

Custom DU® – A Web Based Business User Driven Automated Underwriting System

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Abstract

Custom DU® is an automated underwriting system that enables mortgage lenders to build their own business rules that facilitate assessing borrower eligibility for different mortgage products. Developed by Fannie Mae, Custom DU® has been used since 2004 by several lenders to automate the underwriting of numerous mortgage products. Custom DU® uses rule specification language techniques and a web-based, user-friendly interface for implementing business rules that represent business policy. Via the user interface, lenders can also customize their underwriting findings reports, test the rules that they have defined and publish changes to business rules on a real-time basis, all without any software modifications. The user interface enforces structure and consistency, enabling business users to focus on their underwriting guidelines when converting their business policy to rules. Once a lender has created their rules, loans are routed to the appropriate rulesets and customized, but consistent results are always returned to the lender. Using Custom DU®, lenders can create different rulesets for their products and assign them to different channels of the business, allowing for centralized control of underwriting policies and procedures – even if lenders have decentralized operations.

Introduction

The mortgage industry is very dynamic with frequent volume fluctuations, shifting investor requirements, and evolving regulatory and compliance standards, not to mention ever-changing customer demands. In the mid 1990s, Fannie Mae introduced Desktop Underwriter (DU®), an Automated Underwriting System (AUS) that significantly improved the underwriting process. (McDonald et al., 1996) DU® and other automated underwriting systems have created enormous efficiencies in the mortgage origination process, and most lenders now evaluate conforming mortgage applications using such systems. AUS have expanded the number of loans that

lenders can make by significantly reducing the time and cost of originating a loan and allowing lenders to tailor loan terms based on an individual borrower's risk profile.

The Internet and other technology advances make it a necessity that mortgage operations run efficiently and smoothly. The Internet era is changing the expectations of customers across all financial services including the mortgage industry (Pafenberg 2004). Consumers want personalized services and solutions for their individual financial situation, not off-the-shelf, one-size-fits-all financial products. Mortgage lenders are required to satisfy consumer expectations while still adapting a technology infrastructure that has been primarily designed to process transactions and to meet the needs of investors. The Internet provides the perfect communications conduit for information, decisions, transactions, and procedures.

Building on the success of AUS systems such as DU®, lenders have started looking at ways to extend the efficiencies of technology to other parts of the mortgage process. Fannie Mae developed Custom DU® as a comprehensive system that allows lenders to create and publish their own customized underwriting rules, investor variances and individual loan product messages. Custom DU® provides lenders with the ability to leverage the power of DU® for their other product lines, gaining operating efficiencies giving them more control of their pipelines. Custom DU® enhances the process by allowing additional rules that lenders can apply to their mortgage production. An example is portfolio products. Custom DU® allows lenders to build proprietary underwriting rules for their portfolio products and minimize manual intervention required to underwrite the loan. This enhanced benefit also applies to different products and different channels as explained in the following sections.□□

Custom DU® also allows lenders to customize transaction output, the underwriting findings report. (See Appendix for a sample underwriting findings report) The findings report includes data supporting the underwriting decision from the system in the form of customized, transaction specific messages and underwriting calculations. The lender can choose to leverage existing DU® messages, or develop proprietary messages and conditions.

Business Problem Description

Fannie Mae purchases residential home loans in the secondary market and either retains them for its own portfolio or pools them together as Mortgage Backed Securities (MBS) for sale to investors with a guarantee of timely payment of principal and interest. More than 2,650 lending institutions - including mortgage companies, thrifts, banks, and credit unions - are approved to do business with Fannie Mae in the secondary mortgage market. Fannie Mae's DU® is used to determine if the loan complies with Fannie Mae underwriting guidelines. Fannie Mae purchases only conforming loans whose loan amounts are below a specified maximum loan limit. In addition to the conforming loans, lenders originate loans that are either too large to be eligible for purchase by Fannie Mae or may not be eligible for sale to Fannie Mae. While lenders are able to take advantage of DU® for some of their mortgage products, they still have to address the following challenges:

- Lenders need to underwrite loans that are not sold to Fannie Mae, including the loans they hold in their own portfolios or sell directly to other investors.
- Many lenders want to serve borrowers whose needs exceed conforming guidelines.

In order to address these issues, lenders had to put in place different business processes for conforming and non conforming loans. It also meant that lenders could not replace some of their manual processes entirely. Custom DU® was developed as a tool to address these problems. Specifically, Custom DU® addresses the following objectives:

Business Objectives

Create a single process for all loans: Lenders prefer to underwrite all of their business with one automated underwriting system that they can manage. It is ideal to have a system that allows them to build their own customized rulesets based on their risk factors and operational challenges. These rulesets are typically managed and maintained by business users. Custom DU® helps to support further their underwriting needs.

It builds on their current investment and automated underwriting process and expands it to provide consistent loan recommendations and loan eligibility screening for all the products they originate. Custom DU® provides seamless integration by leveraging the underwriting transaction, the loan file, and key components of the Desktop Underwriter® recommendation.

Originate more loans that meet investor requirements:

Custom DU® allows lenders to manage eligibility criteria for various investors without manual workarounds. Custom DU® also provides a centralized way to change rules, resulting in consistent communication to all personnel.

Reduce operational costs and increase efficiencies: By streamlining the entire loan origination and closing process, lenders can achieve greater efficiencies and potentially pass savings to customers. Fewer mistakes and less redundant workflows turn into quicker closings and an improved borrower experience. In fact, according to a recent mortgage benchmarking study, lenders that deploy automated underwriting at the point of sale recognize the largest per loan cost savings and achieve the greatest per person loan capacity.

Target specific niche markets or product types: Market changes demand that underwriting systems do the same. It is important that lenders can create products that are channel-specific or location-specific without additional paperwork or manual workarounds. Specifically, they need to be able to develop, automate, and implement complex niche products rapidly and on their own schedule. Custom DU® allows them to create different sets of rules for different products without any programming assistance.

Ensure consistent communications: Automated underwriting provides a consistent approach for every loan. It also allows for centralized control of underwriting policies and procedures – even if lenders have decentralized operations. In addition Custom DU® provides them with a capability to create customized underwriting findings with targeted messaging for pricing, processing, closing, post closing, and vendor management.

Technical Objectives

Based on the above business objectives, the development team identified several overall technical objectives which directed the system architecture and design and the technology chosen for implementation.

The system should have an administrative interface and a transaction interface with the following capabilities.

Administrative Interface

- The system must allow lender Product Managers (or other non-technical users with business expertise) to build and maintain a set of underwriting rules. It is critical that the user interface be easy to learn how to use and easy to remember how to use.
- The system must provide the ability for lenders to create new rules, change existing rules, and make them effective immediately, or at a specified date & time.
- The system must provide a capability for lenders to assign different underwriting rulesets to different products. Appropriate rulesets must be chosen automatically based on the characteristics of the loan and the product under consideration during the transaction phase.
- The system must provide a capability for the administrative users to customize their underwriting findings including their format and headings. Changes to their findings setup must be effective immediately for future underwriting transactions.
- The system must provide a test interface so that users can test rules before rolling them out.

Transaction Interface

- The system must provide a seamless integration for customers that are already integrated with DU®.
- The system must deliver a fast, consistent, high quality underwriting experience to customers by underwriting their custom rules without significantly increasing the underwriting transaction time.
- The system must provide a seamless process for end users. They merely need to submit a loan to underwrite and receive results.

Additional Objectives

- The system must be easily maintainable and system maintenance should not have any impact on the lenders' need to make changes to their underwriting rules at will.
- The system must be architected in a manner that supports complete backward compatibility when new enhancements are made to the system.
- Fannie Mae will handle all storage and processing requirements and customers only need access to a PC and a browser.
- All processing (including writing rules and messages, testing, etc.) must be done 24 x 7 with no downtime for migrations.
- Minimal Fannie Mae technical support must be needed to answer/troubleshoot customer

questions. End users must essentially be self supporting from a technical perspective.

Based on these objectives, the following core components were identified in the design of the system:

- Web based GUI that can be used for
 - editing and testing underwriting rules
 - customizing findings
 - associating rulesets with appropriate products
- Repository to store and retrieve
 - lender defined underwriting rules
 - data defined to associate lender rulesets with their products
- Rule engine that can
 - accept loan data
 - identify the appropriate ruleset
 - dynamically load and execute the underwriting rules and generate customized findings

Based on the successful use of business rules in automated underwriting systems, it was an easy decision early in the

Business Rules at Fannie Mae

Fannie Mae has a long tradition of developing rule based systems and the design of Custom DU® benefited from various ideas successfully implemented in those systems. Fannie Mae developed and deployed KARMA (Knowledge Acquisition and Rule Management Assistant) and Business Rule Server to allow policy changes to be implemented quickly and to provide business users with direct ownership and management of Fannie Mae's policies in a way that seamlessly integrates policy into the software applications (Sobieski et al. 1996). KARMA also introduced several business rule management concepts during the life cycle of business rules. As mentioned earlier, Fannie Mae developed and deployed Desktop Underwriter (McDonald et al. 1997), an automated underwriting system that applies heuristics and statistics to the underwriting problem. DU® continues to be the leader among automated underwriting systems with periodic enhancements since its initial roll out. Building on the successes from KARMA and DU®, Fannie Mae developed a formal business rule specification language (Krovvidy and McClintock, 2000) that could be used by business users to specify their business rules in an unambiguous manner. More recently, Krovvidy and Bhogaraju (2005) discuss the concept of modeling rules as data and how it allows shipping and sharing of data and rules across applications, eventually leading to interoperability of business rules. They also mention a case study on how interoperable business rules can be used in mortgage industry.

design that the underwriting rules in Custom DU® must map to business rules.

Traditionally, business rule applications in B2B (Business to Business) or B2C (Business to Customer) systems are designed such that they can receive data and execute a static set of business rules using the data shipped from the sender. The main advantage of using business rules for these systems is the efficient and consistent application of business rules. It is important to note that all transactions in these applications always execute the same set of business rules. For a system like Custom DU®, however, the business ruleset to be executed can be different for each transaction, as the appropriate ruleset is based not only on the lender initiating the transaction, but also on the product that is being underwritten. In addition, the business ruleset can be modified real-time and the updated ruleset must be effective for subsequent transactions. These requirements suggest that business rules should be treated as data and that each transaction should include not only the case data but also the business ruleset as its input.

Application Description

Customers interact with Custom DU® in two different modes. Figure 1 depicts the administrative path and transaction path in a Custom DU® session. The administrative path is used to create underwriting rules and to customize how and when the rules need to be invoked along with an ability to customize the findings from the underwriting engine. During the transaction path, the case is first underwritten by DU®. If it meets the lender defined criteria to be underwritten by Custom DU®, appropriate lender data (including the relevant ruleset, findings from DU® and case data) are sent to Custom DU®. After Custom DU® completes underwriting using the lender ruleset the findings are returned to the customer.

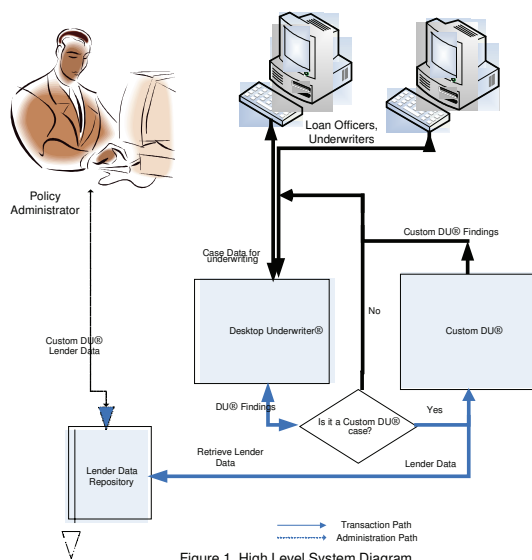


Figure 1. High Level System Diagram

The administrative interface allows them to:

- Create/Update rules and messages
- Test rules and messages
- Create/Update activation rules that determine how rulesets are associated with products
- Customize findings

Figure 2 is a reproduction of a screen shot from the administrative interface of Custom DU®. The left panel provides links to various administrative features of the application. (Due to the constraints on the length of the paper, neither detailed descriptions nor how to create/test rules and messages are included in the paper)

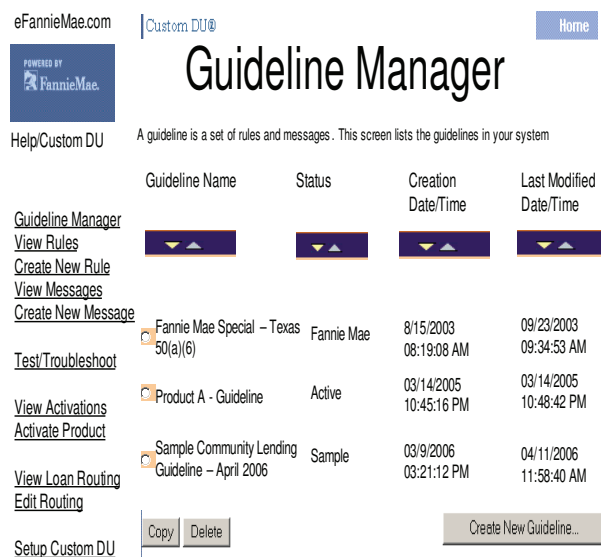


Figure 2. Custom DU® Administrative Interface

The following are some of the important design decisions made during the development of Custom DU® to support the following core principles:

Rules as Data

- An abstract rule language was created and layered over an existing commercially available system. ILOG JRules was selected due to the ability to support dynamic rule loading and XML binding, as well as the dynamic view of rules and data that it incorporates. Custom DU® also uses the open interfaces provided by ILOG JRules product to generate executable code from business rules.
- Sequencing of rules and association of data are predefined.
- Only a small list of predefined actions is provided.
- A custom GUI supports the creation and organization of business rules and related

metadata in an abstract XML format which is persisted to a data repository.

- A code generator is automatically invoked to generate executable business rules when needed for testing or loan transaction processing.

Designed for Business Users

- Custom DU® GUI must enable users to express their mortgage underwriting policy rules as business rules. Users do not need to know about the syntax of the language.
- An abstract data model was created and layered over existing data. Users do not need to know the underlying physical data model.
- The data available for use in the rules is strictly limited to the abstract data model.
- Users are able to customize their own (enumerated list) variables and use them when building rules.
- The system includes numerous pre-defined calculations available for building rules.

Designed for Multiple Lenders

- The system is designed for scalability, and can support several lenders concurrently.
- The rules are stored in a central location, and can be dynamically loaded on demand at run time.

Table 1 shows a high level view of how lenders can create different rulesets for their products and assign them to different channels of the business. These channels can be based on region and/or line of business. Each row represents the underwriting ruleset that needs to be executed based on the product, channel and the date of transaction.

Table 1. Ruleset Assignment

Lender	Product	Channel	RuleSet	Effective Date
1	P1, P2, P3	Wholesale - Dallas	RuleSet A	2/1/2007
1	P1, P2	Retail - NY	RuleSet B	8/15/2004
2	P3	All - Chicago	RuleSet C	4/1/2007
2	Default	Wholesale - NY	RuleSet D	1/21/2005

Development Process

Analysis

Once the project team determined that there were no off the shelf solutions that completely addressed the project needs, the development process began with an extensive analysis effort. Technical and business analysts worked together to identify the desired functionality; capture both business and performance requirements, and design the application flow and user interface. The analysis process was structured and methodical with much work occurring prior to the start of any development tasks. Once the analysis phase was well underway and the core requirements were determined, the development team identified and prototyped some of the more critical algorithmic and risk aspects of the application. These prototypes served as both a proof of concept and a tool for eliciting input from business partners and other stakeholders. The decision to devote significant time to upfront analysis and prototyping resulted in minimal misunderstandings and little rework during the development phase of the pilot project.

Architecture, Design & Development

The project's senior architect put together the overall architecture document for the application and worked with the development teams in developing core architecture principles and interfaces between the different components of the application. Detailed high level and low level design documents were created and carefully reviewed for all the major components of the application. By carefully designing the interfaces, a majority of the components could be developed in parallel. The project team during the initial development effort consisted of 4-6 developers and 2-3 analysts, depending on the tasks that were being performed at a particular time. In addition, a Quality Assurance team was involved in testing the application. The first pilot version was completed in less than 12 months after the decision to build the product in house was made.

When the application was in pilot, the Fannie Mae business team worked closely with pilot customers to understand their experiences with the application. Feedback was solicited and reviewed in order to determine those enhancements that would be needed to make the application attractive to a wider audience. Custom DU® was rolled into full production to interested lenders in 2004. Since the application was designed to be scalable and flexible, the pilot version of the application was seamlessly enhanced to become the production application without any disruption to the pilot customers. Since then

there have been multiple releases with numerous functional and performance enhancements with virtually no customer impact.

In addition to the typical hurdles, such as staffing and budget concerns, the project also encountered some more atypical difficulties during the initial development of the application. The project team included a group of individuals who were brought together because of their skill sets. These individuals reported to several managers scattered throughout the organization. The project team worked at multiple locations and had not previously worked together, which could have caused project delays. They compensated for this by holding regularly scheduled meetings and by documenting and reviewing and revising all relevant information, including use cases and sample screens. In addition, the team members were accustomed to using different development methodologies including XP, Agile and waterfall. The project team used this to their advantage. Within the overall project, the development methodology used for a component was based on the project timeline needs, including dependencies on other components. This approach gave developers the opportunity to learn methodologies which they would not have been otherwise exposed.

One of the key challenges was developing a system for external use and capturing requirements from a small group of potential users. Since many of these lender customers had never managed a rules-based system, it was a challenge to create an interface that accurately represented the way they conceptualized their products. During the requirements gathering phase, lenders commented on screen mock-ups and their initial feedback was to manage the rules with a single ruleset that contained the underwriting rules for multiple products. Later, when they saw the prototype that depicted this approach, they realized this would not work for their environment, where the underwriting rules for many products change on a regular basis. The production version of the tool allowed users to create separate rulesets for each product, so they could make changes to the products independent of one another. Lenders were happy to trade off the challenge of having the same rules replicated across multiple products for the flexibility to make changes for dynamic products in an easy and efficient manner. An additional challenge was creating a user-friendly interface for building rules that allowed business users to build rules as if they were experienced rule writers. The project team was able to leverage their experiences with previous systems such as KARMA (Sobieski et al. 1996) during this phase. The application was designed from the onset to accommodate new functionality without affecting existing customers. One of the most challenging obstacles was the ability to thoroughly test the application prior to roll-out since it cannot always be anticipated exactly how each of

the lenders will use the provided functionality. This risk was mitigated by including testing partners from the onset of all development initiatives and by including significant testing time in the project plans.

The ever changing nature of the mortgage industry forced an iterative approach to development. It was understood from the beginning that the system needed to be built so that it could easily and quickly changed. Creating multiple system components was one way to address the requirement for system flexibility. The team also learned that having the right set of skills was more important than having a large team, and that upfront analysis was important in reducing the amount of rework and miscommunication. Thorough and complete documentation also improved the development process and allowed the staff to provide a superior level of customer support. Additionally, the development team had experience from an earlier effort (Krovvidy and McClintock 2000) in translating business policy to formalized business rules. This experience was shared with business partners, and included emphasizing the significant up-front analysis required before the tool could be used to build business rules. This in turn helped business partners when they trained lenders in creating and maintaining their underwriting rules.

Finally, the Fannie Mae business team works closely with lenders once they choose to use Custom DU® by providing them with extensive training and helps them by sharing best practices on extracting business rules from business policy. Typically, it is more difficult to train about the abstract concepts related to business rules than it is to train how to use the tool.

Maintenance

Fannie Mae has a robust, three-tier product support environment that can respond quickly and accurately to customer problems. The first tier is the DO/DU® Hotline that resolves customer problems directly or escalates them to a production support team. All problems that can not be answered by the production support team are forwarded to the business team and/or the development team for more extensive analysis. These individuals are contacted when production issues arise. In addition, the system has a built in troubleshooting capability that customers can use to debug their cases. This capability provides them with more detailed trace and debugging information about the rules.

As Custom DU® production volume continues to increase, Fannie Mae continues to work proactively to detect and address issues as early as possible. The Custom DU® business team regularly solicits feedback and enhancement requirements from lenders to ensure that the system

continues to meet their needs. The development team regularly monitors performance and storage requirements and proactively implements software upgrades and performance enhancements on an ongoing basis. Soon after Custom DU® was rolled out for general use in 2004, the quick adoption of the tool by various lenders necessitated the implementation of more efficient indexing and compression techniques for storing and retrieving lender data. These enhancements were rolled out in 2005. Similarly, upgrades were made in 2006 to the underlying rules product and third party products used in the application. These changes were made in addition to several functional enhancements made to the system since 2004.

Insights Gained

Key Observations

- A simplified rule language is sufficient for most underwriting, and inadequacies can be rectified through pre-defined calculations or other mechanisms.
- It is important to capture, model, and provide support for metadata outside the underwriting guidelines in order to prevent lenders from embedding it in their underwriting rules.
- The additional layers of rule and data abstraction provided lenders with considerable stability to their underwriting rules, even when significant architectural changes were made to the system and when significant data changes were made to their underwriting data points.
- Initially, the business users wrote simple rules with low complexity. Once they became proficient at rule building, they wanted much more complex and powerful capabilities. It is an ongoing challenge to balance the need for rule building power with the amount of technical knowledge a user needs to be able to use the system.

Lessons Learned

- Approaches with no sequencing or prioritization of rules were tried, but were insufficient for the problem domain. Implicit sequencing of the rules based on typical underwriting use proved to be remarkably well received.
- Previous prototypes using less dynamic bindings to rules and data clearly indicated that an approach that used standard techniques of compilation, testing, and release dates would be unattractive to customers. The ability to create, edit, test, and deploy rules at any time against existing customer underwriting traffic through DU® required an architecture that can treat all

aspects of the system as data – including scheduling information, routing information, underwriting rules, and presentation styles, as well as traditional underwriting data points such as credit and loan information.

- There is a need to model the User Interface based on how end users organize and segment their business. What makes sense from a rules perspective does not always make sense to business users.

Application Use and Payoff

In 1995 it cost about \$4,000 to originate a loan and took 20 days to get approval, and the process relied heavily on paper, courier and fax. After AU systems entered the market, the underwriting space was changed forever. For example, in 2003 the estimated cost to originate a loan dropped to \$1,500 or less and approval took an average of 20 minutes through the use of Fannie Mae's DU□. Now Fannie Mae has again pushed the envelope and introduced Custom DU®, where the lender can customize DU□ with their own rules. The following are a sample set of lenders benefiting from Custom DU□.

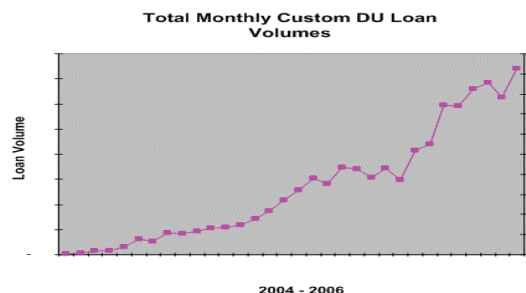
Garritano (2005) discusses how users like a large Dallas-based Mortgage company are able to embed Custom DU® into their loan origination system and directly pass information back and forth seamlessly. With DU® and Custom DU®, this company has been able to take the automated underwriting decision directly to the point-of-sale because it's messaging is so clear and comprehensive. According to this article, this company felt that Custom DU® is one of the best systems built by Fannie Mae. They found that Custom DU® was easy to learn and one didn't have to have a lot of programming knowledge to build the rules. The rules were also easy to test and the system was easy to roll out. Custom DU® not only let them customize the rules to meet their needs but also provided them the ability to move with the industry.

Kersnar (2004) highlights the following proven benefits lenders realize in using Custom DU□: enhanced pull-through rates - enhanced as much as 20% - and an aggressive return on their investment within 12 to 18 months of fully implementing Custom DU□. Another benefit is the improved relationship Custom DU® creates for lenders with correspondents and brokers.

In April 2006, a large mortgage bank announced how they used Custom DU® to leverage their custom business rules on additional products other than standard Fannie Mae loans. In July 2006, a major mortgage wholesale company announced how integrating with DU/Custom DU® would enable brokers get a pre-approval prior to loan submission

giving their clients a decision in minutes, not days. Custom DU® is also seamlessly integrated with some of the leading mortgage vendor technologies to make the service more readily available to the market. The success of the Custom DU® application resulted in a continuous increase in the volume of transactions since 2004.

Figure 3 depicts the growth in Custom DU volumes since 2004.



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Appendix – Sample Underwriting Findings

Underwriting Findings is the report generated after an underwriting transaction. The findings include several messages generated by the underwriting rules, results from several underwriting calculations along with some other data. The messages can be grouped under different sections and are completely customizable by the administrative users. The following list includes some of the customization capabilities provided by Custom DU®:

- Findings report and title
- Findings section and header
- Labels for recommendations from the system
- Messages from DU® findings and how they are mapped in Custom DU® findings

Figures 4 A Sample Custom DU® Findings report

ABC Lender Underwriting Findings

SUMMARY

ABC Lender Recommendation	Not Eligible	DU Recommendation	Approve/Ineligible
Primary Borrower	John Homeowner		
Lender Loan Number		Casefile ID	
Underwriting Run Date	Sep 25 2002 12:41:37PM	Submitted By	a9136dng

Mortgage Information

LTV/CLTV	92.000%/90.000%	Note Rate	6.500%
Housing Expense Ratio	29.000%	Loan Type	Conventional
Total Expense Ratio	8.780%	Amortization Type	Fixed Rate
Total Loan Amount	\$100000.00	Loan Purpose	Purchase
Sales Price	\$114000.00	Refi Purpose	
Appraised Value	\$110000.00		

Property Information

Address	123 Main Street Arlington, VA 22201	Property Type	Detached
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ABC Lender Recommendation

1

This case is not eligible. The maximum qualifying housing to income ratio for this case is 28 percent.

2

This case is not eligible. The loan to value ratio has been exceeded.

3

This case is not eligible. One or more borrowers have a 30 day late mortgage payment in the past year.

4

This case is not eligible. John Homeowner has a FICO score less than the minimum value of 620.

ABC Lender Product Requirements

5

Verify this is not an assumable loan. Jumbo mortgages are not assumable. The borrower may not take over the sellers mortgage.

ABC Lender Processing Instructions

6

If more than 5% of the down payment is from gifts and grants, verify the source of funds meets Fannie Mae guidelines.

7

If there are seller contributions, verify the contribution is less than or equal to 3 percent of the downpayment.

8

Verify a reserve of at least 2 months PITI.

9

Verify mortgage insurance of 30 percent, annual.

10

Verify the employment history recommendation for each borrower follows Desktop Underwriter findings.

11

Verify all borrower assets meet Fannie Mae guidelines. Follow Desktop Underwriter asset recommendations.

ABC Lender Documentation Requirements

12

Two full 1004 appraisals are required, regardless of the Fannie Mae findings report.