The “Business Rules Approach,” which has held sway for over a decade, is being replaced by a new paradigm: decision modeling.

Decision modeling will transform the way companies use decision management products. It will provide a business-friendly, primarily graphical environment for configuration and maintenance, and a seamless linkage between rules, analytics and optimization.

Decision modeling will also transform the way solutions are delivered. A model-driven approach improves support and automation of many aspects of the delivery process, improving quality, increasing reuse of components and dramatically reducing costs.

FICO has been closely involved with the evolution of the Object Management Group’s (OMG) new Decision Modeling and Notation standard (DMN), and is one of the torch-bearers for this approach. This paper provides a basic introduction to the concepts and benefits of decision modeling.
In the 1980s and 1990s, decision-making systems were called “Expert Systems” and Intelligent Knowledge-Based Systems (IKBS). They were mostly implemented with logic programming languages — either directly or using shells — and as a result, applications were largely goal-oriented, or “backward chaining.” Decision structure in such systems was modeled as a hierarchy of goals.

After 2000, the “Business Rules Revolution” turned this approach on its head, with important publications by Barbara von Halle\(^1\), the Business Rules Group\(^2\) and Ron Ross\(^3\). The basic premise was that “Rules are a first-class citizen of the requirements world”: decision-making should be defined primarily using rules. This approach undoubtedly held some advantages: rules were declarative, modular and independent, and allowed the development of “forward-chaining” engines such as FICO® Blaze Advisor\(^4\) decision rules management system. But rules-based decision making also introduced two problems: (a) rules on their own lack structure, which had to be provided by procedural elements such as rule flows, and (b) since “rule discovery” was seen as an open-ended activity, it was difficult to define project scope, and overruns were common.

At that time, FICO, like many other companies, adopted the business rule approach for decision automation projects. FICO used intensive rule discovery workshops to lead the requirements gathering process, and saw the grouping of rules into rule sets as a subsequent design activity. This was essentially a bottom-up approach.

However, over the last few years the decision management has restored high-level structure by focusing on the decisions, rather than the rules. FICO has pioneered a top-down approach called Decision Requirements Analysis (DRA), which decomposes decisions into a network of sub-decisions and supporting areas of business knowledge and data, represented as a Decision Requirements Diagram (DRD). In this decision modeling mindset, rules are just one form of business knowledge, alongside analytic models and calculations, and are seen to have meaning only in the context of specifying the logic for particular decisions in the DRD.

This approach has been applied very successfully by FICO, and has become our standard methodology for defining decision requirements for automation projects. The associated structured workshop technique DRAW has become popular with our customers as a project scoping and requirements analysis tool. A recent book by Dr. Alan Fish of FICO’s Technology Consulting Group provides a comprehensive guide to the techniques and benefits of this approach\(^4\).
In 2014, the Object Management Group (OMG) published a new standard — Decision Model and Notation (DMN) — intending that decision models would "define how businesses make decisions, usually as a part of a business process model... DMN will potentially galvanize the business analyst community into modeling decisions with vigor and to the subsequent benefit of their processes." The development team comprised key R&D staff members from a variety of leading business and academic institutions, including Decision Management Solutions, Escape Velocity, FICO, IBM, Oracle, Knowledge Partners International, Model Systems, TIBCO and the University of Leuven.

FICO® DMN Modeler, released for early access in the first half of 2015 and for general access in the second half of the year, allows users to create and interchange decision models in DMN 1.0.

Business processes may be modeled as sequences of discrete repeatable activities, using OMG's Business Process Model and Notation (BPMN). Within a business process model, decision-making is one type of activity, represented as a distinct task in the flow. BPMN 2.0 provides a special "business rules task" to represent automated decision-making. Typically, this involves the invocation of a decision service by the BRMS. "User tasks" may be used to represent human decision-making.

In this simple example to the left (throughout this paper the examples are taken from the DMN specification), the Collect Application Data activity is followed by a Decide Routing activity. A gateway then routes the case according to the result of the decision: cases with an ACCEPT routing are taken to the Offer Product activity; those with a DECLINE routing are taken to Decline Customer.

Process models like these can specify when decision-making occurs in the business process, and what agent (human or system component) is responsible for the decisions. They do not describe how the decision-making is carried out. For this you need a decision model: this is the purpose of DMN.
Decision Requirements Level

DMN adopts the DRD as the graphical notation for the “decision requirements level” of decision modeling.

The DRD allows a domain of decision-making to be modeled at a high level of abstraction, using only four types of elements corresponding to commonly used business concepts: decision, input data, business knowledge model and knowledge source.

- **A decision element** (shown in pink) corresponds to the business concept of an operational decision. It is the act of determining an output value from a number of input values, using some decision logic. The inputs to a decision may be input data elements or the outputs of other decisions. The decision logic may include the invocation of one or more business knowledge models.

- **An input data element** (shown in light blue) corresponds to the business concept of data. It is a data structure whose component values describe the case about which decisions are to be made. Input data elements typically model high-level concepts of business significance, e.g., “Application form”, “Claims history” or “Invoices.”

- **A business knowledge model** (with clipped corners) corresponds to business concepts such as “expertise,” “know-how” or “policy.” It is a function that encapsulates an area of business knowledge as executable decision logic, possibly expressed as business rules, an analytic model, or an algorithm. The business knowledge model is parameterized, and is therefore a reusable component that may be called from multiple decisions, or from other business knowledge models.

- **A knowledge source** (with a wavy edge) defines an authority for decisions or business knowledge models — for example, a manager responsible for a decision, a policy manual, or a piece of legislation with which a set of rules must comply.

In this simple example, the **Routing** decision is seen to depend on **Application** input data and two sub-decisions: **Eligibility** and **Application Risk**. The **Eligibility** decision applies a set of **Eligibility Rules** (defined by the **Product Manager**) to the **Application** data. The **Application Risk** decision applies an **Application Risk Score Model**.
(created using analytic modeling) to the Application data, to calculate a score which is then banded using the Application Risk Category Table. This DRD shows the high-level structure of a domain of decision-making, revealing the relationships between a number of decisions, areas of business knowledge, areas of data and the responsible authorities.

**Decision Logic Level**

The decision logic level of DMN provides an expression language for specifying decision logic (FEEL: Friendly Enough Expression Language), and a corresponding notation that allows boxed expressions to be associated with elements in the decision requirements level.

Boxed expressions allow the decision logic to be decomposed into small pieces that can be notated in a standard way and associated with elements at the decision requirements level. A DRD plus its boxed expressions form a mostly graphical language that completely specifies a decision model.

This simple "boxed invocation" might be associated with the Eligibility decision in the DRD on the previous page. It determines the value of Eligibility by calling the Eligibility rules business knowledge model, providing three parameters — Employment Status, Country and Age — whose values are derived using FEEL expressions from the Application input data.

One form of boxed expression that is particularly important in DMN is the decision table. This simple example might be associated with the Eligibility Rules business knowledge model in our example DRD. It represents a set of rules for determining Eligibility from Employment Status, Country and Age parameters. DMN defines a set of conventions for decision tables that removes any ambiguity in their interpretation. For example, the "Priority" hit policy in this table, and the ordering of the allowed values in the Eligibility column indicate that if multiple rules match then INELIGIBLE takes priority over ELIGIBLE.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Binding (Type must match Parameter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: number</td>
<td>years and months duration(DateOfBirth, Application.Date).years</td>
</tr>
</tbody>
</table>

**Eligibility rules**

<table>
<thead>
<tr>
<th>Priority</th>
<th>Employment Status</th>
<th>Country</th>
<th>Age</th>
<th>Eligibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DECLINE</td>
<td>-</td>
<td>-</td>
<td>INELIGIBLE, ELIGIBLE</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>not(UK)</td>
<td>-</td>
<td>INELIGIBLE, INELIGIBLE</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>&lt;18</td>
<td>INELIGIBLE, INELIGIBLE</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>ELIGIBLE</td>
</tr>
</tbody>
</table>
Complete, Executable Decision Models

The two levels of DMN — decision requirements and decision logic — together provide a complete decision model. At the decision requirements level, the notation of the DRD is simple enough to make the structure of the model immediately apparent; yet, the decision logic level provides a specification of the decision-making which is precise enough to allow full automatic validation and execution.

By associating a decision model with an activity in a business process model, it becomes an executable specification for the decision-making to be carried out in that activity. If the decision model is encapsulated in a decision service (e.g., using FICO® Blaze Advisor® or FICO® Decision Modeler), the orchestrator (e.g., FICO® Application Studio) can execute the decision-making automatically at the correct point in the process.
A New Structural Principle

The decision modeling paradigm facilitated by DMN embeds a number of important structural principles in enterprise decision management:

- **Decision models contextualize decision-making.** Business decision-making is defined in the context of business processes and activities; business rules are given meaning by the decisions that use them. The DRD forms a bridge between a business process model and business rules.

- **Decision models reveal the structure of decision-making.** The DRD shows how decisions depend on each other, on business knowledge (of all types), on case data and on authorities.

- **Decision models provide a framework for knowledge management.** DMN identifies components of business knowledge, and allows them to be modeled precisely in their most natural form: business rules, analytic models or algorithms. Business knowledge models in the DRD reveal points of adaptivity and opportunities for optimization, and encourage re-use of automated components.

- **Decision models allow decision-making to be partitioned.** Boundaries may be drawn on the DRD, providing a clear visual indication of components of the decision-making — for example, for distinguishing between human and automated decisions, showing the scope of decision services, or partitioning work for project planning.
Conclusion

Decision models redefine our view of the enterprise. In BPMN 2.0, business process models became executable. This fostered widespread adoption of business process modeling, to the extent that business processes are now seen as intrinsic to an organization. DMN 1.0 will do the same for decision modeling: organizations will be defined by their decision-making structures, expressed in decision models.

Adapting to DMN and reliance on decision modeling isn’t simply a matter of remaining current with the latest in decision management technology. Rather, decision modeling presents organizations with a clear value proposition, one that significantly impacts the potential for profitability, regulatory compliance and competitive advantage. By enforcing standardization of decision processes — in decision requirements and logic — organizations will lower costs, expedite time to market, simplify training and realize widespread operational improvements. Decision modeling brings a new level of transparency to decision-making that changes the paradigm of decision management.

References:
5. Decision Model and Notation (DMN) Version 1.0, OMG (2014)