

OCTOBER 2006

Master Data Management: Consensus-Driven Data Definitions for Cross-Application Consistency

By Philip Russom

TDWI BEST PRACTICES REPORT



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About the Author

PHILIP RUSSOM is the senior manager of research and services at The Data Warehousing Institute (TDWI), where he oversees many of TDWI's research-oriented publications, services, and events. Prior to joining TDWI in 2005, Russom was an industry analyst covering BI at Forrester Research, Giga Information Group, and Hurwitz Group. He also ran his own business as an independent industry analyst and BI consultant, and was contributing editor with *Intelligent Enterprise* and *DM Review* magazines. Before that, Russom worked in technical and marketing positions for various database vendors. You can reach him at prussom@tdwi.org.

About TDWI

TDWI, a division of 1105 Media, is the premier provider of in-depth, high-quality education and research in the business intelligence and data warehousing industry. Starting in 1995 with a single conference, TDWI is now a comprehensive resource for industry information and professional development opportunities. TDWI sponsors and promotes quarterly World Conferences, regional seminars, onsite courses, a worldwide Membership program, business intelligence certification, resourceful publications, industry news, an in-depth research program, and a comprehensive Web site (www.tdwi.org).

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This report series is designed to educate technical and business professionals about new and emerging BI technologies, concepts, or approaches. Research for the reports is conducted via interviews with industry experts and leading-edge user companies and a survey of BI and DW professionals.

This series is complemented by TDWI's Technology Market report series, an exclusive benefit for TDWI Members that describes a community of vendors and products in a particular technology market to aid Members in researching products and making purchasing decisions.

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Executive Summary

Master data consists of facts that define a business entity, facts that may be used to model one or more definitions or views of an entity. Entity definitions based on master data provide business consistency and data integrity when multiple IT systems across an organization (or beyond) identify the same entity differently.

In an Internet-based survey that TDWI ran in mid-2006, the business entity most often defined in master data is the customer (74%), followed by products (54%) and financials (56%). Other entities include business partners (49%), employees (45%), locations (41%), sales contacts (25%), and physical assets (21%).

Depending on where and how it's practiced, MDM solutions fall into three broad categories. Operational MDM is built into and/or used to integrate operational applications for ERP, CRM, financials, and so on. Analytic MDM is prominent in data warehousing, because of the balance between tracking data lineage (to ensure you have the right data) and repurposing data to create new structures (like aggregates and time series). Enterprise MDM is far broader in scope than operational and analytic MDM and—as a discrete infrastructure—may encompass them.

MDM has long been practiced as part of a larger application, as seen in analytic MDM (usually for a data warehouse) and operational MDM (usually for an ERP system). The current trend is to take MDM out of its isolated silos and make it a separate solution, so it can achieve a broader enterprise scope that integrates master data and related definitions across more systems. Today, few organizations practice MDM as a separate solution (20%), although most of those embracing the practice have done so with enterprise scope (76%).

In TDWI's MDM survey, 83% of respondents reported that their organizations have suffered problems due to poor master data, and 54% claimed to have derived benefits from good master data. Data warehousing and BI issues are deeply affected, with reporting and other BI functions either suffering (81%) or succeeding (54%) based on the quality of master data. For example, when compliance involves reporting, MDM helps to populate reports accurately (to avoid an audit) and to answer questions about data's lineage (in the event of an audit). But master data also affects other business functions, like customer service, marketing, purchasing, product introductions, and the supply chain. And it assists with business integration issues like mergers, acquisitions, and reorganizations.

A first step in designing a software solution for MDM is deciding whether business entities and their storage should follow a hierarchical, multidimensional, object-oriented, relational, or flat data model. A common struggle early in MDM practice is to get beyond reacting to master data problems (like out-of-sync systems) and start proactively searching for opportunities for improvement (like including more systems in the MDM grid).

As a key success factor, most organizations need business people to be involved in the creation of business entity definitions, if the definitions are to be valid and useful. Likewise, for master data to achieve its goal—consensus-driven definitions applied consistently—it must be shared ruthlessly, which in turn demands a central organizational structure with an executive mandate, like a data governance committee or data stewardship program. These much-needed corrections to how master data is managed have deep ramifications for organizational structures and staffing.

Master data management is about defining shared business entities, like customer, product, and financials.

MDM practices tend to be operational or analytic, but can be both when the scope is enterprisewide.

MDM is cross-functional by nature, so it benefits from a governance organization that fosters collaboration between business and IT.

Research Methodology

Report Scope. This report is designed for technical executives who wish to understand what master data management is, how it's practiced today, and why it should be done in a holistic manner. The report describes a range of technology best practices for managing master data and its system of record, plus organizational best practices that are key to success, like data governance, stewardship, and architecture.

Terminology. TDWI defines *master data management* as “the practice of defining and maintaining consistent definitions of business entities (e.g., customer or product) and data about them across multiple IT systems and possibly beyond the enterprise to partnering businesses.”

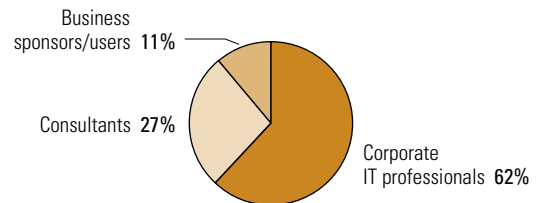
Survey Methodology. This report's findings are based on a survey run in mid-2006, as well as interviews with data-management practitioners, consultants, and software vendors. In May 2006, TDWI sent an invitation via e-mail to the data-management professionals in its database, asking them to complete an Internet-based survey. The invitation also appeared on several Web sites and newsletters, and 802 people completed all of the survey's questions. From these, we excluded the 61 respondents who identified themselves as academics or vendor employees, leaving the completed surveys of 741 respondents as the data sample for this report.

Survey Demographics. The majority of survey respondents are corporate IT professionals (62%), whereas the remainder consists of consultants (27%) or business sponsors/users (11%). Judging by how they answered survey questions, it's likely that most of the survey respondents work in or have experience with data warehousing. Due to branching in the survey, some questions allow responses only from individuals with direct experience with master data management initiatives.

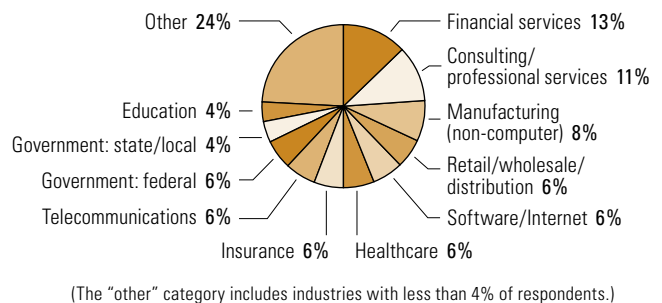
The financial services and IT consulting industries (24% combined) dominate the respondent population, followed by manufacturing (8%) and other industries (single-digit percentages). We asked consultants to fill out the survey with a recent client in mind. By far, most respondents reside in the US (60%), trailed by Europe and Asia, respectively. Respondents are fairly evenly distributed across all sizes of companies.

Demographics

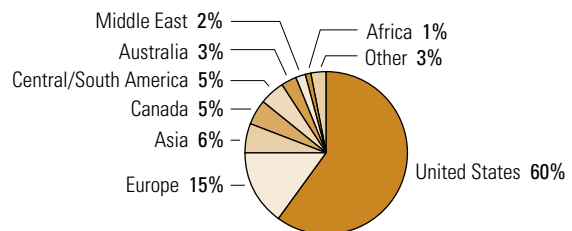
Position



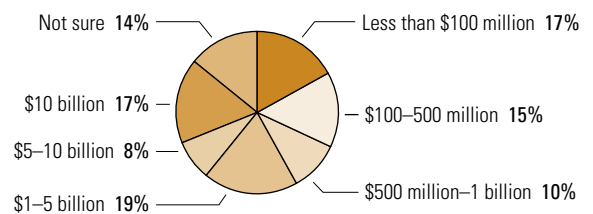
Industry



Geography



Company Size by Revenue



Based on 750 qualified respondents.

Overview of Master Data Management

For many people in IT, this decade is all about integration. It's about integrating customer data, integrating application silos, integrating data for BI purposes, integrating with partners, integrating with governments, and integrating through new interfaces like Web services. As if the list weren't long enough, the practice known as *master data management* (MDM) has become a candidate for even more integration work.

Hence, a lot of data-management professionals and their business counterparts are asking: "What is master data management? Why should I care? Why is it imperative now?" This report seeks to answer these and related questions.

What Is Master Data Management?

We need to build up to an answer to this question by describing (in procedural order) the technical components and best practices that are subsets of master data management:

- **Master data.** Master data (sometimes called reference data) consists of facts that define a business entity, facts that may be used to model one or more definitions or views of an entity. Entity definitions based on master data provide business consistency and data integrity when multiple IT systems across an organization (or beyond) identify the same entity differently.
- **Business entity definitions.** Today, the business entities modeled via master data are usually customer, product, or finances. But master data can define any entity, like employee, supplier, location, asset, claim, policy, patient, citizen, chart of accounts, and so on.
- **System of record.** Common across the many approaches to MDM is the creation (or selection) of a system of record (sometimes called a trusted source). The point is to establish a central, authenticated master copy from which entity definitions (and perhaps physical data, too) are propagated among all IT systems integrated via the MDM solution.
- **MDM hubs, master files, and application databases.** The system of record can take many forms. Many users build a central database (like a data warehouse or operational data store) as a hub through which master data, metadata, and physical data are synchronized. And some hubs are simply master files or master tables that collect and collate records. Sometimes a pre-existing application (typically for ERP or CRM) has the needed definitions already, so it's selected as the system of record and the basis for entity modeling elsewhere.
- **Master data integration.** Regardless of the technology approach, the goal of the system of record is to provide a central mechanism for collecting and sharing consistent definitions, usually across otherwise unrelated IT systems. Obviously, this requires technologies and best practices for system integration, data integration, and application integration. Hence, many technical users consider MDM to be an integration practice, enabled by integration tools and techniques for ETL, EAI, EII, and replication. When the system of record is a hub that connects many diverse systems, multiple integration technologies may be required, including newer ones like Web services and service oriented architectures (SOA).
- **Master data management.** Drawing from the above definitions, we can now say that MDM is the practice of defining and maintaining consistent definitions of business entities, then sharing them via integration techniques across multiple IT systems within an enterprise and

The first step toward MDM is to define core business entities.

Second, establish a central system of record or hub.

Third, use integration techniques to collect and share master data.

Finally, acquire, improve, and share master data via an MDM solution.

sometimes beyond to partnering companies or customers. More simply put: MDM is the practice of acquiring, improving, and sharing master data.

MDM Solution Types. MDM solutions in most organizations are built into or closely associated with a larger application, though some span multiple applications. Due to these associations, MDM solutions fall into three broad categories (see Figure 1):

- **Operational MDM.** Upstream in the general flow of data, one or more MDM solutions are built into and/or used to integrate operational applications for enterprise resource planning (ERP), customer relationship management (CRM), supply chain management (SCM), financials, and so on. Since the applications don't change frequently, master data and entity definitions don't either. Furthermore, these applications and their business processes support transactions and sometimes operate in real time, so operational MDM must, too.
- **Analytic MDM.** Downstream in the data flow, data warehousing has long involved some form of MDM, because of the balance between tracking data lineage (to ensure you have the right data) and repurposing data to create new structures (like aggregates and time series). Entity definitions change often due to data discovery, analytic business modeling, and other iterative practices. Analytic MDM is also seen in practices that resemble data warehousing, like customer data integration (CDI) and financial performance management (FPM).
- **Enterprise MDM.** Today, MDM is practiced mostly in isolated silos or with a short list of applications that don't step beyond the bounds of either operational MDM or analytic MDM. However, some organizations have moved to the next level with *enterprise MDM*, which is an autonomous infrastructure that can integrate master data across multiple IT systems and businesses. Spanning the whole data flow is daunting, because enterprise MDM must satisfy the diverse requirements of both operational MDM and analytic MDM. Yet, enterprise MDM is a worthy goal, because it extends beyond IT silos and organizational boundaries the general benefits of MDM, namely: well-designed entity definitions applied consistently.

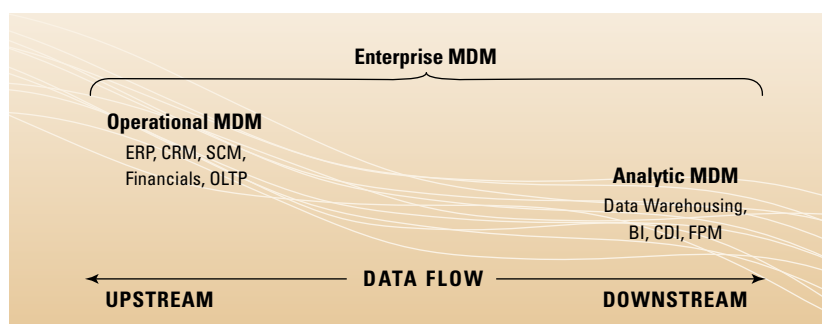


Figure 1. MDM solutions can be upstream or downstream relative to the flow of data.

"We don't use the term master data. Instead, we manage corporate data assets and perform reference data management," said Denise Jeffries, a technical manager on the enterprise data management team at R. L. Polk & Co. "We just make sure all data is defined appropriately and that everyone understands—through the definitions—what the data is and how it should be used. In a nutshell,

we assure data definition, structure, and consistency.” Polk is a leading provider of information about the automotive industry, and master data management is one of the many best practices that makes their information products clean, consistent, and current.

Why Should We Care about Master Data Management?

The main reason that technical and business people should care about MDM is the long list of problems that occur when it’s ignored. Somewhat less compelling is the short list of benefits that come from improving master data and its integration across IT systems.

The Problems of Poor Master Data. In an Internet-based survey that TDWI ran in mid-2006, a whopping 83% of respondents reported that their organizations have suffered problems due to poor master data. (See Figure 2.) Hence, the vast majority of users attests that MDM problems are real, numerous, and severe.

Poor-quality master data creates problems mostly within data warehousing and BI—but also outside it. (See Figure 3.) The top three problems relate directly to data warehousing, namely inaccurate reporting (81%), arguments over which data is appropriate (78%), and bad decisions based on incorrect definitions (54%). Others are general data management problems that sometimes impact data warehousing, like data governance and stewardship limitations (53%), limited visibility for data lineage (52%), and no understanding of master data homonyms (46%). Other problems cited by survey participants are business problems, like poor customer service (35%), inefficient marketing (32%) or purchasing (18%), and new products delayed (17%).

The Benefits of High-Quality Data. Though a vast majority of users have suffered problems from poor master data, a much slimmer majority (54%) claims to have derived benefits from good master data. (See Figure 4.) Still, this indicates that benefits are possible and can be identified.

As with master data problems, the benefits likewise relate most strongly to data warehousing and related data management practices, followed by general business issues. (See Figure 5.) Near the top of the list are data warehousing and BI issues, like accurate reporting (75%), better decision making (69%), and easier auditing of information’s origins (47%). Mixed with these are general data management issues, like data quality (76%), consistent definitions (65%), and data governance (39%). Low-ranked benefits are mostly general business issues, like risk reduction (33%), superior customer service (21%), and supply chain optimization (15%).

Good MDM yields good reports. Users can clearly see the impact of MDM—both negative and positive—on visible products of information management, especially reports of various types. For example, in TDWI’s survey, inaccurate reporting is the leading problem and accurate reporting is the second leading benefit. The survey aside, most of the users that TDWI interviewed pointed to reports as an area where both technical and business people seek improvement via MDM.

Though all reports may benefit from improved MDM, regulatory and financial reports are a hot spot, because they are scrutinized carefully today and can cause dire consequences when discrepancies are found. In fact, many interviewees admitted that they and their peers live in fear of an audit, and that they feel MDM can help them avert or prepare for such an event. For example, the consistently applied definitions of MDM ensure that reports are populated with correct data, and the data lineage of MDM answers questions in the event of an audit. Similar concerns are seen in the survey, where roughly half of respondents reported “limited visibility for data lineage” as a problem and “easier auditing of information’s origins” as a benefit. Despite its negative impetus,

USER STORY

Whatever you call it, MDM is about data definition, structure, and consistency.

83% surveyed reported MDM problems, mostly in BI and warehousing.

54% reported MDM benefits, like better data quality and reporting.

“Audit paranoia” is a significant driver for MDM.

USER STORY

MDM facilitates financial consolidation and auditability.

“audit paranoia” is a significant driver for increased efforts in master data management, as well as related areas like data quality, data warehousing, and report design.

“Our master data management efforts focus on financial data, modeled hierarchically to represent the P&L business units and geographic divisions of our organizational structure,” said the data architect at a firm serving the oil and gas industries. “We stepped up these efforts recently, to give IT broad tracking of system changes through a change management process. On the business side, executives want to speed up financial consolidations through data consistency and to assure fast and accurate auditing for the sake of Sarbanes-Oxley compliance.”

Has your organization suffered problems due to poor master data?

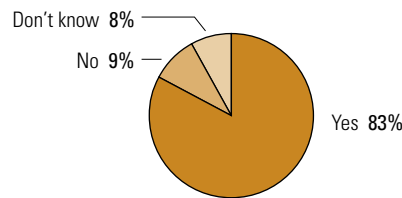


Figure 2. Based on 741 respondents.

What kind of problems?

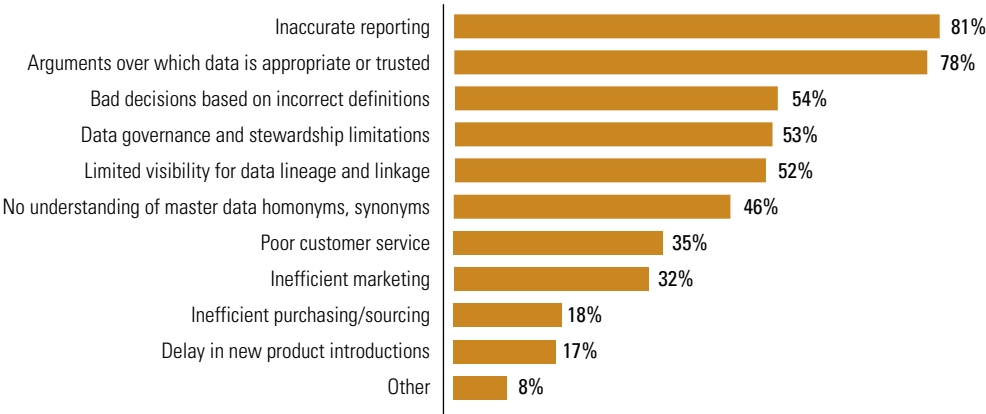


Figure 3. Based on 2,921 responses from 615 respondents.

Has your organization derived benefits from good master data?

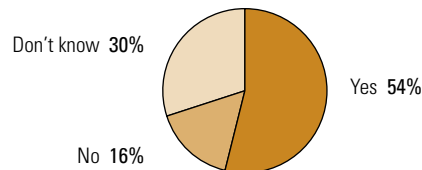


Figure 4. Based on 741 respondents.

What kind of benefits?

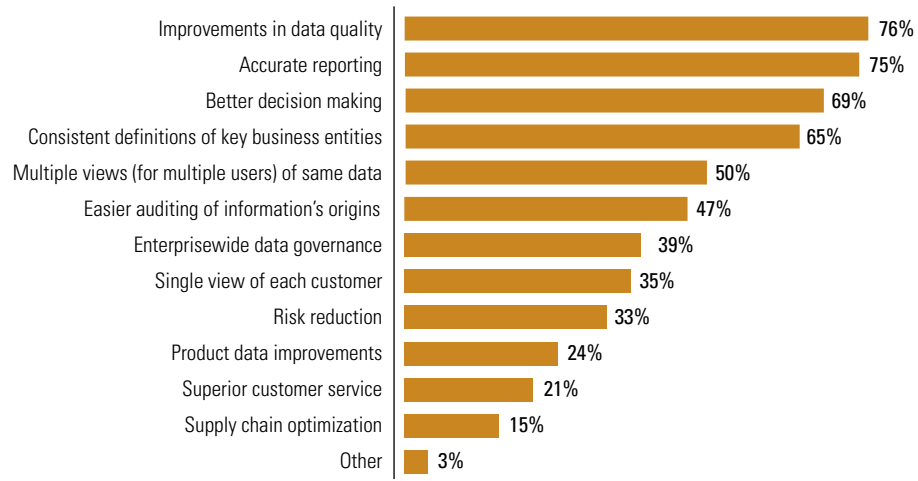


Figure 5. Based on 2,224 responses from 402 respondents.

Why Is Master Data Management Imperative Now?

Trends unique to this first decade of the new millennium have brought MDM to the forefront:

- **Technology Trends.** As an integration practice, MDM is late to the data integration frenzy of this decade, yet still part of it. For many technical users, MDM is an extension of other growing practices, like data warehousing, BI, data quality, and metadata management. In some cases, MDM's central definitions are part of a general trend toward centralized IT.
- **Business Trends.** After Enron and WorldCom, many corporations have entered an age of accountability, where executive actions are driven by audit paranoia, which MDM helps alleviate. Market consolidation is rampant in some industries (banking, high tech, telco), and MDM can be a useful component in the quick-but-critical integration of customers, financials, and products demanded of a merger, acquisition, or corporate reorganization.
- **MDM Trends.** Although MDM has long existed in a few isolated silo applications, companies now practice it in more silos and with more connections among silos. Forward-looking companies even practice enterprise MDM, with a broad scope across many applications and businesses. As with many data management practices, the general trend in MDM is toward broader and better integrated enterprise scope.

Andy Everett is a data catalog administrator at the Washington State Department of Transportation. "There's definitely an inherent relationship between metadata management and master data management," he says. "We collect metadata, master data, and their documentation in a central metadata repository which our knowledge workers can access over the Web. From the repository, you can see what databases use what master data. Since there's a natural disconnect between data in its original context and data as a shared resource, the repository includes a taxonomy of definitions used to categorize the data."

USER STORY

Like metadata management, MDM benefits from a central repository.

The State of Master Data Management

Status and Scope of MDM Projects

Given that MDM is broadening beyond silos into enterprisewide usage, TDWI's survey of MDM practices asked about the status of standalone MDM solutions (Figure 6). A mere 11% of respondents reported reaching the implementation phase, while 9% have reached deployment. Combining these into 20% shows that a minority of organizations have made a tangible investment in MDM as a standalone solution. The low results are most likely due to MDM being relatively new as an individual focal point outside of a larger application.

In fact, 21% have no plans, probably because silo forms of operational MDM and analytic MDM are adequate for them. With 46% of respondents representing organizations in the exploration phase and another 13% in design, it's likely that many more standalone MDM solutions will appear in the next few years.

Only 20% practice standalone MDM, though 76% of these do so with enterprise scope.

Of the 20% minority who had reached implementation or deployment, we asked: "What is the scope of your organization's MDM solution?" (See Figure 7.)¹ A surprisingly high 52% responded that the scope is "whole enterprise" or "a single department that spans the enterprise" (24%), like an IT or marketing department. Although few organizations are practicing MDM as a standalone solution (20%), most of those embracing the practice have done so with enterprise scope (76%).

What's the status of your organizations MDM solution?

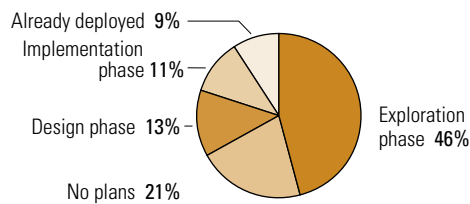


Figure 6. Based on 741 respondents.

What is the scope of your organization's MDM solution?

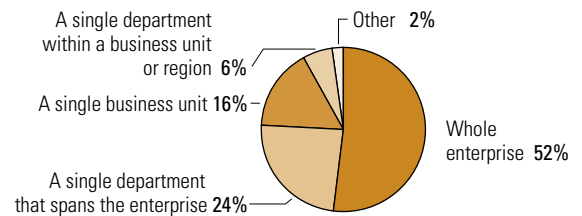


Figure 7. Based on 148 respondents.

MDM in Business Initiatives and Technology Solutions

MDM often supports applications and initiatives for BI, CRM, ERP, and financials.

Under the assumption that MDM is usually a component of a larger solution, TDWI asked survey respondents to identify the business initiatives and technical solutions that MDM supports. Their responses belie their organizations' priorities for MDM usage:

- **Business intelligence and data warehousing.** In the survey, analytic MDM stood out, as business intelligence (82% in Figure 8) and data warehousing (85% in Figure 9) bubbled to the top of the lists of business initiatives and software solutions to which MDM contributes. This is no surprise, since these are the prominent forms of analytic MDM, and the population of users that TDWI surveyed includes many data warehousing professionals.
- **CRM and CDI.** Users ranked customer-oriented applications high, namely CRM (49% in Figure 8) and CDI (63% in Figure 9). Note that these applications—though related by

¹ Note that some of the questions in the survey were available only to the 148 respondents who claimed to have implemented an MDM solution. This way, the responses reflect actual experience, not intentions or impressions.

their focus on the customer—involve two MDM practices, namely operational MDM and analytic MDM, respectively.

- **Product information management and related applications.** Product information management is treated to MDM by 47% of respondents. Supply chain initiatives and supplier solutions ranked low (24% in Figure 8 and 20% in Figure 9, respectively), along with related procurement applications like purchasing and sourcing (15% in Figure 8).
- **Financial applications and others.** In the phone interviews TDWI conducted, roughly half of users described MDM in the context of financial applications. But financial applications barely registered in the survey, with only a few mentions of it as an “other” usage.
- **MDM as a standalone solution.** According to survey respondents, MDM is rarely autonomous (5% in Figure 8 and 3% in Figure 9). In other words, at this point in history, MDM is still closely associated with larger business initiatives and software solutions, as opposed to the relative independence of enterprise MDM.

MDM is seldom autonomous. It's almost always part of a larger initiative or solution.

Which business initiatives does your MDM solution support? (Select all that apply.)

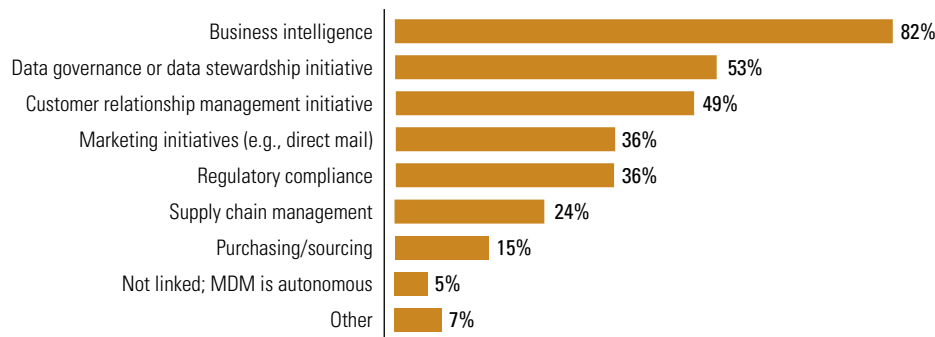


Figure 8. Based on 453 responses from 148 respondents.

Which technical solutions does your MDM solution support? (Select all that apply.)

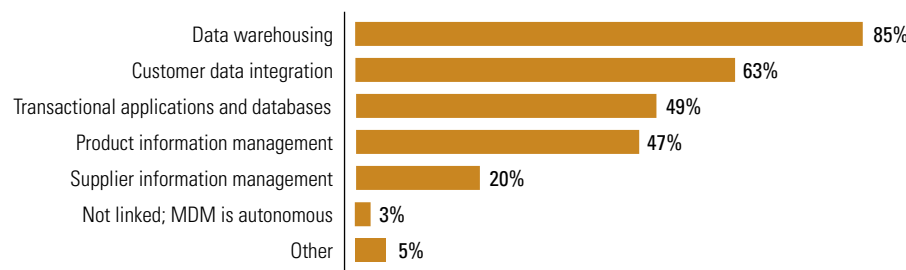


Figure 9. Based on 403 responses from 148 respondents.

“We have a four-year plan to consolidate 23 systems into one ERP system,” said Peter Panagiotatos, the director of global business intelligence at The Stanley Works, a worldwide manufacturer of hand tools and hardware. “But first, we must agree on common definitions of data for cross-unit applications, and establish an appropriate organization for managing these. Otherwise, the

USER STORY

MDM plays a role in system consolidations.

consolidations won't work correctly." The plan calls for one master data repository for both ERP and business intelligence—in other words, both operational MDM and analytic MDM. Panagiotatos, who has long practiced MDM for data warehousing, feels that MDM will benefit business operations. "MDM for the warehouse is good for decision making, but MDM for ERP has a deeper impact on day-to-day business."

MDM Budget and Return on Investment

Separate MDM budgets are rare; funding comes from larger projects.

Only 6% of survey respondents claim a separate budget or line item for MDM. (See Figure 10.) In far more cases (45%), MDM funding is part of a larger initiative's budget. This makes sense, because MDM is usually practiced as part of a larger application, like those listed in Figure 8.

Of the 6% of respondents who have a budget line item for MDM, we asked: "How will the budget for MDM change for the next budget period?" (See Figure 11.) Most reported it will stay the same (23%) or increase (48%), indicating upcoming growth for standalone MDM solutions.

How is MDM funded in your organization?

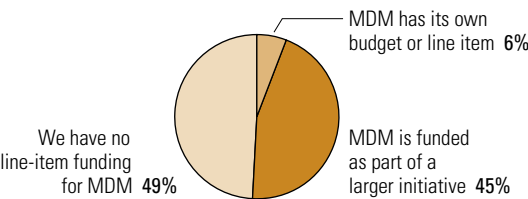


Figure 10. Based on 741 respondents.

How will the budget for MDM change for the next budget period?

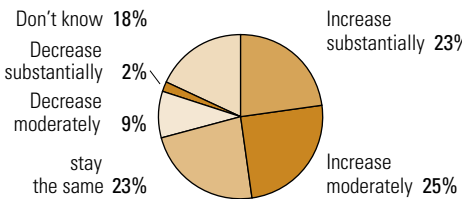


Figure 11. Based on 44 respondents.

Users think MDM yields ROI.

Budgets aside, return on investment (ROI)—whether quantified or perceived—affects the level of effort an organization puts into an IT practice. Almost half of survey respondents expressed a belief that ROI is possible from MDM efforts (48% in Figure 12). A high percentage (39%) said they "don't know," their uncertainty probably due to the fact that very few organizations have quantified MDM as a separate discipline or budget. Given that users perceive an ROI for MDM and that MDM budgets (though rare) are growing, MDM usage will assuredly increase.

Does your organization believe it can achieve a positive ROI by investing in MDM?

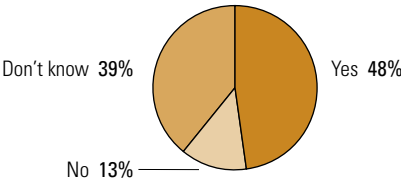


Figure 12. Based on 741 respondents.

"Master data helps us unify customer data into a consistent view across business units," says JB Sastry, an enterprise data architect at GE Consumer Finance, which won TDWI's 2006 Best

Practices Award for CRM. “Our business organizations are driving the uses of this data, within and subject to the permissible contractual obligations, to leverage the 360-degree view of each customer with a long-term view. Naturally we expect to use master data to enable and enrich our customer-oriented processes and touch points.”

USER STORY

MDM enables a consistent view of customers.

Technical Best Practices for MDM

Getting Started with MDM

Reactive versus proactive approaches to MDM. Some organizations start applying MDM in an isolated area, move on to other isolated areas, and maybe pull these together into an enterprise approach later. Isolated starting points are more often problems than opportunities, and the organization is reacting to problems that need immediate attention. Ultimately, however, you need to get beyond the hectic fire drills of “reactive MDM” and also apply “proactive MDM,” which explores data and metadata to identify opportunities for master data improvement.

MDM should be both reactive and proactive.

Surviving MDM in the long run requires a mix of reactive and proactive practices. This may require separate processes and even separate personnel. TDWI’s MDM survey suggests that a third of organizations are still stuck in the early, reactive phase (36% in Figure 13), whereas over half (59%) have gotten beyond it to also practice MDM proactively.

What is your strategy for finding MDM problems and opportunities?

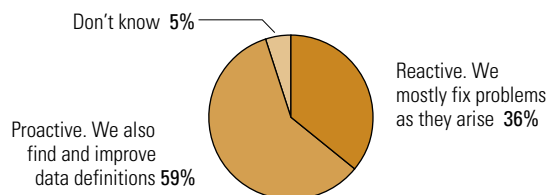


Figure 13. Based on 148 respondents.

First applications for MDM. By far, the most common first application for MDM identified in TDWI’s survey is data warehousing and business intelligence (61% in Figure 14). This is natural, since these analytic disciplines have long required analytic MDM. That is, they collect data about the same business entity from multiple sources, integrate and transform this data to create even more information about defined business entities, then store and present diverse views of the same entities, to satisfy data analysis or reporting requirements.

Most users first do MDM with a data warehouse.

Other first applications for MDM focus on customer data or product data (both 13% in Figure 14). The survey aside, several users interviewed by TDWI also identified ERP and financial applications as where they first applied some form of MDM.

Where did you first deploy an MDM solution?

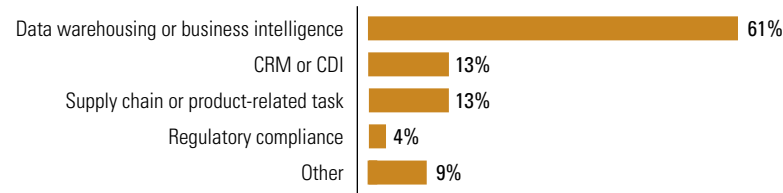


Figure 14. Based on 148 respondents.

Modeling the Business with Master Data

Business Entities Defined via Master Data. Conventional wisdom says that master data is usually about customers, sometimes about products, and rarely about anything else. While there’s some truth to this myth, it gets less true as organizations move beyond common starting points like customer and product. In particular, various financial entities (chart of accounts, budgets, profit) are progressively the subject of MDM, and some of the users TDWI interviewed for this report started there, instead of with customers and products. Other areas of MDM growth focus on employees, locations, and physical assets.

- **Customers.** No surprise, the business entity most often defined in master data is the customer (74% in Figure 15). Few organizations have only one definition of customer (13% in Figure 17). Half reported approximately 10 definitions, and 18% claimed approximately 25 or more.
- **Financials.** Surprisingly, financials ranked second on the list of business entities defined with master data (56% in Figure 15), barely edging ahead of products.
- **Products.** Third on the list, products (54%) ranked just ahead of related entities like business partners (49%) who supply or distribute products. Few organizations have but one definition of product (11% in Figure 18), though 38% reported approximately 10 definitions.
- **Employees.** TDWI has noted many companies stepping up data warehousing, data quality, and now MDM efforts with human resource data. It’s not just the employee that’s modeled. Master data definitions are useful for anything that appears on a pay stub, like 401k withholding, tax deductions, vacation time accrued, and expense reimbursements.
- **Locations (41%) and physical assets (21%).** As an example, utility companies model energy distribution equipment (meters, light poles, power transformers, pipeline segments, etc.) to include descriptions of these fixed assets, as well as their precise locations. This helps locate these assets quickly during an outage, as well as associate them with geographic entities like municipalities (for taxation) and risk zones (for insurance assessments).
- **Other business entities.** Ten percent of respondents selected “other” and entered business entities modeled via master data. Examples by industry include: education (students, student records, teachers, schools), government (citizens, foreign nationals), law enforcement (crimes, cases, criminals), and life sciences (tissue samples, test results, pharmaceuticals).
- **The number of business entity types described by master data.** In Figure 16, 42% of respondents claimed to manage 25 or fewer business entities, whereas another 42% manage approximately 50 or more definitions. This suggests that the average falls between 25 and 50, though in some modeling methods the number swells into the hundreds.

“The need for serious master data management arose several years ago when we started introducing new products,” said a database architect at a large financial services firm. “At first, the core business managed 401ks for our client companies. But now we have products for pensions, payroll outsourcing, healthcare insurance, and human resources tracking—basically, anything that can be a payment or deduction on the pay stubs our clients give their employees. Each of these products is represented by a back-end IT system and a business unit, but they all agree through consistent master data.”

USER STORY

Master data can define employees and other HR entities.

Which business entities do you need to model with master data? (Select all that apply.)

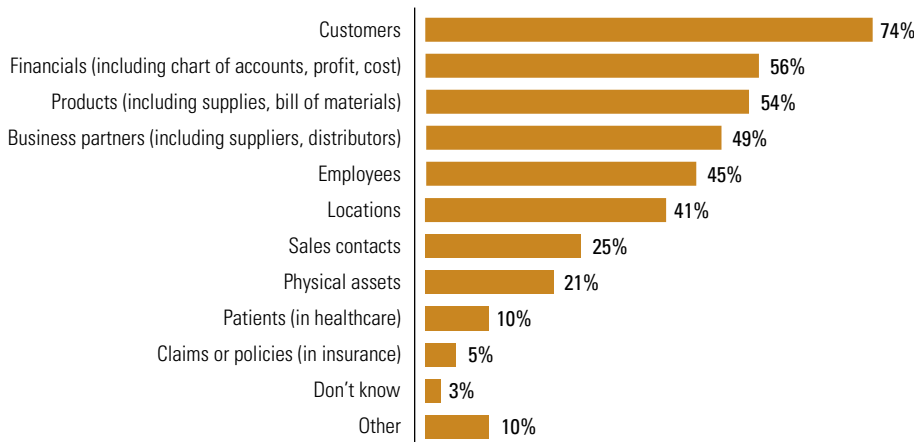


Figure 15. Based on 2,982 responses from 741 respondents.

Approximately how many different business entity types do you need to manage master definitions?

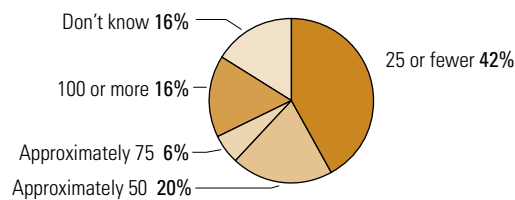


Figure 16. Based on 741 respondents.

Approximately how many definitions of “customer” does your organization have?

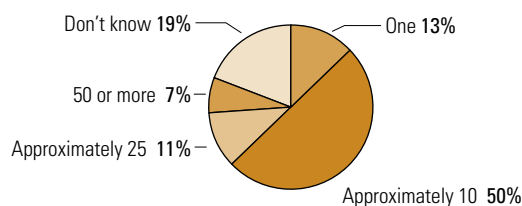


Figure 17. Based on 741 respondents.

Approximately how many definitions of “product” does your organization have?

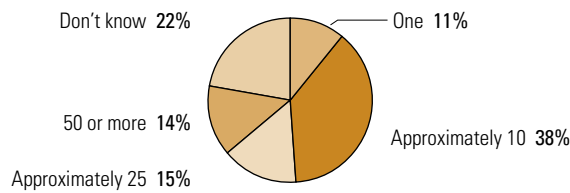


Figure 18. Based on 741 respondents.

Master Data Modeling Approaches. Data models for master data can be object-oriented, hierarchical, flat, relational, and so on:

- **Master data modeling should be object-oriented.** Recent years have seen vendors’ tools for databases, data modeling, and integration support a mix of object and relational data models. The rise of XML-described data has brought back hierarchical models, which objects can represent easily. MDM is ably served by this kind of object-oriented data modeling, given the hierarchical and multidimensional relationships found among most business entities.
- **Flat versus hierarchical models for master data.** While interviewing users about MDM best practices, TDWI encountered two approaches to entity modeling worth noting here. At the low end, when MDM simply provides a system of record that lists a record for every instance of an entity (as most customer-data-oriented MDM does), the data model is simply a flat record (albeit a “wide” record with many fields) stored in a relational table or file. At the high end, the model can be a complex hierarchy, as when a large company defines financials with multiple dimensions per region, nation, and office, as well as per charted account and budget. Deciding how flat or how hierarchical the model should be is a basic design decision in MDM. Obviously, the latter takes more time and expertise.
- **Hierarchical models can increase the number of entities modeled.** As an extreme example, note that TDWI interviewed users who manage master data for over a thousand entities. This is possible when a complex product is defined as a hierarchical collection of parts and subassemblies or when products have parent-child relationships within a product family.

USER STORY

A rich hierarchy of master data serves both business and IT goals.

“The real reason we have consistent master data for tracking products and related entities from cradle to grave is to collect better costing data, which means better profitability and partner activity,” said Bob Schumann, the leader of enterprise data at Owens Corning. “In other words, we’re leveraging data to achieve business results, which shows that master data management is driven by strategic marketing’s goals on the business side.” On the technology side, data definitions are modeled in a hierarchy that includes purely product attributes, but also costing attributes, marketing attributes, and even attributes specific to a business unit. Given that Owens Corning has approximately 45,000 products that relate in product families, a very rich hierarchical data model results.

MDM Connects Layers of the Data Warehouse Technology Stack

Complexity is the greatest challenge to MDM in a data warehouse and BI context. Incoming data involves many entities (perhaps with multiple operational definitions), and the data transformation process creates even more definitions for analytic and reporting purposes. All these definitions, their

component data, and their relationships must be documented for reuse and consistency, and the documentation should be visible through a tool (like a metadata repository or equivalent database) that's useful to both technical and business people.

As if all that weren't hard enough, the relationships are likewise complex, often forming a hierarchy or an object-oriented structure with inheritance. And, of course, master data (both inside and outside the warehouse) changes periodically, so everything described here must identify change flexibly and adapt to it.

Hence, data warehousing and BI professionals tend to be combat-hardened veterans of master data management—though few of them use the term. Most see MDM and MDM-like practices as part and parcel of data warehousing's individual layers, namely data integration, metadata management, data modeling, and report design. Whatever you call it, managing master data across the many layers of the technology stack is required for a deep and rich data warehouse.

"Master data management and governance strategies are critical to ensuring data integrity and consistency within any data warehousing environment," according to Brian Hickie, McKesson Pharmaceutical's vice president of business intelligence. "At McKesson Pharmaceutical, we learned just how important these strategies are with our most recent enterprise data warehouse implementation. As a result of lessons learned, master data management and governance will be extended and will become critical core competencies in ensuring data consistency and integrity throughout both the transaction and business intelligence environments during our ongoing platform decommissioning and ERP expansion."

USER STORY

MDM is a core competency within data warehousing and beyond.

Operational MDM Is Often about Code Tables

A common data structure built into an operational application is the code table. Sometimes the format of the code comes from an external standard, like a ZIP code, Social Security number, uniform product code, or vehicle identification number. Other times, the code comes from an internal standard, like a chart of accounts, product number, or sales region. Or the code may be unique to the application, like customer service codes in financial services or claim processing codes in insurance.

Code tables are an operational MDM issue. These codes are core to the architectures of individual applications, but they also provide consistency and integration across applications. Codes must be well defined, in terms of their business meaning, data model, and appropriate application use. There should be a central "trusted source" or "gold copy" for each code set—usually a master code table or file. In some architectures, all applications access the one master code table directly. In others, the list of acceptable codes (along with associated data and metadata) is replicated to all databases and applications that are governed by the master code table.

"I think of what I do as primarily metadata management, secondarily code and reference data management," said Mark Weaver, the semantic evangelist at WellPoint, Inc., a leading healthcare insurer. "The codes are mostly atomic, describing gender, age brackets, and other attributes of the business. But they also relate in hierarchies to provide a consistent, cross-application view of a customer, claim, or policy. We started broad metadata and code management when we went from mainframe to client-server systems. And we continue to do it, because it saves money and improves customer service through data consistency and quality."

USER STORY

Metadata, codes, and master data are all related.

Organizational Best Practices for MDM

Master Data Ownership and Control

TDWI asked MDM implementers: “What organizational structure primarily owns or controls your MDM solution?” (See Figure 19.) Most respondents identified technology organizations, like the data warehousing team (22%), enterprise data architecture group (20%), and IT department (16%). They ranked far lower organizations with direct business involvement, like a line of business (12%), data governance committee (8%), and data stewardship program (7%).

What’s wrong with this picture? First, most organizations need business people to be involved in the creation of business entity definitions, if the definitions are to be valid and useful. Second, for master data to achieve its goal—consensus-driven definitions applied consistently—it must be shared ruthlessly, which in turn demands a central organizational structure with an executive mandate, like a data governance committee or data stewardship program. These much-needed corrections to how master data is managed have deep ramifications for organizational structures and staffing.

What organizational structure primarily owns or controls your MDM solution?

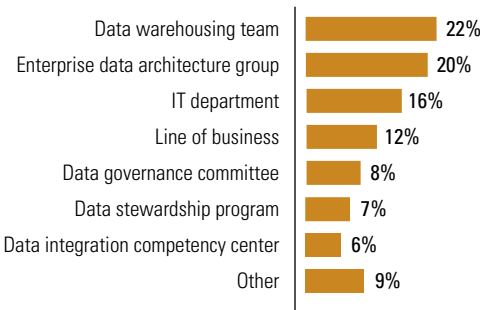


Figure 19. Based on 148 respondents.

Organizational Structures for MDM

MDM and other cross-functional data management practices. Master data management is similar to data warehousing and data stewardship, in that all three benefit from a cross-functional team. Organizations already practicing data warehousing or stewardship should borrow ideas from these teams, in terms of what works specifically within their organization. In fact, due to similarities across these three practices (plus information deliverables they share in common) some organizations consolidate them into a single cross-functional team. Even if teams are kept separate, they must collaborate closely because of the data and business goals they share. Either way, these and other increasingly collaborative data management practices are ripe for consolidation under the control of a data governance board or similar organizational structure.²

² TDWI defined data governance and its relationship to data stewardship in the report *Taking Data Quality to the Enterprise through Data Governance*, 2006. For governance in a BI context, see TDWI’s report, *Smart Companies in the 21st Century*, 2003. Both reports are available at www.tdwi.org/research.

Data Governance

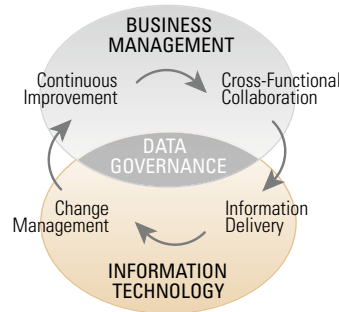


Figure 20. Data governance unites IT and the business through people and process.

Data governance. A data governance committee or board is cross-functional. It's populated with a mix of technical data experts and business people whose management effectiveness depends on complete, clean, and consistent data. In addition, its technical people represent multiple data management practices, including data warehousing, data quality, MDM, metadata management, database administration, enterprise data architecture, and so on. For all these people, governing data is a part-time responsibility that complements their “day jobs.”

The data governance committee provides common ground where data stakeholders can collaborate about how to share and improve data. And it establishes change management processes for proposing, reviewing, and implementing changes to data, systems that manage it, and business processes that handle it. In short, data governance unites IT and the business through people and processes to effect data improvements. (See Figure 20.)

Enterprise MDM needs data governance. One of the goals of data governance is to give data management practices broader reach and visibility, perhaps even enterprise scope. In that context, data governance isn't necessarily appropriate to application-specific forms of MDM, like operational MDM or analytic MDM. However, enterprise MDM is difficult to pull off without data governance's central organization representing all data stakeholders.

Organizational structures involving MDM. Data governance is not the only organizational structure that can help pull master data efforts together. Many data stewardship and enterprise data architecture programs have an enterprise breadth and executive mandate similar to data governance. And some teams that do MDM as part of a larger application are cross-functional in nature, like teams focused on data warehousing or ERP. Competency centers (also called centers of excellence) that focus on data integration and quality can also give scope to MDM efforts.

TDWI asked an enterprise data architect at a chemical company how he defines master data management. “On the surface, MDM is about the master data that defines products, customers, financials, employees, and so on. Data definitions aside, it's really about *sharing* data, which requires one definition, one context. In fact, you wouldn't need master data management, if you weren't sharing data.” To facilitate data sharing internally, data governance and stewardship programs define business entities and propagate these through an enterprise metadata repository. For sharing data with numerous external partners, the company complies with standards-based definitions of chemicals and related products.

USER STORY

**Sharing data requires
MDM and data standards**

Staffing an MDM Team

MDM teams are cross-functional by varying degrees.

Cross-Functional Staffing. There are two prominent requirements to consider before staffing MDM:

- **All master data management efforts should be cross-functional, to some degree.** That's because deciding what data means, how it should be defined, and how users should use it is best done as a consensus-driven collaboration between technical and business staff. This is a critical success factor, and survey respondents ranked a "lack of cross-functional cooperation" as the leading inhibitor to MDM technical implementations.
- **The scope of cross-functional interaction varies according to the type of MDM practiced.** For example, operational MDM in an ERP context requires a relatively narrow cross-functional team consisting of technical personnel who are expert in the ERP software and its data, along with line-of-business managers who understand the processes in which the ERP is used. In other words, application-specific MDM serves one system and its end-users within one business unit, and so needs a small team with loose policies and procedures for collaboration. At the other end of the spectrum, however, enterprise MDM serves multiple systems and the end-users of multiple business units, so the cross-functional team requires more people to represent more organizational units of IT and the business, plus well-developed policies and procedures that foster collaboration across multiple organizations.

Technical Staffing. The cross-functional nature of master data management is visible in the make-up of some of the technical teams that implement it:

MDM implementers must be expert in multiple data practices, plus know the business.

- **Mixture of technical and non-technical team members.** According to TDWI's survey, MDM is most often implemented by a data warehousing team (and most of these are cross-functional), followed by a "cross-functional team from business and IT" (49% and 45%, respectively, in Figure 21). So, respondents clearly recognize that MDM requires a consensus-driven collaboration between IT and business.
- **Hybrid team members.** Some implementers tend to be hybrids with both technical and business skills, namely business analysts (30%) and data stewards (24%).
- **Special organizational structures for the MDM team.** Roughly 3% of survey respondents selected "other" and entered a specialized organizational structure as the implementer of MDM, like a data governance board, competency center, or enterprise architecture group. Furthermore, note that only 20% of all survey respondents were allowed to answer the question in Figure 21 (because they've implemented MDM), and only 20% of those reported having a dedicated MDM team. That means that a mere 4% of organizations overall have a dedicated MDM team. Hence, MDM is still new to specialized organizational structures—which usually go hand-in-hand with enterprise MDM—because it's still practiced mostly as operational MDM or analytic MDM, which are components of larger applications.

TDWI asked MDM implementers: "What skills are required to implement MDM successfully?"

- **MDM requires many technical skills.** Each respondent selected six skills on average, indicating that the technical implementer must have a daunting collection of skills in data management, application development, and integration design (see Figure 22). Furthermore, business modeling (68%) and process modeling (43%) ranked highly, reminding us of MDM's close ties to business skills.

- **Skills for analytic MDM and operational MDM differ slightly.** For example, skills we associate with data warehousing also apply to analytic MDM, namely data integration design (74%), metadata management (64%), and multidimensional database modeling (43%). Likewise, skills from the world of operational applications—which also apply to operational MDM—include entity modeling (53%), application integration design (53%), and application development (39%). Other skills could apply to both practices, like data quality design (71%), business modeling (68%), and relational database modeling (54%).
- **Enterprise MDM requires the broadest skill.** When enterprise MDM consolidates analytic and operational practices, the list of skills doubles. But this is not a barrier, since only a quarter of respondents felt that a lack of MDM experience or related skills was an inhibitor to an MDM technical implementation.
- **MDM’s technical skills are cross-functional and thus demand cross-training.** Note that MDM is cross-functional in two senses. The first involves an IT-to-business collaboration of the larger team, whereas the second involves a collaboration of multiple data management practices within the technical implementation team. This affects technical staffing, because team members—whether MDM specialists or not—should be cross-trained in multiple data management practices, similar to the cross-training typical of data warehousing teams. This generalization applies whether practicing operational, analytic, or enterprise MDM.

Who develops and maintains MDM solutions in your organization? (Select all that apply.)

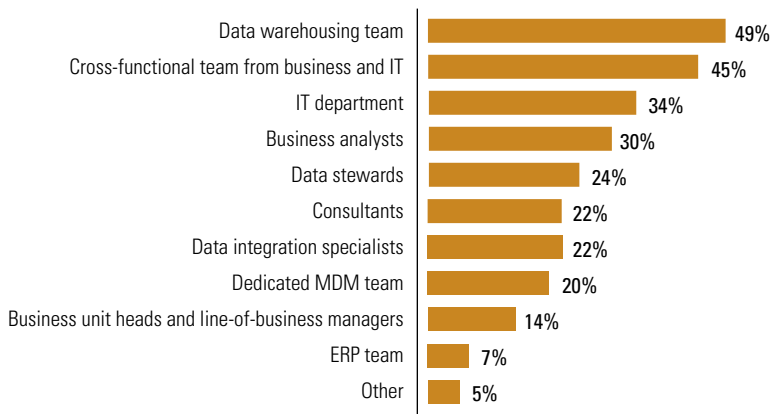


Figure 21. Based on 404 responses from 148 respondents.

What skills are required to implement MDM successfully? (Select all that apply.)

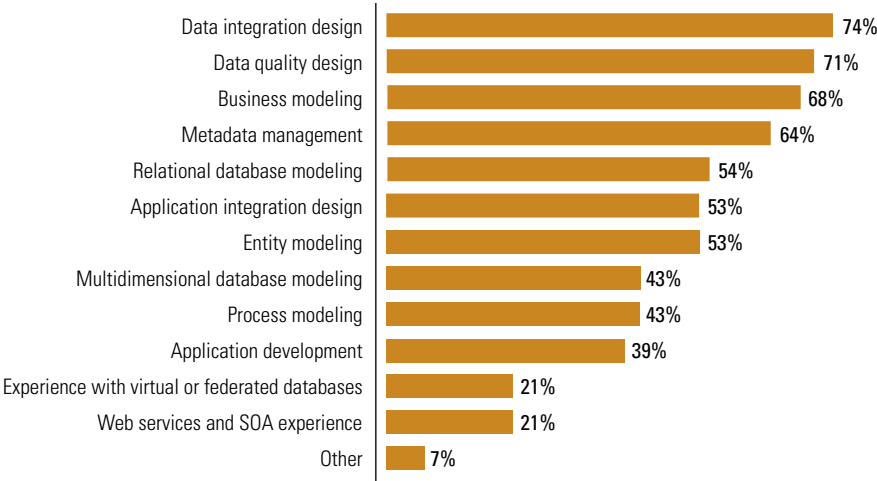


Figure 22. Based on 905 responses from 148 respondents.

USER STORY

World-class financials
via data governance
and MDM

Nationwide Financial Services (NFS) is a publicly traded Nationwide subsidiary with nearly \$4.4 billion in annual revenues through annuities and retirement products. NFS is also TDWI’s 2006 Best Practices Award winner in the MDM category.

Over several decades, NFS had implemented more than 100 legacy applications across dozens of lines of business, functional units, subsidiary companies, and geographic locations. As a result, NFS grappled with problems common to the large enterprise—inconsistent data, poor visibility, and sub-par data governance and reporting capabilities. The need for a single source of consistent, accurate financial data prompted Nationwide to undertake an ambitious re-engineering of its Finance data infrastructure, distinguished by an aggressive master data management initiative.

Whereas most companies approach MDM by extracting operational data from systems and storing it in an MDM repository, Nationwide built its MDM repository to also propagate reference data out to the operational systems. The MDM repository was built in conjunction with data warehouse, ERP, and financial applications. This ensures the consistency and integrity of data in the operational systems, which is especially important as data is exchanged between these three interconnected systems. In other words, this broad data integration infrastructure knits together both analytic and operational systems atop a reference- and metadata-driven architecture.

In tandem, Nationwide built a financial data governance organization comprised of business and IT stakeholders, and implemented processes that defined ownership and responsibility for data, metadata, and master data across Finance. The data governance team’s painstaking attention to data detail is paying dividends with consistent data definitions that make it possible to consolidate and compare numbers across organizational boundaries so users are confident in the integrity of the data.

The business results are significant, allowing Nationwide to become a world-class financial organization via a more transparent and streamlined analytic process. Nationwide has gained more accurate and reliable forecasting, and the flexible reporting architecture to accommodate business changes. It is supplying a common set of financial information in a timely, comparable and accessible manner.

Recommendations

Note that MDM is about sharing. If you're not sharing data, you don't need MDM. If you are, you'll need to define how applications and databases should represent shared business entities, like customer, product, financials, and so on. To reach the goal of sharing data, you'll need to share definitions of data first, plus establish teams, policies, and procedures for sharing.

Enlist business people. For master data to achieve its primary goal—consensus-driven definitions applied consistently—the consensus must be driven by a cross-functional team of technical and business people. For business entity definitions to be valid and useful, most organizations need business people to be involved in their creation. Furthermore, the way business people handle data through applications should comply with the definitions.

Create your own definition of MDM. Just about every organization has its own definition, because MDM is enabled by diverse technologies and varying amounts of business participation. Plus, the number of applications and business units involved varies greatly.

Embrace MDM for its benefits. TDWI data shows that analytic MDM yields more accurate reporting and greater confidence in analyses that key decisions are based on. Operational MDM makes business processes consistent for better customer service, marketing, and sourcing.

Include MDM in your compliance strategy. When compliance centers on reports, MDM helps assure that reports are populated with correct data, drawn from correct sources. In the case of an audit, MDM that includes data lineage information enables IT and business people to quickly and credibly answer auditors' questions about the origins and use of report data.

Manage master data for more than customer, product, and finances. These are the business entities that most organizations start with, because they represent the greatest need. But a mature MDM practice will branch out to the entities of human resources (employee, benefit, salary), physical assets (location, office, equipment), or an industry (patient in healthcare).

Establish both proactive and reactive processes for MDM. Get beyond reactive MDM, which addresses problems that need immediate attention. As a complement, also apply proactive MDM, which explores data and metadata to identify opportunities for master data improvement. A long-term strategy should include both reactive and proactive practices, with staffing for each.

Choose carefully a style of data modeling. This is a foundational design decision that can enable or limit a software solution for MDM. Models may be hierarchical (for financials or any entities related in a roll up), multidimensional (for analytic data), relational (typical of non-analytic customer data), or flat (for code tables and other simple lists).

Give enterprise MDM required organizational structure through data governance. When done with enterprise scope, MDM benefits from a data governance board or similar organizational structure. This provides a cross-functional team that brings technology and business people together to achieve consensus on master data definitions and a broad range of other data management issues. It also provides centralized processes and infrastructure for sharing data and master data, plus collaborating for its improvement and managing its changes.

As a complement to this report on master data management best practices, TDWI Members will receive the report Segmenting Master Data Management Solutions within an upcoming TDWI Membership Quarterly. Part of TDWI's Technology Market Report series, the other report describes a community of vendors and products in a particular technology market to aid Members in researching products and making purchasing decisions.

Consider MDM whenever you plan to share data across systems and businesses.

Practice MDM to assure consistent data for reporting and decision making, plus many operational tasks.

The broad scope of enterprise MDM requires a broad multi-functional team to make it effective.



Actuate Corporation
701 Gateway Boulevard
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650.837.2000
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650.849.4000
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1201 Monster Road SW, Suite 250
Renton, WA 98057
Phone: 425.277.9126
Fax: 425.687.2842