportunity. Generally, these teams do not use the existing report templates, but rather extend BI by inventing new ones to fit their specific needs. The general three-step BI process is as follows:

Step 1: Assess whether or not the data warehouse might be useful in producing a solution to a problem or an opportunity,

Step 2: Identify the expertise and capabilities needed to produce the solution, and then

Step 3: Pull together a team of individuals from the appropriate functional areas, perhaps including a financial super user or an IT professional.

This ad hoc team structure has made advanced BI possible. Generally, only one team member works with the data warehouse, using Business Objects to perform data retrieval and analysis. Often, the extracted data undergoes additional analysis using Excel®, MS-Access®, or SAS®.

Following are five examples of advanced BI work at Cardinal Health. They illustrate the wide variety of work in terms of business functions, problems, and opportunities. They range from a large, enterprise-wide customer support system to a single special-purpose report (see Figure 3).

### ***Creating a List of Inventory Items to Drive Sales for Care Continuum Customers***

During a regular meeting of the care continuum management team in the Southwest region, the members, once again, noted the growing problem of excess inventory. (Care continuum customers represent one of the firm’s market segments.) Initial analysis indicated that the problem was caused, in part, by stocking items with multiple substitutes. The proposed solution was to create a list of items that met the majority of these customers’ requirements, then guarantee availability of those items, and have the sales force focus on them when interacting with customers. But, what

**Figure 3: Five Advanced BI Projects**

Project	Description
Product List	Identified “best value” inventory items guaranteed for availability.
Delivery Plant	Located alternate warehouses for locally out-of-stock items.
Entelligence	Created a Web-based purchase management system that allowed customers to take advantage of data warehouse capabilities.
Standard Reports	Consolidated and standardized HR reporting templates for company-wide use.
Supplier Diversity	Identified suppliers who met the Federal Government’s small business diversity requirements.

items should be on this list? The region’s inventory coordinator believed the data warehouse could help solve the problem, so a team was formed with individuals from operations, inventory, and accounts management.

By examining the products flowing from the region’s plants, the team created an initial list of items. Nine sales people then tested the list with clients, and found that it was not broad enough because it did not reflect items shipped from outside the region. Further analysis generated a second list, which was again tested by some sales people. In the end, the list was further refined by listing only “best value” products, that is, products that represented best value for the money.

The care continuum sales team then used this list to drive sales. Ordering from the list provided customers with better fill rates because all the items were guaranteed to be in-stock. Later, redundant items were deleted.

The region’s operations manager made the list available to her peers at a regular meeting. The concept and the process became a model for the enterprise. Later, all but 400 of the 1,300 items on the region’s list appeared on the national list.

### ***Identifying an Alternate Delivery Plant to Ensure Fast Product Delivery***

An inventory manager realized that orders from one customer were failing because items were out-of-stock at that customer’s “normal, local” delivery plant. She envisioned a solution of rerouting these orders to an alternative delivery plant that had the stock in inventory. By speaking to customer service representatives and materials management experts, she verified that automatically re-routing these orders would not create operational problems.

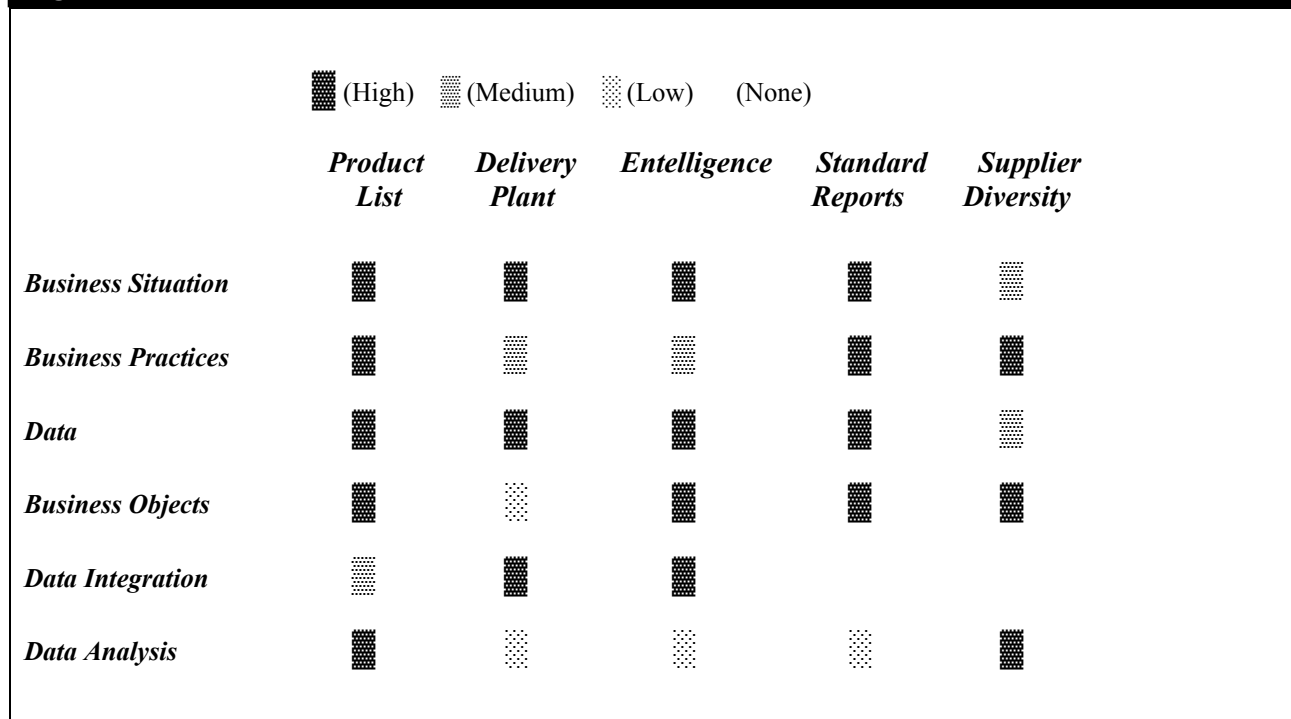
She knew that the data warehouse contained the data to solve the problem. So she enlisted the help of the materials management IT group to build a solution. Initially, they created a test file from SAP R/3 for her to manually determine the default alternate delivery plant. Then, the IT materials management group modified SAP R/3 to automatically use this alternate shipping location when the normal location was out-of-stock.

Her solution reduced the manual work associated with these orders. In addition, Cardinal Health lost fewer sales, had fewer drop-shipments and returns, and even reduced inventory levels. The inventory manager shared her solution with other divisions, which applied similar logic to their business. In fact, IT and materials management initiated a formal project to apply this logic to filling orders for items that are active in some regions but discontinued in others.

### ***Giving Customers Access to Their Own Data through the Entelligence Product***

With the rise of Internet-based commerce, the e-business team at Cardinal Health wanted to give customers Web-based access to their own data in the Cardinal Health data warehouse. The goal was to foster greater customer satisfaction and retention by providing them with a tool for investigating ways to reduce their costs by modifying the nature, timing, and volume of their purchases.

A team with members from e-Business and IT was put together, based on their knowledge of the data warehouse and the customers. They first created a logical data warehouse for each customer, which excluded sensitive data, simplified the reporting structure, and restricted customers to their own data. The team then built a prototype and pilot-tested it by bringing customers on campus. It then solicited pilot sites at customer organizations. The number of pilot sites grew from 4 to 25 prior to full roll-out.

**Figure 4: The Five Teams' Use of the Six Capabilities**

Cardinal Health called this new product “the Intelligence Purchase Management System.” In its initial 18 months of operation, the user base grew to 600 customer organizations. The product generated subscription fees, reduced customer churn, and provided cost savings by reducing the number of work-hours needed to support customers. Intelligence continued to evolve as the group’s e-business vision evolved and as the regional e-business managers and Cardinal Health’s overall e-business team reviewed customers’ and the sales force’s requests for changes.

### ***Complying with a Corporate Mandate through Standard Report Templates***

When Cardinal Health acquired Allegiance Corporation in 1999, it required all Allegiance divisions to regularly provide a wide variety of human resource (HR) information. Because Allegiance was not using SAP R/3’s report generator, each division needed a report template to comply with this corporate mandate. A team of HR business analysts and members of the co-located HR IS unit undertook the task because they were involved in the data warehouse development effort, they understood the data, and they knew how to access the data using Business Objects templates.

By surveying the HR staff in each division, the team determined the data each staff wanted to “pull” from

the data warehouse. An HR business analyst then produced master templates, which division HR staff could pull from the “corporate documents” area of Allegiance’s intranet. The team then trained the HR employees to access and modify the templates to suit their division.

### ***Reporting on Supplier Diversity for the Federal Government***

To comply with government contracts, Cardinal Health must file supplier-diversity reports quickly and accurately. These reports provide statistics on the company’s small or minority-owned business suppliers. They draw data from numerous areas of the data warehouse, including archived balance sheet and accounts payable data. To create these reports, the company established “rules” to accurately identify all suppliers who qualified and were certified as small or minority-owned businesses. The reports were produced by a team of financial analysts from corporate finance because they knew the data in the data warehouse, as well as how to get data from the various business units.

Once the team finalized the template for these reports, which included over 180 queries, it was produced and accepted by the regulatory body. Then, financial analysts in the small business unit were trained how to

use the template and were made responsible for modifying it in the future.

## THE NATURE OF THE ADVANCED BI TEAMS

These five teams were clearly quite different from one another. However, they did possess six common capabilities:

1. comprehension of the *business situation* (problem or opportunity) to be addressed,
2. understanding of the *business practices* associated with the situation,
3. ability to locate and retrieve needed *data* (via the data warehouse or social networks) in order to resolve the situation,
4. proficiency with *Business Objects*, to access data in the data warehouse,
5. expertise in *data integration*, to pull together and work with data from a variety of sources (data warehouse, SAP R/3, other information systems, etc.), and
6. adeptness in *data analysis* (using Excel, MS-Access, or SAS).

Figure 4 shows each team's dependence on each of these capabilities.

As shown, capability use varied by project. For the most part, all the capabilities were provided by the business professionals on the team, not by IT professionals or data warehouse specialists. While teams were needed to garner all the needed skills, it appeared that each team's performance was greatly enhanced by including a *single* individual with both business practice and data access capabilities, or with both data availability and data access capabilities.

We were especially impressed with three attributes of Cardinal Health's BI teaming process. The first was each project leader's ability to identify individuals across the enterprise who had the knowledge to solve the problem at hand – and then get them onto the team. Second, we were impressed with the team members' ability to identify, access, and acquire the needed knowledge, no matter where it existed in the enterprise. Third, we were impressed with each team's ability to diffuse its learnings to others. Importantly, Cardinal Health had no formal mechanisms to facilitate these behaviors. Instead, they seemed to occur naturally, as a consequence of Cardinal Health's organizational infrastructure.

## THE NATURE OF THE ORGANIZATIONAL INFRASTRUCTURE ENABLING CARDINAL HEALTH'S ADVANCED BI CAPABILITY

An "organizational infrastructure" is conceptually similar to a "technical infrastructure." Just as the effectiveness of an application system depends on the robustness of its enabling technical infrastructure (e.g., desktop clients, servers, networks, databases, middleware, etc.), the effectiveness of employees in carrying out their assigned duties depends on the robustness of their enabling organizational infrastructure (e.g., values, norms, rules, resources, etc.). An organizational infrastructure develops as a function of the policies and practices that frame organizational life, both formal (evaluation systems, control systems, resource allocation procedures, HR practices, etc.) and informal (leadership styles, supervisory feedback, co-worker interactions, etc.). Our analyses identified two aspects of Cardinal Health's organizational infrastructure core that are relevant to employees' ability to leverage the data warehouse: the data infrastructure and the information culture. See Figure 5.

### Figure 5: Organizational Infrastructure Enabling Cardinal Health's Advanced BI Capability

- Data Infrastructure
  - an enterprise-wide data model
  - an enterprise-wide, limited set of data access tools
  - a robust support environment
- Information Culture
  - a data-driven decision style
  - business-led IT decision-making
  - dense and robust social networks
  - "pull" reporting structures

### The BI Aspects of the Data Infrastructure

Three aspects of Cardinal Health's data infrastructure have most contributed to its advanced BI capabilities. The first has been its *common data model* – housed in the data warehouse. This model established a common business language across the medical products and services business. Because of this data-driven common business language, Cardinal Health's business



professionals now share a common understanding of the firm's business metrics, so that in their daily work, they can see the business performance of functional units and the overall enterprise. With these metrics and the common language, employees can more easily collaborate, as exemplified by the advanced BI projects.

The second contributing aspect of the data infrastructure has been the decision to *limit the variety of end user tools*. Everyone is trained on the same tool set. Even though they are at different skill levels, everyone speaks the same "data warehouse language." Furthermore, by limiting the number of tools, Cardinal Health has optimized its spending on training and support.

The third contributing aspect of the data infrastructure has been the *robust support environment*. Early on, management recognized the importance of sufficiently funding communication, training, and creation of a distributed support structure. The communication and training created a huge base of expertise across the enterprise, all of which can be brought to bear when problems or opportunities arise. The distributed support structure has proven equally valuable because all Cardinal Health's business professionals know they can get sound support locally and quickly if they encounter difficulties or complexities "pulling" or manipulating data. They know that co-workers, super users, their unit's business analysts, their unit's IT support group, and even corporate IT are all there to help. This fail-safe support environment has prompted Cardinal Health's business professionals to not hesitate in tackling innovative, complex, and advanced BI endeavors.

### **The BI Aspects of Cardinal Health's Information Culture**

Cardinal Health's information culture has four important advanced BI aspects: a data-driven decision style, business-led IT innovation, dense social networks, and a pull reporting structure. The first three reflect values and norms stretching over three decades. The last component – pull reporting – was developed more recently, as a result of its decision to eliminate all "push" reporting systems during SAP R/3 implementation.

The first BI-relevant aspect of its culture is that all key *decisions are data-driven* to the extent possible. This means that decisions are based on solid and confirmable marketing and financial data. As a consequence, accessing and applying stored data to support business decisions and actions are second nature for the business professionals.

The second important cultural aspect is that *IT decisions are business led*. The vast majority of decisions about how, when, and where to use IT to enable or support business initiatives and processes are initiated and led by business professionals. However, this does not mean that the company's IT professionals are passive agents. Rather, they are actively involved in innovating with the business professionals. The business professionals view the firm's IT professionals as highly knowledgeable about the business, as highly capable of delivering on their promises, and as exceptional custodians of IT resources. IT staff are seen to provide increased service levels while keeping the IT budget flat or below the inflation rate. What is perhaps most telling is that the question of "IT's value to the business" seldom arises. Instead, the value of IT is implicitly addressed during normal business decision-making. Senior executives understand the need to invest in and innovate with IT.

The third cultural contribution to Cardinal Health's advanced BI capabilities is its *dense social networks*. Most employees have deep and wide social networks because the company has had such low turnover and because it has a bias for moving employees across functional and geographical boundaries to progress their careers. As a result, employees know many other employees, and what those employees do and know. Hence, they can quickly and accurately identify who might possess the expertise they need for an advanced BI project.

Finally, the fourth important contributor to Cardinal Health's advanced BI culture is its "*pull*" reporting structure. Data can only be obtained by proactively pulling it from the data warehouse, either by using an existing Business Objects template, revising an existing template, or creating a new template. Thus, using the data warehouse is part of how employees work. It's a routine aspect of the company's operations. Essentially, employees are personally responsible for crafting their own information environment in carrying out their work.

## **RECOMMENDATIONS**

One advantage of data warehouses is that they can be designed to not constrain data queries and retrievals to designers' original intentions. As a result, data can be extracted, summarized, and combined by users to discover solutions to problems the design team did not envision. As the Cardinal Health case shows, a data warehouse can create the foundation for advanced BI work. However, the enterprise must also commit to the warehouse being an enterprise-wide data resource with tools for accessing it, and to informing and train-

ing employees on this resource. Many organizations have, in fact, created such a data warehouse capability. However, few have evolved it into an enterprise-wide advanced BI capability, as Cardinal Health has.

But, as the Cardinal Health evolution has shown, business intelligence does not reside in the data warehouse. But rather, BI emerges in the minds of employees when they identify and access data, combine data with their own or others' knowledge of a business situation, and produce novel resolutions to the issue at hand. In our view then, a company's organizational infrastructure – its data infrastructure and information culture – is the core driver of advanced BI capabilities. With these structural components in mind, we offer the following three recommendations for developing advanced BI capabilities.

***Recommendation #1: Establish an organizational climate where business professionals are expected to be in command of their own information destiny.***

“Being in command of one's own information destiny” means that all employees understand that it is their personal responsibility to actively participate in building an information environment to support their own decision-making and problem-solving. Cardinal Health's business professionals cannot expect reports to periodically be provided to them. Instead, they must retrieve (either by themselves or working through a co-worker) the desired information by executing an existing template, modifying and then executing an existing template, or creating and then executing a new template.

To establish such an organizational climate, two elements must come together. First, employees must see value in basing their decisions on hard data. If an organization's decision style is not fact-based, then employees will likely not make the effort to understand, find, or access the data and metrics important in their work. Second, employees at all levels need to be technology-savvy. While many technology issues should be left to the experts, when an organization's employees are technology-complacent, they are not aware of available technologies. More to the point, they are not technologically curious, so they fail to ask, “I wonder if this is technologically possible?” Having business professionals willing to “push the envelope” technologically is a key attribute of the advanced BI teams at Cardinal Health.

Over time, Cardinal Health's organizational culture has pushed its business professionals to take control of their own information destiny. They are expected to support decisions using hard data, and actively par-

ticipate in building their own personal information environment. While such a culture cannot be built quickly, organizations can take the following three actions to move in this direction:

1. Decentralize IT and data governance structures because decentralization broadens awareness, familiarity, and competence with IT functionality and data availability.
2. Build up a rich portfolio of metrics to assess and direct business decisions, actions, and behaviors.
3. Reduce the number of automatically distributed standard reports while still requiring employees to perform at high levels.

These three actions will expand the use of an existing data warehouse by encouraging greater use in everyday work.

***Recommendation #2: Encourage rich social networking across the organization.***

An advanced BI capability depends on employees developing deep knowledge of where expertise exists in their enterprise. Most business professionals do not have personal access to all the data and knowledge needed to effectively resolve all the problems and opportunities they confront. Therefore, they need to identify, contact, and collaborate with others to get that data and knowledge. Generally, to find expertise, people ask someone they know. If they know many people, they have a dense social network. If they also know about what those people know, they have a robust social network. Without dense, robust social networks, we believe advanced BI efforts will bear little fruit because such efforts depend so heavily on quickly and collaboratively assembling the needed expertise.

Most Cardinal Health employees are well-positioned in numerous social networks that have been nurtured over many years. While the drivers of these social networks are rather unique (long-tenured employees who have lived through cross-functional and cross-unit career paths), there are nine actions enterprises can take to foster social networking:

1. Consider the long-term impacts of planned workforce reductions – even though they clearly have very attractive short-term impacts in tough economic times.
2. Value tenure during workforce reductions; in many companies, the most experienced and well-connected employees are often the first to be let go.

3. Orchestrate cross-functional and cross-unit career paths so that, over time, employees are able to work with many different people.
4. Make extensive use of cross-functional and cross-unit teams.
5. Use virtual teams rather than co-located teams.
6. Commingle workspaces.
7. Implement knowledge management capabilities.
8. Implement enhanced communication and collaboration capabilities.
9. Hold formal and informal meetings to bring together diverse employee communities.

**Recommendation #3: Establish a distributed support infrastructure that emphasizes local “first-responders.”**

Advanced BI requires, at the least, vigorous use of a data warehouse. A vibrant advanced BI capability will not materialize where business professionals use their data warehouse timidly – rather than stretching it and molding it to their needs. Unless they know that help is always nearby, employees are unlikely to aggressively use a data warehouse by creating new, unproven accesses.

At Cardinal Health, employees just expect super users and unit support staff (and, if needed, unit and corporate IT professionals) to be available to answer their questions or provide expertise. This depth of data warehousing expertise has provided a fail-safe environment, which means that there is always someone who can get business professionals out of any data warehousing situations they get themselves into. With this assurance, the business professionals are not timid in their uses of the data warehouse.

Cardinal Health’s support environment is unique because it is largely the responsibility of the business units, not IT. Corporate IT nurtures and supports the environment, but the business professionals who serve as the experts and super users are the first-responders. While such a support infrastructure cannot be quickly established, organizations can take four actions to develop it:

1. Identify business roles that both are broadly distributed across the organization and would benefit from intensive data warehouse use. Leverage these roles within support infrastructures.
2. Provide universal data warehouse education and training.

3. Provide a highly visible, accessible, and informal problem escalation process, such as from super user to unit business analyst staff to unit IT staff to corporate IT.
4. Include in performance evaluations an individual’s responsiveness to others’ formal or informal requests for data warehousing help.

## CONCLUSION

In today’s world of global hyper-competition, companies want to see demonstrable results from their use of information technology. Many organizations have invested in data warehousing to improve their competitive position. One view of a data warehouse is as a “queryable source of data in the enterprise.”<sup>9</sup> That is, it is a product delivered by information technology to the organization. Another view is to see the data warehouse as a component of an advanced business intelligence capability, as we have described in this article. As such, the data warehouse becomes integral to the competitive capacity of the business.

One of the unique features of Cardinal Health’s data warehouse and BI capability is that no one thinks of it as such. Instead, employees see it as one of many tools for solving business problems. As the integrity and timeliness of the data have improved, and as employees have been able to easily access and integrate financial, sales, and logistics data, they are creating the metrics and the business intelligence they need to build innovative solutions to the business situations they face.

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<sup>9</sup> Kimball, R., Reeves, L., Ross, M., and Thornthwaite, W., *The Data Warehouse Lifecycle Toolkit: Expert Methods for Designing, Developing, and Deploying Data Warehouses*, John Wiley and Sons, New York, 1998, p. 19.

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mately 35 mid-level business managers across the firm to identify examples of BI initiatives. From that sample, we selected five for more intensive examination. In Phase IV, we conducted face-to-face interviews with the members of these five teams.

## **APPENDIX: RESEARCH APPROACH**

Our understanding of the Cardinal Health approach to business intelligence was derived from over 60 interviews conducted by the research team both on-site and via telephone. Our investigation consisted of four phases. In Phase I, we interviewed the IT leadership team to understand the firm, its business environment, and the motivation and process for its BI efforts. In Phase II, we interviewed senior business managers across the firm to understand the business value they have derived from the BI capability, as well as how they were exercising this capability daily. In Phase III, we conducted telephone interviews with approxi-