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Technology for Operational Decision Making

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Executive Summary

"Most discussions of decision making assume . . . that only senior executives' decisions matter. This is a dangerous mistake."

Peter Drucker

Success in business relies on making the right decisions at every level. Organizations and executives focus on high-impact, strategic decisions. Operational decision making is often neglected because the individual front-line decisions seem to lack impact. This is a mistake because these little decisions add up. A company's brand identity is defined by thousands of these little decisions:

- > The price a company offers a particular prospect for a product determines if the prospect thinks of the product as expensive or a good value.
- > The way a customer service representative cross sells to a particular customer determines if the customer feels valued or just over-sold.
- > The options that a website, kiosk, or ATM offers to a particular customer make a company seem easy or hard to do business with.

Each of these operational decisions has a very small individual impact, but the cumulative impact is huge because decisions of these types occur so often.

Consider this example: A once-a-year contract for a distribution channel worth \$1M in profit next year versus the decision to retain customers worth \$50 each in profit next year. It might seem clear that more time and money should be spent getting the channel renewal decision correct than on customer retention decisions. Yet a company with just 26,000 customers on an annual contract must make 500 renewal

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decisions each week. Even for a small customer base like this, the value of retention exceeds that of the channel renewal decision:

Decision	Value	Frequency	Impact
Renew channel contract	\$1,000,000	1/year	\$1.0M/year
Retain individual customer	\$50	500/week	\$1.3M/year

While the channel renewal decision will be the subject of many meetings, many hours of analysis, and will use all available data from both inside and outside the company, the operational decision to retain particular customers is often made by lower level or outsourced front-line staff, by the website programmer, or by the maker of the CRM system in use.

Operational, or front-line, decision making has become both more important and more complex in recent years. Organizations are using more systems to run their business over more channels and are increasingly operating 24x7. Making operational decisions in real time and embedding those decisions in software are increasingly important. And these operational decisions must account for legislation, risk-value tradeoffs, and rapidly changing business conditions.

In order to take control of these operational decisions, a company must focus on being decision-centric. A decision-centric organization:

- > Is focused on the *effectiveness* of its decisions rather than aggregated historical metrics.
- > Recognizes *decision making* as a competency and devotes resources to elevate, understand, and continuously improve its decisions.
- > Knows which decisions matter, who makes and who owns each decision, and who uses the right technology to support or manage each decision.

- > Uses decision-centric processes, decision-centric measures and key performance indicators (KPI), and an approach for managing and improving the decisions that drive its business.

This approach is known as Enterprise Decision Management.

Enterprise Decision Management (EDM) focuses on the *operational decisions* that create value in your business, recognizes these decisions as reusable assets, and makes them widely available via Decision Services. Companies adopting EDM identify the operational decisions that matter to their business and drive results. They create Decision Services that replace decision points in processes and systems to make those processes and systems simpler, smarter, and more agile. Finally they close the loop, ensuring that the way operational decisions are made is monitored and constantly improved.

Companies adopting EDM in order to become decision-centric share a number of characteristics.

- > They focus primarily on *operational decisions*.
- > They use *business rules* so business users can define and manage those decisions.
- > They use their data to add *analytic insight* to improve these decisions.
- > They ensure ongoing improvement of decision making through *decision analysis*.
- > They embed these decisions in processes to make them simpler, smarter, and more agile.

EDM is a management discipline, not a technology stack. It takes advantage of many widely used technologies better and integrates some that are less widely used. In many ways, the technology for EDM has recently reached a level of maturity that makes it possible to tackle a wide variety of EDM challenges.

Churn Prevention at AT&T Mobility

The AT&T Mobility data warehouse contains 120TB of mobile phone consumer data. Data from network switches, billing systems, and a wide variety of corporate systems is integrated into the data warehouse on a variety of schedules. One operational system that is automating decisions based on these data is the call center system.

AT&T has developed and continually updates a churn algorithm for customers. Once a consumer has 3-4 months of telephone usage data, a propensity-to-churn score is generated nightly and stored in the data warehouse. This model primarily uses bill payment information and usage information and is constantly refined. By the time a customer gets within 120 days of the end of a contract, the algorithm is predicting propensity to churn with 90-plus percent accuracy.

The system combines this score with other information about a customer, such as a Lifetime Value model, data usage, and phone choice to see what the best retention offer is for that specific customer. The offer is then displayed on the call center representative display screen whenever a consumer calls for assistance. These offers might include early termination, early phone upgrade, or more. If the system cannot find a suitable offer, it will display the propensity-to-churn and Lifetime Value scores for a call-center representative to make his or her own decisions based on the conversation with the consumer.

The same decision flows to a different system for sales representatives in the stores, in direct mail campaigns, and to route customers to different call centers.

These include Business Process Management Systems (BPMS) and Service-Oriented Architectures (SOA) changing the way organizations automate and manage their day-to-day operations; additional large investments made in Business Intelligence systems and data warehouses to capture and understand all of a company's data; and repeatedly proven analytic and business-rules technology integrating into mainstream development approaches.

The available technology for operational decision making can be divided into a number of categories. There is an Infrastructure layer that underpins the rest of the technology and an Execution layer that wraps decision making in a broader context. Decision making is built on a robust Data layer and consists of Data Analysis tools and a Decision Management layer. Many products exist in each of these categories suitable for use when automating operational decisions. These products also support more traditional business intelligence, performance management, and analytic tasks as well.

Like with all initiatives, investments must be made, and there are risks and issues with adopting EDM and applying technology to the automation and improvement of operational decisions. Most of these will be familiar, but a few are unique to EDM. All of these can be mitigated – and the ROI of successful EDM projects is high, often *very* high. Not every project or area of a business lends itself equally to EDM. Finding the right areas in which to apply EDM is critical to success, and companies can use an adoption scorecard to help them focus on the most fruitful areas by considering factors that make EDM more, or less, applicable.

The remainder of this paper provides more details about this technology, introducing the available technology types and discussing what makes a technology product suitable for EDM. It also details the risks and issues involved in adopting EDM. How these risks might be mitigated is outlined, and an adoption scorecard to help select appropriate uses is proposed. A reference architecture and some definitions of terms complete the paper.

Applying EDM

Identify Operational Decisions

The first step in applying EDM is to identify and make explicit the operational decisions within a process or system that can be automated. A decision audit may be conducted to document and describe each operational decision within a process, a business area, or even a whole organization. Such an audit identifies who makes a decision, who decides how it should be made, how often it is made, how much time is available to make it, and other key attributes.

Decisions, such as whether to approve a loan or identify someone as eligible for a product offer, may be made manually by people or embedded in software. These decisions are typically easy to identify, however, some operational decisions may have never been formally identified and described before. These could include decisions that have historically been made at an organizational level but which could be made for a specific customer. These are sometimes called “micro decisions” (Taylor & Raden, 2007) and

include such operational decisions as customer-specific pricing (instead of generic pricing) and personalized recommendations for next action (instead of blanket offers).

Externalize Decisions

Once identified, operational decisions must be externalized. This means removing code that implements them from other systems – disentangling them – and explicitly identifying them as Decision Services. This means separating them so they can be enhanced, managed, and used across the organization. This simplifies maintenance and reduces the total cost of maintenance.

The next three steps handle the automation of these operational decisions as Decision Services.

A Decision Service is a self-contained, callable service with a view of all the conditions and actions that need to be considered to make an operational business decision. It is a service that answers business questions for other services.

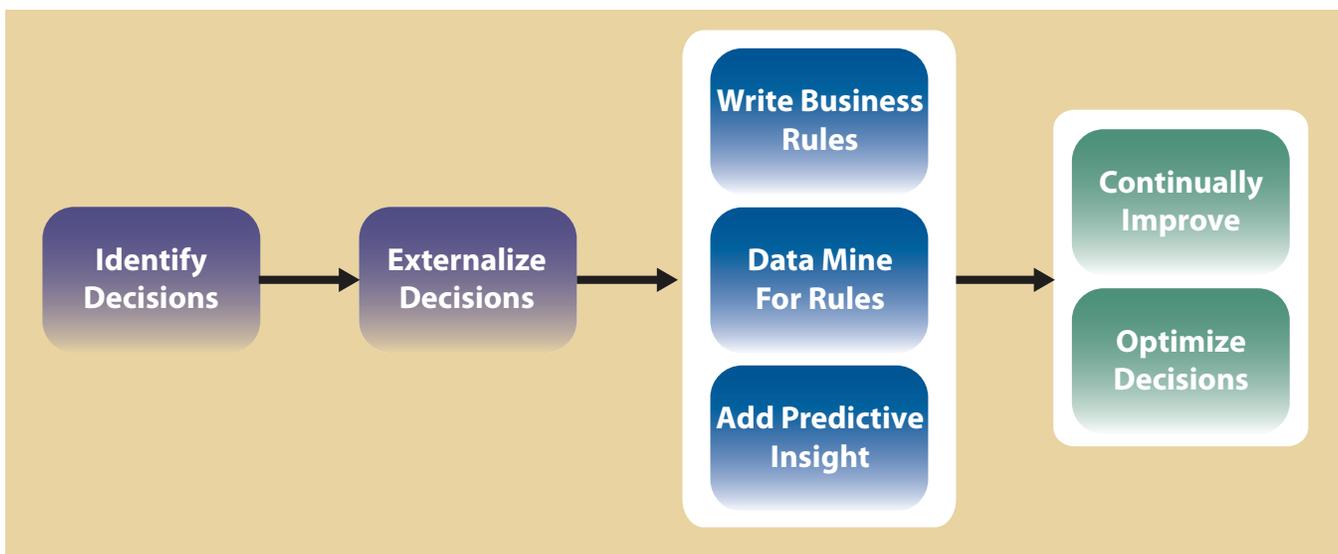


Figure 1. The main steps in EDM.

Business Rules

The policies and procedures that drive how a decision is made can and should be represented using a declarative definition of what should be done. Business rules are ideal for this. Business rules are declarative, expressive, and easy for non-technical users to understand, making it possible to define how a decision is made completely and correctly. Properly deployed, the use of business rules adds agility to the Decision Services by involving the line-of-business experts directly in maintaining the decisions being executed. It essentially eliminates the go-between programmer and places rule management in the hands of those responsible for revenue or cost.

Data Mining

While many of the business rules used to make a decision come from written and explicit sources – regulations, policies, procedures, user preferences – it is often necessary to use data mining to create and improve business rules. Data mining tools typically “see” facts and probabilities that the people involved would not be able to detect on their own. Many rules have thresholds, or limits, in them, and data analysis can be used to find statistically significant or historically effective values for these. Data mining can also be used to develop segmentation models and these are often represented by Business Rules as well. Essentially, one can make the rules better reflect what works, or at least what has worked in the past, by analyzing data.

Predictive Analytics

One of the main challenges when making decisions is the uncertainty inherent in guessing what will happen in the future. To treat a customer properly, set a price correctly or select the right supplier, one needs visibility into the future. How will the customer react to each treatment? What price will be acceptable and profitable? Which supplier will deliver on time and to budget? But without a crystal ball, certainty about the future is impossible. However, we can turn uncertainty into probability using predictive analytic techniques.

Information about the behavior of a specific customer and of customers statistically similar to them can be used to predict how likely they are to react favorably to a particular offer. Information about suppliers and their past deliveries can be used to predict how likely they are to be on time in the future.

Such predictive models can be developed and integrated so that rules for the decision are based on the likelihood of relevant future outcomes. These models can be assessed to see if there is causality or merely correlation and can be subjected to sensitivity and root causes analysis.

Continuous Improvement

Decisions are not stable. What makes a good decision changes over time as markets move, competitors change behavior, and customers’ expectations change. Effective decisions must be monitored and managed over time so they can be continually improved.

Customer Service at Continental Airlines

Continental Airlines assigns seats to more than two dozen booking classes that are complicated by domestic and international alliances and connections. The need to have the system operate as close to real time as possible is obvious – a booking agent or website needs to know what seats are available and how to price them as interactions occur. The system is designed to meet multiple objectives. Obviously, maximizing revenue is a prime concern, but attending to the needs of good customers and even special cases, such as bereavement fares and children flying alone, are equally important. By streaming near real-time updates to its data warehouse, Continental has developed an intricate revenue management system that updates seat inventory as seats are sold, enabling it to keep planes full while maximizing revenue per passenger. This information also helps Continental ensure its best customers receive upgrades when available and manages rerouting when connections are missed.

The flight management dashboard for a hub, for example, shows flights with more than a 15 minute delay. For each flight, it shows a map of flight arrivals, how long the passengers have to make the various connections, and how many of the people trying to make each flight were profitable customers. This information is delivered to the director of operations so they can do their best to fix things, for example by providing a cart to drive a passenger to their connection gate. Customer service is improved by focusing on the decisions that can be made by operations directors and making sure the right analysis is done and options presented. Continental Airlines used these systems to go from “worst to first” in the JD Power customer service studies.

Performance management tools and techniques can be applied to operational decisions. This allows the distribution of decision choices, results of specific choices, and overall rates and volumes to be measured. Adaptive control techniques can also be used to continually compare the “champion” or current approach with “challengers.” Champions and challengers represent sets of business rules and predictive analytics that form a decision beneficial to the enterprise. The champion is the current production solution, the challenger is a possible replacement. These challengers change some aspect of the approach – new models, new rules – and are applied to a small percentage of transactions. If one of them performs better over time than the champion, it can be promoted to the champion and new challengers are devised. This constant challenging leads to continual improvement and helps ensure that changes outside the organization don’t lead to a decision being made poorly for an extended period.

Optimize Decisions

The ultimate objective of EDM is that of optimal decision making. Constant use of adaptive control techniques will improve a decision, making it increasingly optimal. Some decisions lend themselves to optimization where an optimization model can be used to find the best result given the constraints and tradeoffs of a decision.

Available Technology

A range of technology is required to effectively manage operational decisions. This technology is available today from a number of vendors. It is robust, cost effective, and well understood. To analyze the available technology, it is best to divide it up into a number of layers – Infrastructure, Data, Analytics, Decision Management, and Execution.

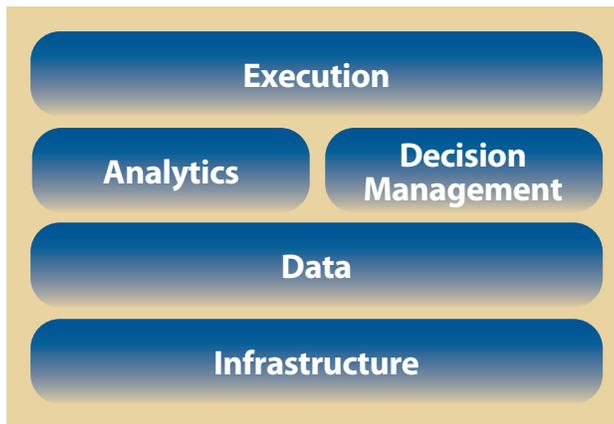


Figure 2. Layers of available technology.

While all five layers have a role to play in EDM, the three in the middle are the focus of this report. Data, Analytics, and Decision Management are the technologies that are either specific to EDM or where the requirements for supporting EDM are distinct from other uses of the technology. Infrastructure and Execution technology is relevant to EDM in the same way it is relevant to many other solution spaces. Nothing about them is unique to their use in EDM, but they are included for completeness.

Infrastructure

It is possible to manage decisions effectively within monolithic applications. Many organizations have done so. As component-based approaches based on a Service-Oriented Architecture have become more

widespread, however, they have become the norm for projects aimed at managing operational decisions. Adopting Service-Oriented and Event-Driven Architectures allows Decision Services to be externalized and managed effectively while remaining easy to integrate with other components. This improves reuse and increases agility relative to approaches that embed the operational decision in a monolithic application. Adopting EDM in a component-based environment requires a suitable infrastructure in which three main components have a role:

SOA Platform

For most organizations, the SOA platform is made up of a number of products that deliver service security, a service repository and related metadata management, transaction and service management and versioning. An SOA platform handles the administration and control of the large number of services that a service-oriented architecture requires as it is developed.

Enterprise Service Bus

An enterprise service bus (ESB) is a piece of software that acts as a message broker, allowing applications and services to communicate without point-to-point connections. Layered on top of standards-based messaging, an ESB enables an organization to pass information between loosely coupled services and ensure delivery of events. An ESB will support both synchronous and asynchronous (publish-subscribe) communication, various forms of routing (policy-based, content-based) and mediation/processing of messages.

Event Correlation Technology

Organizations need to respond to specific events of business significance, yet the “event cloud” often contains much lower-level events. Event correlation technology handles the detection of multiple simple events over time, as well as pattern matching and other forms of correlation to identify these more

complex events. This technology is often combined with EDM technology in products known as Complex Event Processing (CEP) solutions.

Execution

At the opposite end of the stack are Execution environments. In particular, the growing use of Business Process Management Systems (BPMS) and the use of more service-oriented and componentized enterprise applications support the development of composite applications. Composite applications are valuable when creating EDM solutions because they make it easier to integrate Decision Services with existing and new systems. The expectation that separate components or services will provide different elements of the overall application means that a composite application does not generally require any major revision to take advantage of a Decision Service. Composite applications also reduce the barrier for adopting new technology suitable for developing EDM solutions. If there is an established framework for integrating components built with different tools into a composite application, then IT departments will have fewer problems adopting new technology specific to the construction of Decision Services. The two main components in this layer then are:

Business Process Management Systems

A BPMS supports the definition, execution, and management of business processes. It typically handles both system-to-system interactions and human-to-system interactions. It manages state, ensures completion of multi-step processes, and provides reporting and analysis tools. Many decisioning components are integrated directly with applications built on a service-oriented foundation or with event-based architectures. Using a BPMS that supports the use of services as tasks in a process means that a Decision Service can be brought directly into a process. It can make decisions for each transaction flowing through the process and immediately feed the result on to the next step in the process allowing the process to continue.

Service-Oriented Enterprise Applications

As service-oriented approaches have become more popular, enterprise application vendors have responded by making it easier to integrate new services into their applications and, more recently, by breaking up their applications into a collection of services. While this evolution is not yet complete (most enterprise applications are still sold as large multi-purpose solutions) the move away from monolithic applications to a collection of independent services is underway. Applications that have started this process are increasingly easy to integrate with independently developed services. This allows Decision Services to be rapidly integrated. For instance, an application expected to build a call-center screen by collecting answers from multiple independent services, can easily include the results of a Decision Service where a more monolithic approach would not.

Data

The first layer essential for effective EDM is a data layer. The data layer must be able to deliver accurate, up-to-date, and fine-grained information for use in managing operational decisions. This data might be used offline to develop analytic models, to mine for business rules, or to understand what has happened in the past. It might be used inline to drive a specific operational decision, support a manual decision-making process, or to show the state and results of decision making. Making this work requires technology to store both structured and unstructured data, technology to integrate data from disparate systems, and technology to effectively move and manage data.

A best practice for EDM is to ensure that the data available for reporting and management analysis is synchronized with the data available for data mining and predictive analytics. This ensures, for instance, that management reporting and analytic models will show the same number of customers in a segment, making it easier to discuss and adopt analytic models and results. Ensuring that the data structures available for modeling

and reporting are also available to operational systems is likewise a best practice. This ensures that an operational system will be able to use a model that has been developed as the operational environment will have all the data elements that the model used.

There are a number of software components in the Data layer.

Database Management System

First and foremost is a database management system (DBMS). Typically, but not always, this will be a relational database management system (RDBMS).

Data Warehouse

Because of the demands placed on operational databases, it is usually essential to make data available for reporting and analysis through a data warehouse. Ideally, an enterprise data warehouse that integrates all the critical information across the enterprise will be used. In addition, data warehouses with atomic data rather than data marts with aggregated results are preferred as they can directly support data mining and advanced analytics. Analytic models require detailed records. If only aggregated data is available, for example from a Data Mart, operational databases will use direct extracts instead. EDM can put high and varied workloads on a data warehouse, combining intense analytic model building with rapid individual transactions.

Content Management

EDM often requires that operational systems access content stores to enrich answers with unstructured content. Also, some more advanced systems are beginning to run analytics against unstructured information, extending the content management environment into the analytics group.

Event Store

To better handle systems that must analyze large numbers of events, some organizations are adopting event stores that allow events not otherwise persisted

to be analyzed. Most EDM systems will use stored data and analytics against the data warehouse. Some will also need to execute analytics against events. These will mostly use analytic models that executed directly against event queues, avoiding the need to persist the events themselves. However, some may find the use of an event store beneficial.

Integration Technology

There is a large number of integration technologies available to bring together multiple sources of data. Enterprise Application Integration (EAI), Enterprise Information Integration (EII), and Customer Data Integration/Master Data Management (CDI-MDM) products allow effective linkage and integration of data from multiple data sources to support specific decisions.

Extract Transform Load

Extract Transform Load (ETL) systems allow programmed and controlled movement of information between data formats, different databases, and data warehouses. Because many EDM systems require access to multiple data sources, ETL and other integration technologies are often important.

Click Stream Data

Click stream data, information on the behavior of those using websites at a very detailed level, is increasingly being integrated with other kinds of information in EDM systems. Because of the huge number of entries in a click stream, this data is typically managed separately and analyzed using its own tools. Click streams are often stored in a data warehouse or data mart.

Not all EDM projects will need all these technologies, but EDM is generally most successful when a robust data infrastructure ensures that clean, integrated, meaningful data is available. Organizations that already have a data warehouse are likely to already have many of these tools in place allowing them to leverage the original investments when adopting EDM.

Data Analysis

EDM requires data be analyzed and delivered as machine-readable artifacts. Taking the form of data-mining outputs or predictive analytic models, these artifacts allow operational systems to use insight gained from historical data much as visualization helps business users. Various categories of technology support data analysis for EDM including:

Data Mining Tools

Typically used by staff with a statistical background to conduct formal analysis of the data, though there is a growing collection of products accessible to business users. These tools allow Decision Services to use statistically valid business rules and calculations derived from the historical data. Where a human user could use a picture to understand the relationships of two types of customers, a Decision Service needs the kind of mathematical representation produced by a data mining tool.

Predictive Analytics Workbenches

Tools that turn patterns and analyses of data into executable models that turn uncertainty about the future into probabilities. Used by staff with a strong statistical background, predictive analytics workbenches allow data to be cleaned, extrapolated, integrated, analyzed, and mathematically processed. Many different methods are required to ensure that a suitable technique can be found for each situation. The end result is an executable model (a formula, say) that makes a prediction about the future or how likely something is to be true. Because this is executable, a Decision Service can use it to help in its decision, executing different rules when a customer is predicted to be high risk, for instance.

Business Intelligence and Performance

Management Suites

These traditional analytic tools are required in support of EDM. Reporting on the effectiveness of decisions or of decision alternatives requires reporting and dashboards. If an EDM solution is aiming only at partial automation of an operational decision, then the people involved will need Operational BI tools to help them finalize the decision.

Visualization Tools

Tools used by those doing data mining and predictive analytics to understand data being analyzed. They can be important in assisting decision makers when only partial automation of an operational decision is possible.

Text Analytics

Tools to turn unstructured text into usable structured information – entity recognition and extraction, for instance – can be important for some operational decisions. While most data mining and predictive analytic work relies only on structured data, being able to represent a piece of unstructured data to include it in a model is sometimes very valuable.

Decision Management

The last layer is most directly related to the management of operational decisions. Three main approaches can be used: Decision Management Applications, focused on the automation and improvement of a specific class of decisions, are the most widely deployed and best known; Business Rules Management Systems can be used to manage decisions for which analytics are not important, such as compliance, or by including executable analytic models as “black boxes”; Decision Management platforms, making it possible to manage a wide variety of models and rules for many different decisions are increasingly common.

Decision Management Applications

A packaged, decision-centric application that uses a pre-defined set of analytic models and business rules to automate a particular decision such as fraud detection or underwriting. Decision Management Applications often come bundled with case management and process management capabilities to handle the transaction of which the decision is a part.

Business Rules Management Systems

A set of software components for creating, storing, managing, and deploying business rules. While there are many reasons to use a business rules management system (BRMS), its use as a platform for EDM is the most powerful. A BRMS allows both technical and business users to work on the rules for a decision and many of these systems can integrate analytic models as part of the decision-making framework. Indeed most of the established BRMS are migrating towards becoming Decision Management Platforms.

Managing Growth in Emerging European Banking Market

This bank handles more than two million individual customers and more than 150,000 small and large business customers in this emerging and highly competitive environment. Growth is critical, and to meet increasing customer demands the bank had grown its employees and branches substantially. Because of this rapid growth, it was hard for the bank's geographically dispersed representatives to engage in consistent interactions, and sales offers varied from branch to branch, clerk to clerk, agent to agent. The bank could not effectively learn from each experience or follow-up on campaign outcomes.

By automating core customer-facing decisions, the bank delivers a supportive environment to unify the way its representatives interact with customers, provide client-centric service, ensure consistent offers across the branch and call-center network, and reduce operational costs. Automated recommendations prompt representatives with next-best-offers based on customer behaviors, leads data, and real-time account information. These same offers are used for both inbound and outbound calls ensuring consistency. The effectiveness of outbound marketing in the bank's call center has increased by 180 percent while call center staff are more efficient, handling 400 percent more customer interactions.

Decision Management Platforms

Platforms allowing a company to define its response to a number of decisions, develop or integrate analytic models, and specify business rules. Some of these platforms are provided as part of hosted offerings, often by companies offering data services. Others are used on premise to automate decisions not covered by Decision Management Applications. Decision Management Platforms typically combine the functionality of several elements, such as business rules management and data mining. They may not offer every option that best-of-breed components offer, but they are generally better integrated. Their ability to combine explicit business rules and expert knowledge with implicit knowledge in the form of predictive analytics makes them particularly well suited for EDM.

Requirements for Suitable Products

There are a number of needs common to EDM systems, such as real-time decision making, large transactional volumes, the kinds of people involved both in developing systems and using them, some unattended decision making, and much more. These needs result in some specific requirements for products if they are to be successfully used in developing EDM systems.

Rapid Response Performance

EDM, with its focus on operational decisions, can require high-performance systems. Operational processes often run in real time and require an answer or decision multiple times during execution. These decisions must be made rapidly enough to ensure that the process is not delayed. Even when people remain engaged in the decision, such as when options are presented for a person to choose from, the response time of the EDM solution is still critical when the user is engaged in a conversation with a customer, or a dispatcher is directing a truck or a service crew. This is particularly important for data and Decision Management components.

Operational Volumes

A corollary of the real-time performance requirement is the need to support very high volumes. The value of applying EDM in a specific area typically increases with a higher volume of decisions. In fact, some decisions for which EDM is used are very high volume (thousands of transactions per hour) and even simple decisions can show clear ROI by providing consistency and quality to the collection of decisions. It is helpful, therefore, if technology for EDM can handle very high operational volumes as this will allow it to show a return on the widest possible range of decisions. In addition, these high

volumes create a great deal of data, both transactional and about the decisions made. This data needs to be stored and sometimes analyzed immediately.

Transactional Integration

Many decisions are managed as part of a transactional context. To be effective in these circumstances, the technology used must support effective integration with the transactional systems, especially in areas like fail-over and time-out management. One of the key benefits of EDM is increased straight-through processing or unattended operation. This means the operational decision-making components of the system must be tightly integrated with the rest of the transactional environment. Analytic technologies, in particular, have traditionally not been tightly integrated with transactional systems, which is unacceptable for EDM solutions.

Collaborative Development

Managed decisions exist at the intersection of business, information technology, and analytic expertise. To be effectively managed, therefore, all three groups must be able to collaborate on the definition, monitoring, and improvement of decisions. Technology that makes this collaboration easier and allows different amounts of complexity to be exposed to different groups at different times is particularly useful. This argues clearly for robust suites that can provide a seamless environment for all of these activities, with repositories that are durable and agile. Whether this is provided by a single software vendor or assembled from components with a unifying abstraction layer is an open issue.

Decision Analysis

Decisions are not static but must be monitored and improved continually. As market conditions and competitors change, the effectiveness of a particular decision approach will also need to change. Tools that make it easy to monitor and improve decisions are more useful than those that are more opaque

because they support more rapid identification of the changing effectiveness of decisions. Being able to conduct impact analysis and understand how decisions were made are advantageous when managing and improving decisions.

In addition, some decisions are formally audited, such as the price offered to a customer for a product, and others may have legal compliance issues, such as those in personal credit, insurance underwriting, or a multitude of government operations. Even where formal requirements do not exist, customers and managers may want to know exactly how a specific decision was made that necessitates the availability of accurate logs.

Technology that supports accurate logging as part of making a decision, and that supports the integration of these logs across multiple products, is particularly useful. Once again, this creates demand for data storage and management as the logs must be kept and made available for analysis.

Assessing Risk in Real Time for On-Line Merchant

An on-line merchant with millions of customers needed to assess risk for transactions before they were sent to a credit card processor. Existing data was analyzed, and several predictive models addressing specific data segments were built and deployed using PMML. Integrated with business rules, these models allowed transactions to be assessed quickly and effectively. Because understanding the impact of these decisions was critical, the merchant used an integrated reporting environment to monitor decisions and their effect on credit-card transactions daily.

Standards Support

Many EDM solutions require that multiple products be used together and used effectively. Support for emerging and established standards is important in making this easier to do. Support for modeling standards such as Predictive Model Markup Language (PMML) and the Java Data Mining standard (JDM), as well as for emerging business rules standards like the Rule Interchange Format (RIF) and Production Rule Representation (PRR), allow decision specification to be shared. Support for user interface implementation standards, like those relating to Portlets, allows integrated portals or monitoring environments to be developed while support for data standards allows for easier data integration. The standards for EDM are still evolving, and it is not yet possible to develop solutions based completely on standards. Nevertheless, the support of standards by products and vendors should be an important consideration going forward.

Simulation and Testing

An ability to simulate or test a decision before putting it into production can be enormously powerful. Decisions are often complex, and determining if one approach is better than another can be tricky. An ability to effectively simulate a decision before deploying it makes it possible to see what will happen. Simulating a single decision can be useful, but it is even more valuable to simulate the impact changing a particular decision has on other decisions. Changing a decision might impact those downstream at other points in the life cycle, or it might change decisions made for other transactions. A good simulation and testing environment should allow this kind of cross-decision analysis.

Service Oriented

Perhaps the most important requirement is support for a service-oriented or component-based approach. EDM solutions are more effective when the whole system of which they are part is defined in a service-oriented way. Technologies that work well in support of service-oriented applications will have broader applicability to EDM than those that do not. Suitable technologies may be service-oriented themselves, allow access from service-oriented applications, or merely be compatible with a service-oriented approach. Being able to package up rules, optimization models, and analytics into coherent and self-contained Decision Services is one thing. Ensuring that all the data, integration, visualization, and reporting that these services might need are likewise available is another. EDM solutions require multiple technologies to be used in combination, and they must be integrated with systems of record and transactional environments. Using a service-oriented

approach allows Decision Services to be managed as reusable assets, easily integrated with other systems, and helps ensure that ongoing changes in the decision-making logic are isolated to a single coherent component. Support for service-orientation in the products used is essential.

There is also a growing trend for offering service-oriented products “in the cloud” or as a service. Cloud computing or SaaS (Software as a Service) is an interesting model for Decision Services because they must be plugged into a variety of systems, processes, and channels. Taking advantage of the cloud computing model allows Decision Services to be available everywhere there is an internet connection. The combination of this ease of access and the power of these options to limit the need for up-front software licenses or hardware makes Decisions-as-a-Service or decisions in the cloud an increasingly interesting option for those adopting EDM.

Drug Safety at Medco Health Solutions, Inc.

Medco is a pharmacy benefit manager providing traditional and specialty prescription-drug benefit programs and services for its clients and members through its national networks of retail pharmacies and its own mail-order pharmacies. Medco dispensed approximately 95 million prescriptions during fiscal 2007 through its mail-order pharmacies. Medco offers a drug utilization review, a systematic evaluation of individual and population use of prescription drugs, to identify and address overuse, underuse, and misuse of prescription drugs.

The RationalMed service is a patient-safety program designed to improve patient care and lower total health care costs. RationalMed analyzes a patient’s available prescription, and inpatient and outpatient medical and laboratory records, to detect gaps and errors in care, and engage physicians, pharmacists, and patients in making appropriate changes. This requires the capture, integration, and management of enormous amounts of complicated data including point-of-sale information captured via CICS/DB2. This data is analyzed, and the resulting models are used to decide which patients have utilization issues or safety risks so the RationalMed service can identify the physicians, pharmacists, and patients involved, targeting them with suggestions.

Risks and Issues

A number of published works offer real-world case studies that show proven value to adopting an EDM approach to solving problems around operational decision making (Ayres, 2007; Davenport & Harris, 2007; Taylor & Raden, 2007). There are also, however, risks and issues to consider and mitigate in adopting the approach. Some of these issues are normal for any new approach – for instance funding, organizational issues, poorly defined objectives, and a lack of executive sponsorship. Others, however, are specific to adopting EDM for which strategies are discussed below.

Funding

Of course, EDM requires adequate funding. Because EDM projects often replace one kind of cost with another – maintenance programming with software for business rules management, for instance – getting the funding right can require changes to how budgets are set and managed. In addition, some organizations put the monitoring and improvement of decisions into a second project. This creates a risk that the first project to automate a decision will succeed, but the long-term value of decision management will not be achieved.

Mitigation for EDM projects:

- > Ensure that the projects used to initially implement EDM take a holistic funding approach, considering the costs of all elements of development so that the cost of programmers, for instance, can be offset against the cost of new software.
- > Try and include the cost of reasonable and typical changes to the system in the cost analysis. Traditional, existing approaches often result in much higher costs for ongoing changes than does EDM. Including a reduction in the true costs of these

changes as a benefit from EDM will improve the ROI for the new approach.

- > Include the work of ongoing monitoring and improvement of decisions in the budget.

Organizational

Any project that requires multiple disparate groups within an organization to work together carries organizational risk. Cooperation in establishing an effective working environment for a cross-functional team and inter-department priorities can be quite a challenge. A typical EDM project requires collaboration between analytic, technical, and business groups. Organizations with a poor history of cross-group collaboration or with an adversarial relationship between the business and/or analytics group and IT need to be particularly careful. Organizations can also struggle when users disagree with automated decisions.

Mitigation for EDM projects:

- > Creating a new, hybrid group with individuals from analytics, IT, and business departments can be very effective. This group can be temporary or become the core of a Center of Excellence.
- > Use smaller, less complicated projects to build trust, especially where groups have no history of working together. Starting with smaller projects is essential to build the trust that will be required for larger ones.
- > Ensure the project plan has time allocated to tasks that will bring the analytic, IT, and business groups together.
- > Ensure that business users get the testing and release management skills they need to own and maintain deployed decisions.
- > Provide users an option to override the automated decision and then track and monitor these to determine which works better.

Organizational Change in Operations

Because of its focus on operational decisions, EDM affects operational systems and operational processes. Many of these changes can be adopted seamlessly – an increased rate of straight-through processing, for instance, merely reduces the workload of those handling manual review. Sometimes the replacement of a manual decision with an automated one can be more disruptive. Groups that may have been used to referring every decision to managers may now have automation that empowers them directly, changing power structures. Staff used to spending time approving individual transactions may have to move to a more analytic role as individual transactions are handled automatically.

Mitigation for EDM projects:

- > Include human resources in the project to ensure that any changes to job descriptions, roles, and responsibilities are managed appropriately.
- > Carefully evaluate the measures and bonus/commission structures used by those impacted by the new system to ensure they are incented to use it.
- > Provide training and support for staff impacted by the application to ensure that a lack of understanding is not holding anyone back.

Culture Clash in Decision Development

EDM typically requires close collaboration between IT, analytics, and business groups. In most organizations these groups rarely, if ever, have collaborated deeply before. Business users are used to asking IT to develop systems and then playing only an arms-length role. Similarly, IT departments are often reluctant to allow non-technical business users to participate actively in development and will need to partner

more effectively with business users. Analytic groups often work in splendid isolation, focusing only on the accuracy and predictive power of their models. This will not support the EDM model.

Mitigation for EDM projects:

- > Conduct cross-training exercises across the various groups involved to at least develop an awareness and understanding of other groups. Teaching programmers some of the basic concepts of analytic model development and introducing analytic staff to the test and deployment process used by IT can help increase understanding. Training where all the groups involved attend the same class can also help build a cross-functional team environment.
- > Start in areas where the groups currently have established working relationships.
- > Bring analytic and business staff into discussions of technical details at least at the level of trade-off analyses to increase buy-in.

Garbage-In, Garbage-Out

Garbage In, Garbage Out is a common enough phrase in systems development. Because EDM relies on data both for analytics and for repeatable decision making, it is particularly vulnerable to bad data. If the data being analyzed for models is inaccurate, or if the data against which rules are being run is inconsistent, then the decisions will be “bad.”

Mitigation for EDM projects:

- > Focus existing data quality and integration projects on the raw transactional data that are so important to data mining and analytic model development. If quality is being applied only to aggregated data suitable for reporting, then this quality effort will be wasted and will need to be repeated for analytic data sources.

- > Always apply multiple analytic techniques and approaches to missing and outlying data when developing models. This offsets the risk that problems in the data will be exaggerated by any one technique.

Analytic Skills

Many organizations lack the deep analytic skills that are required for advanced EDM solutions. Most are limited to using reports and dashboards to visualize and lightly analyze data. The analytic skills required to develop predictive models are significantly more advanced.

Mitigation for EDM projects:

- > Find resources in your organization to help you get started. They may be in the marketing department or logistics, rather than an analytic group, but they can get you moving.
- > Start developing relationships with specialized outsourced providers of analytic services. Realistically this may be the only way to rapidly add capacity to analytic skills.
- > In the longer term, consider establishing a relationship with suitable college programs that may become a source of analytic skills.

System Integration Complexity

Most organizations adopting EDM will be using multiple products together to develop solutions. They will be integrating Decision Services into multiple systems, often on different platforms, and bring together tools that might only have been used independently in the past. This creates new kinds of integration complexity that should not be underestimated and must be managed. In particular, integration between web or applications development teams and data warehouse/analytic teams may not have been required in the past.

Mitigation for EDM projects:

- > Use modern products such as Enterprise Service Buses and advanced Extract Transform Load or data integration engines. An EDM project is a good prompt to adopt a more modern and powerful middleware solution if you have not already done so.

Shortage of Experienced Practitioners

EDM is a relatively new approach outside of a few well-established areas such as financial services/retail credit. As such, it may be difficult for an organization to find enough experienced EDM practitioners to staff a project. All organizations then, will have a need to find experienced people, take maximum advantage of them (as there are not likely to be as many as one would like), and develop internal expertise in necessary skills.

Mitigation for EDM projects:

- > Once again, establishing relationships with system integrators or outsourced providers of services will be critical.
- > Identify the resources you have in house. While you may not have any EDM practitioners, many of the skills you need will exist in your organization and can be pulled together to get EDM started.
- > Invest in a longer term training and development program.

Velocity of Business Change

It is often the case that EDM is focused on areas of the business with the highest rate of change in the organization. Although EDM is an approach designed for these circumstances, this does not alter the fact that areas of the business that undergo rapid and regular change are inherently more difficult to support and manage than others.

Mitigation for EDM projects:

- > Choose projects with a reasonable rate of change to show the value of the approach. Systems built using an EDM approach are more agile and easier to alter in response to business change. Too much change, however, may overwhelm the approach, especially if the team lacks familiarity with it.
- > Prioritize the use of a BRMS when you have a high rate of change as they allow for the rapid creation, modification, and management of business logic. Predictive analytic tools are not specifically designed for high-change environments, and more programming and testing will be needed if the rate of change is high.

An EDM Adoption Scorecard

EDM can be more effectively applied to some decisions than to others. While it is hard to develop a set of absolute guidelines that allows a specific decision to be assessed in terms of yes or no, it is possible to determine the relative suitability of decisions. For instance, the volume of decision making makes a process much more attractive for EDM.

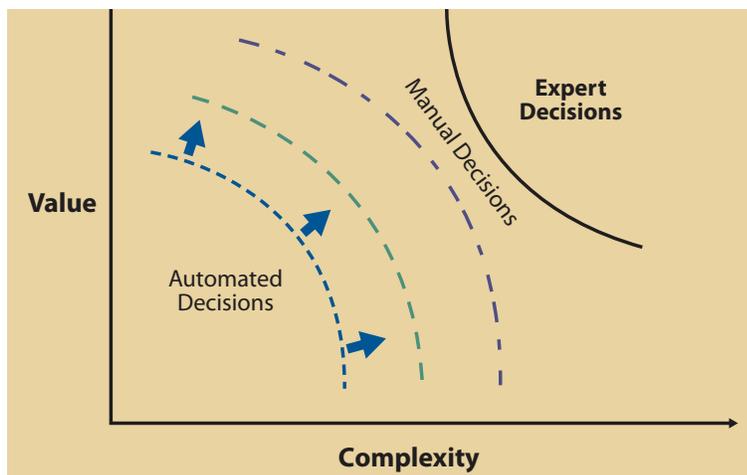


Figure 3. Where EDM can and should be applied¹.

Many organizations find the choice of a first EDM project straightforward – it is obvious where to start. In fact, EDM projects are often driven by specific business problems like the introduction of new regulations or the need to urgently replace a legacy system. That said, when trying to choose between alternative EDM projects, or when reviewing a set of operational decisions to see where EDM makes sense, it can be helpful to have a more systematic approach.

On a basic level, EDM works best with decisions of lower value and lower complexity. As shown in Figure 3, improving technology is increasing the range of value and complexity that can be automated, squeezing the usefulness of manual, but non-expert decisions. When these lower value, lower complexity decisions must be made repetitively in high volumes, or when speed is critical, EDM is ideal. Higher value, higher complexity decisions, such as acquiring a company or designing a new product, require human expertise.

Figure 4 is a scorecard with a series of characteristics, a number of alternative assessments for each, and a score. To use the scorecard, assess each characteristic for a given operational decision, and determine the score. Calculate the cumulative score for a decision to see how appropriate EDM would be for that decision.

To see how this might work, consider a claims payment decision in an insurance company. First consider the standard features of a claims decision at a typical multi-state or multi-country insurance company. Decisions about claims are made frequently and are moderately complex. Claims decisions are repeatable but do have periodic changes to how they should be made. Claims adjustors are reasonably senior and extensively trained, but they don't own the decision-making guidelines. Most claims decisions are impacted by policies from multiple sources

1. Figure 11.3 "The increasing power of technology makes replacing manual decisions with automated ones possible and effective." (Taylor & Raden, 2007)

Technology for Operational Decision Making

Characteristic	Assessment	Score	Notes
Decision-making frequency	Weekly or Daily	0	More frequent decisions make EDM more valuable.
	Several times a day or more	+5	
	Hourly or better	+10	
Decision-making complexity	Straightforward	+10	Complex ones may require human decision makers.
	Moderately Complex	+5	
	Extremely Complex	-5	
Decision-making repeatability	Ad hoc	-10	More repeatable decisions are more usefully automated.
	Repeatable but variable	+5	
	Mechanically repeatable	+10	
Rate of change in decision	Rare	-10	Decisions are more agile when EDM is used, and rapid change will increase the value of this.
	Periodic	+5	
	Regular and rapid	+10	
Seniority of staff making decision	Very Senior	-10	Senior staff decisions are often strategic rather than repetitive operational decisions.
	Intermediate	0	
	Very Junior	+10	
Need for unattended operation	None	0	If unattended operation is valuable, then automation will be likewise.
	Some	+5	
	Essential	+10	
Role of risk analysis in decision	None	0	A need for risk assessment in a decision shows a clear need for analytics.
	Limited	+5	
	Extensive	+10	
Compliance issues in decision	None	0	EDM improves compliance and helps demonstrate it.
	Internal Only	+5	
	Internal and External	+10	
Ownership of decision-making guidelines	Outside the organization	+10	If decision-making guidelines are imposed on decision makers, then automation will add value.
	Senior to decision makers	+10	
	With decision makers	0	
Number of policies, regulations, or guidelines	1	0	More sources of rules and regulations make it harder for manual decisions to work.
	<5	+5	
	>5	+10	
Involvement of third parties or outsourced groups in operational decision making	None	0	Automation improves control over third parties.
	Some	+5	
	Extensive	+10	
Existing process automation	Complete	+5	Processes that are already automated lend themselves better to decision automation.
	Partial	0	
	Non-existent	-5	
Existing BI/DW	Enterprise-wide, detailed	+10	Strong existing data infrastructure makes analytics easier.
	Variable	5	
	Non-existent	-10	
Number of users impacted	1-10	-10	
	11-99	5	
	1,00+	10	
Data is available electronically	Yes	+5	If data is not available electronically, then automation will be expensive.
	No	-20	

Figure 4. EDM adoption scorecard.

(company, federal, state) causing compliance rules to change. It is often the case, that the adjustor cannot remember, understand, or apply the hundreds of new regulations consistently, which illustrates the reason an EDM solution would be deployed.

Scoring items in this claims payment example, we find the following:

Decision-making frequency	Hourly or better	+10
Decision-making complexity	Moderately Complex	+10
Decision-making repeatability	Mechanically repeatable	+10
Rate of change in decision	Periodic	+5
Seniority of staff making decision	Intermediate	0
Role of risk analysis in decision	Extensive	+10
Compliance issues in decision	Internal and External	+10
Ownership of decision-making guidelines	Outside the organization	+10
Number of sources of policies...	>5	+10

... for a total score of +75. This score would be further affected by the need for unattended operation (allowing self-service claims approval, for instance), the degree to which the claims processing was outsourced and/or automated, and the existing data infrastructure. But regardless of the scores resulting from these items, it is pretty clear that insurance claims are a good candidate for EDM.

In contrast, we could consider a decision such as whether or not the company should do business in a particular state. This is an infrequent decision with complex, ad-hoc decisions being made by very senior staff. Lots of risk analysis is involved, but policies and compliance are only an issue internally. There is no process automation, and the decision makers own

Inbound Marketing at North American Telco

Customers hate telemarketing calls – especially at dinner time. So smart marketers now focus more on inbound marketing, taking steps to be ready to react when customers call into the contact center. Recent research by Teradata concluded that inbound acceptance rates are up to three times as high as outbound. To support this, a real-time analytic infrastructure builds a unique profile dynamically each time a customer comes into a channel. It retrieves information from the data warehouse and uses real-time information that is dynamically gathered during the interaction. This dynamic profile is then run through a set of business rules to determine the individual's eligibility for campaigns or offers. Once eligibility is determined, the analytic infrastructure runs real-time analytics to determine the likelihood estimate for this individual to respond to any of the offers for which he or she qualifies. Once likelihood estimates are calculated, they are applied to a set of arbitration rules to determine the most relevant, prioritized offer to deliver to that customer. The same strategic insights that guide what to say on the call center channel can be reused on other channels, such as the in-store or in-branch computer screen or on the web site.

the policies. Since it's a strategic decision, not an operational one, normally this is not a candidate for EDM. Running through the scores, this decision ends up with a total score below 0, demonstrating its lack of suitability. Many decisions are not so clearly strategic or operational. This is where the scorecard helps sort out the relevance of applying EDM.

While we are not suggesting that there is some “magic” score, the scorecard can give you a sense of the relative value of applying EDM to a particular decision.

Reference Architecture

The reference architecture for EDM covers both design time (how are operational decisions designed and put into production?) and deployment time (how are they executed in the context of a typical IT architecture?).

At design time, a series of conceptual components must update a central “decision repository” containing the definitions of how decisions should be made – the rules and models. This might be a physical repository or a logical one implemented by several linked repositories each supporting a different aspect of development. Decisions are identified and modeled in the repository, where they are linked to KPIs, business processes, and other aspects of the business. Rule modeling, based on policies and regulations, and analytic modeling using historical data, create the rules and models needed for a decision. These decisions can be verified, validated, and simulated using historical data. Decision designs that are useful and complete can then be deployed.

Once these decisions are deployed, they must operate in an IT environment that is typically complex. They must be able to support event-driven architectures and Enterprise Service Buses, and provide decision making for processes defined in Business Process Management Systems if those components are in use. Integration with legacy applications to ensure that decisions are made consistently even in legacy environments and with other Enterprise Applications is also required. This puts decisions, and the Decision Services that implement them, at the heart of the IT architecture.

When considering technology for operational decision making, it is useful to have a reference architecture or framework. Such a reference architecture can be considered structurally or procedurally. It is also useful to consider the reference architecture separately for decision design and decision deployment.

Design Architecture

The design time elements of the reference architecture cover everything up to and including the deployment of the decision. They do not consider the mechanics of deployment or the ongoing maintenance of deployed decisions. Decision design involves the creation and updating of artifacts in a decision repository.

- > Rules in decisions are based on regulations, policies, organizational objectives, and expert knowledge, and sometimes extracted from legacy software code.
- > Analytic models and insight are derived from operational data, especially historical operational data.
- > Decisions are verified and validated to ensure they are complete and correct.
- > Decisions are simulated to see how they will affect the business.
- > Decisions are deployed from the decision repository into production environments as Decision Services.

Different products package up these capabilities in different ways, but these capabilities are all required to deliver effective operational decision automation.

As an automated decision is designed, requirements such as throughput, data available at the point of decision making, regulations to be enforced, and more should all be considered. Service level goals and business objectives are used to make design trade-offs

Technology for Operational Decision Making

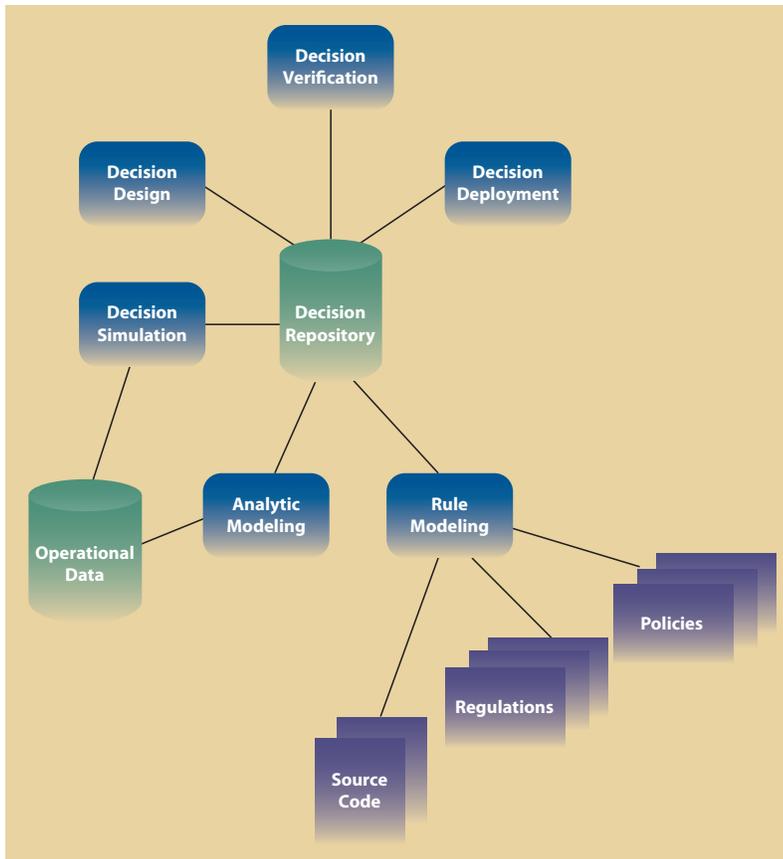


Figure 5. Decision Design Reference Structure.

and technology choices. Depending on the design of the decision either analytic insight or business rules or both will be required to successfully implement the decision.

In order to add analytic insight, data must first be understood. What is the available data telling us? What insights might we gain from the data? Is all the data needed available, accurate, and reliable? Once the data is understood, it can be mined either for business rules or as the basis for building analytic models.

Rules mined from data, along with rules modeled explicitly or mined from legacy code, are integrated into a decision to define the logic needed to make the decision. Combined with any analytic models, this represents the candidate decision.

Most automated decisions, if not all, need to be verified and validated to ensure all circumstances are considered and, for instance, to ensure that nothing contradictory is being proposed. They should also be simulated to ensure the outcome is what is expected and desired. Simulation and verification, along with modification, will likely take multiple iterations to get the optimum decision function design.

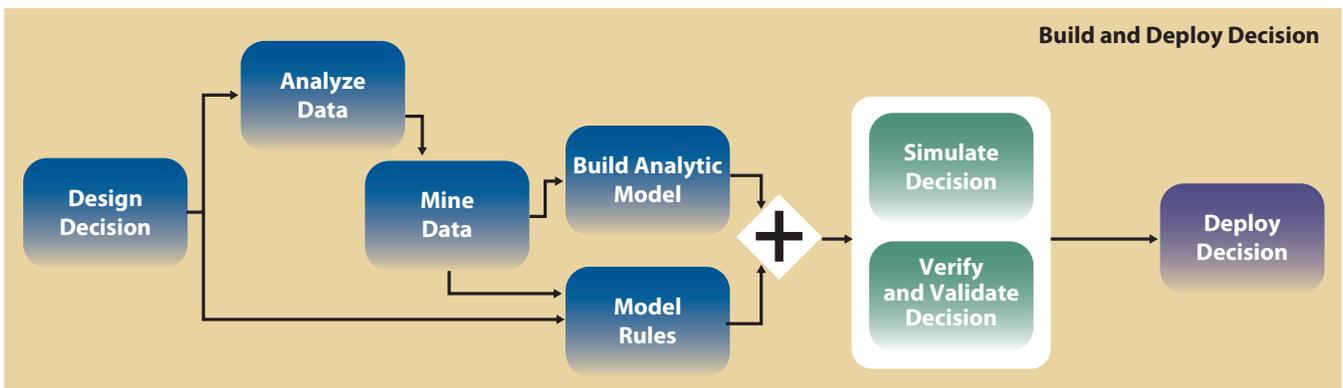


Figure 6. Decision Design Process.

Deployment Architecture

To be effective, managed decisions must be integrated into the processes and systems that run operations. This requires a software infrastructure that allows Decision Services to be widely available within the operational environment and accessible through a variety of mechanisms. Individual Decision Services might be used in one or more processes, enterprise applications, or event correlation services. An Enterprise Service Bus might use Decision Services to handle events, and Decision Services might put new events onto the Bus. The applications and processes using the Decision Services should support a variety of channels and user types, and the Decision Services will thus support cross-channel, consistent decision making. It is this cross organization, cross-channel consistency that is best achieved using a Service Oriented Architecture (i.e., web services designs).

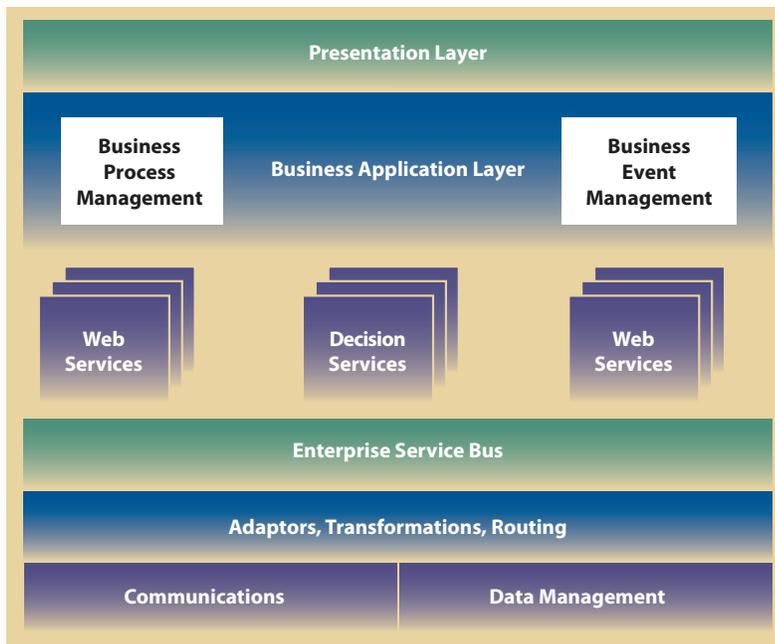


Figure 7. Decision Services at the heart of an architecture.

Analytic Marketing at Canadian Bank

One of Canada's largest banks, and one of North America's leading diversified financial services companies, wanted to increase its dominance in the Canadian consumer banking market. The bank had a history of success with its CRM approach and knew it could achieve continued growth by evolving CRM capabilities to include retail banking, additional geography, and additional lines of business. The bank implemented a decision management platform to handle relationship pricing, concession guidelines, event-based retention offers, and segment-focused value proposition and marketing, as well as to support a relationship-based financial planning initiative for the mass affluent.

The bank saw a 20 percent increase in high value clients, doubled their service package penetration in four years (35 to 70 percent), achieved a 45 percent success rate in "event trigger" leads and increased profit in the mass affluent sector by 26 percent.

Modifying Existing Decision Services

Once deployed, Decision Services will need to be modified. First, the effectiveness of existing decisions needs to be assessed. This typically involves using Corporate Performance Management or Business Intelligence tools to analyze business results log files and map those results to KPIs. If the effectiveness of a decision is satisfactory, then little if any change will be required, unless some external regulatory change requires that the rules involved in a decision need to be updated or managed. If the effectiveness is not satisfactory, then new approaches will need to be devised and tested, new rules written, and new analytic models developed. A sufficiently significant update justifies a complete build and deploy process as described above.

Conclusion

Enterprise Decision Management (EDM) involves an unrelenting focus on the decisions that create value in a business, especially the operational decisions that drive front-line processes and systems. These operational decisions have become more complex as the array of channels has grown, and the volume of transactions and demands of customers has increased. Recognizing these decisions as reusable assets drives consistency and compliance into the systems and processes that interact with customers. These same decision points allow the vast and growing array of a company's data sources to be put to work in making better, more precise decisions.

EDM is an approach, a management discipline, but it relies on the effective deployment of technology. EDM enables the creation and management of Decision Services used widely across an organization – across channels, processes, and systems. These Decision Services improve the thousands of front-line operational decisions made every day by call-center staff, websites, ATMs, tellers, and other people and systems that interact directly with customers. Automating these decisions increases revenues, delivers cost efficiencies, and improves brand image by systematically improving these interactions.

Decision Services are created by extracting and consolidating decision-making functions out of monolithic applications consistent with current SOA design principles. Building on the basics of a data infrastructure – data warehouse, operational data, unstructured data – EDM uses Business Rules Management Systems to manage these decisions and adds data mining and predictive analytics to improve them. Because the definition of a good decision changes constantly, EDM includes a feedback adaptive control loop to discover the best ways to improve each decision.

Like all initiatives, investments must be made, and there are risks and issues with adopting EDM and applying technology to the automation and improvement of operational decisions. All of these can be mitigated and the ROI of successful EDM projects is high, often *very* high.

EDM has much to offer companies with high-volume, operational decisions that matter to their business. Companies focused on improving their operations, on competing with analytics, on improving compliance, or on strategic agility would do well to adopt it as an approach. While it can seem daunting when you consider all the possible decisions that could be impacted, EDM can and should be adopted incrementally.

Organizations adopting EDM will become increasingly decision-centric, focusing explicitly on the *effectiveness* of its decisions rather than aggregated historical metrics. The recognition of *decision making* as a competency and the allocation of resources to elevate, understand, and continuously improve its decisions make a decision-centric company a true analytic competitor.

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James Taylor, CEO of Decision Management Solutions, is an expert in EDM. Previously, James was a Vice President at Fair Isaac Corporation where he developed and refined the concept of enterprise decision management or EDM. Widely credited with the invention of the term and the best known proponent of the approach, James is a passionate advocate of decision management. He has 20 years of experience in all aspects of the design, development, marketing and use of advanced technology, including CASE tools, project planning and methodology tools, as well as platform development in PeopleSoft's R&D team, and consulting with Ernst and Young. He has consistently worked to develop approaches, tools, and platforms that others can use to build more effective information systems.

James is an active consultant, speaker, and author. He is a prolific blogger, and his articles appear in industry magazines and on popular websites. He has contributed chapters to "The Decision Model" (forthcoming), "The Business Rules Revolution: Doing Business The Right Way," and "Business Intelligence Implementation: Issues and Perspectives"; and is co-author of "Smart (Enough) Systems: How to Deliver Competitive Advantage by Automating Hidden Decisions" (Prentice Hall, 2007) with Neil Raden.
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Neil Raden is an "industry influencer" – someone who is followed by technology providers, consultants, and even other analysts. His deep knowledge of the analytical aspects in information technology is the result of 30 years of intensive work. Neil is the founder of Hired Brains, a research and advisory firm in Santa Barbara, CA, offering research and analysis services to technology providers and venture capitalists, as well as providing consulting and implementation services in Business Intelligence and Analytics to many Global 2000 companies.

Neil began his career as a casualty actuary with AIG in New York before moving into software engineering, consulting, and industry analysis, with experience in the application of modeling and analytics in fields as diverse as health care and nuclear waste management to cosmetics marketing and many others in between. He is an active consultant, industry analyst, speaker, and author. His blog, "Competing on Decisions," can be found at intelligententerprise.com, and his articles appear in industry magazines. He is the author of dozens of sponsored white papers for vendors and other organizations, and he has contributed to numerous books and is the co-author of "Smart (Enough) Systems: How to Deliver Competitive Advantage by Automating Hidden Decisions" (Prentice Hall, 2007) with James Taylor.
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Glossary of Terms

Adaptive Control	Modifying a decision service to adapt to changing conditions so that it remains as close to optimal as possible.
Business Rule	A statement of the action an organization should take when a set of business conditions is true.
Business Rule Management System	A complete software product for the creation, management, and deployment of business rules.
Champion/Challenger	The development of multiple challenger approaches that can be tried in production and compared to the current champion to see if one of the alternative approaches will perform better.
Data Mining	The use of mathematical analysis techniques to extract rules or conclusions from historical data.
Decision Service	A service designed to answer business questions for other services.
KPI	Key Performance Indicators are financial and non-financial measures or metrics used to help an organization define and evaluate how successful it is, typically in terms of making progress towards specific objectives.
Optimization	A mathematical programming technique that finds the maximum or minimum value of a function given various constraints.
Predictive Analytic Model	An executable function or formula that uses patterns in historical data to make useful predictions about future events.

Appendix – Product Information from Sponsors

The sponsors of this research provide a range of products suitable for use in the adoption and implementation of EDM. This appendix contains information provided directly by them.



Teradata

Teradata Corporation, the global leader in data warehousing and analytic technologies, provides solutions that help make smart companies smarter. Teradata gives companies the people, technology, innovation, and a world-class network of customers and partners enabling them to gain competitive advantage to master their markets. Learn more at Teradata.com.

Active Enterprise Data Warehouse

The Active Enterprise Data Warehouse platform combines strategic analysis and operational insights to provide a mission-critical active data warehouse that meets the demands of both back-office workers and front-line users. It takes maximum advantage of the Teradata massively parallel processor (MPP) architecture. The Active EDW platform has these key EDM relevant attributes:

- > **High-performance hardware** – Exploits industry-leading Multi-Core Intel® Processor technology in high-performance processing nodes with optimized and flexible configurations of enterprise-class disk drives
- > **Teradata Database** – The Teradata Database has been the leading RDBMS as defined by the Gartner Data Warehouse Magic Quadrant and ASEM analysis since they first appeared. Included in the Teradata Database is in-database data mining for quick delivery of predictive analytics prescribed by the EDM vision. Teradata Database has also been integrated with numerous operational systems via Service Oriented Architectures, Web services, portals, and web sites, using both JEE and .NET technologies.
- > **Scalability** – Linearly increases capacity and performance from a one-node to a 1024-node system and from 2TB of disk to more than 10 petabytes.
- > **Availability** – Reduces or eliminates the impact of hardware failures with redundant, hot-swappable components. During a node failure, the system's clique architecture enables full performance continuity.
- > **Mixed Workload Management** – This component of the Teradata Database allows multiple workloads of different style to run concurrently without adverse effects. This industry-leading capability allows EDM online workloads to be given a higher priority than batch, query and reporting, data mining, and other typical data warehouse tasks. Consequently, Teradata Database is the only proven solution that can support the run-time automated tasks prescribed by EDM using the same data prescribed for EDM design time.

Teradata Data Warehouse Appliance

Teradata Data Warehouse Appliance is a simple, powerful, low cost solution for EDM analytic workloads. Delivered ready to run, the Teradata Data Warehouse Appliance is a fully-integrated system that's purpose-built for data warehousing. It's built on the industry-leading Teradata Database, multi-core Intel data warehouse servers, SUSE® Linux operating system, and enterprise-class storage all pre-installed into a power-efficient unit.



CGI

For over 30 years, CGI has provided IT and business process services to financial institutions around the world, including 24 of the top 25 banks in the Americas and 17 of the top 25 European banks. CGI banking-focused solutions include core banking, end-to-end wealth management, trade finance, business intelligence/data warehousing, and customer relationship management. CGI and its affiliated companies employ approximately 25,500 professionals, with offices in Canada, the United States, Europe, and Asia Pacific.

Strata® Enterprise

Strata® Enterprise is a patented decision management solution with which organizations can make profitable and efficient decisions throughout the customer life cycle and across the enterprise. Organizations count on Strata to improve performance in every area of their businesses, including marketing and customer acquisition, originations, servicing and customer management, retention and churn, and collections and recoveries. Strata advantages include:

- > **Smarter decisions** – Strata monitors and evaluates customer data from multiple sources, and then modifies strategies relevant to each customer's distinct preferences and performance.
- > **More consistent decisions** – Strata enables consistent application of business policy across all channels and business operations. Use of targeted recommendations minimizes human judgment inconsistencies.
- > **Clearer results** – Strata provides feedback on the effectiveness of business rules. A clear picture of the bottom-line impact of policy changes improves decisions.
- > **Improved flexibility** – Business users have the flexibility to modify business rules without engaging additional IT resources.



Chordiant

Chordiant helps leading global brands with high-volume customer service needs deliver the best possible customer experience. Unlike traditional business applications, Chordiant Customer Experience (Cx) front-office solutions blend multi-channel interaction management with predictive desktop decisioning, enabling companies to capture and effectively anticipate and respond to customer behavior in all channels, in real time. For global leaders in insurance/health care, telecommunications, and financial services, this deeper understanding cultivates a lasting, one-to-one relationship that aligns the most appropriate value proposition to each consumer. With Chordiant Cx solutions, customer loyalty, operational productivity, and profitability reach new levels of return. For more information, visit Chordiant at www.chordiant.com.

Chordiant Decision Management

Chordiant Decision Management comprises a suite of predictive decisioning applications that form the core of Chordiant's vertical Cx solutions for the insurance/health care, telecommunications, and financial services industries. With Chordiant decisioning, companies become more responsive to customer needs and more agile in the face of market pressures by delivering consistent, Next-Best-Action-driven interactions across all channels. Business line managers and marketing managers can create customer interaction and marketing strategies that help build customer loyalty while increasing efficiency and profitability.



Zementis

Global organizations increasingly recognize the value that predictive analytics offers to many of their solutions and products turning data into operational decisions for a more certain future.

The Zementis commitment to open standards drives the adoption of ADAPA® as the preferred deployment vehicle for predictive models developed by either an in-house analytics team or in collaboration with the experienced team of decision technology scientists at Zementis.

For more information, please visit www.zementis.com.

ADAPA® Enterprise Edition

The ADAPA® (Adaptive Decision And Predictive Analytics) Enterprise Edition is a decision engine framework that combines advanced predictive analytics, rules execution, open standards, and superior deployment capabilities to offer intelligent solutions that meet your enterprise challenges.

ADAPA® empowers people and businesses to develop, deploy, and maintain sophisticated decision support systems in a straightforward way. ADAPA® enables enterprises to leverage the power of predictive analytics in real time. Automated smarter results can be turned into actions that meet business goals and regulatory rules to unlock the potential for more revenue, lower risk, and higher profit-margins.

ADAPA® consumes model files conforming to the PMML. This vendor-independent standard is supported by most statistical analysis tools, commercial or open source, and supports an extensive collection of statistical and data mining algorithms, and predictive techniques.

ADAPA® Predictive Analytics Edition

The ADAPA® Predictive Analytics Edition is a fully hosted SaaS solution on the Amazon Elastic Computing Cloud (EC2). It requires zero client install and provides a pay-as-you-go option, eliminating need for the upfront investments in hardware or software licenses.

ADAPA® combines the benefits of open standards, cloud computing and SaaS to deliver an extremely scalable, highly agile Enterprise Decision Management solution at significantly lower total cost of ownership (TCO). Subscribe on Amazon, launch your private, secure ADAPA® instance, deploy, and use your predictive decision models in minutes. That's how easy it is!

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