



# **Business Rules with MDA**

UML for Enterprise Applications: Model Driven Solutions for the Enterprise Workshop

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#### **Overview**

- MDA and Business Rules Introduction
- Reference Model of Open Distributed Processing
- Business Rules case study
  - CIM models
    - Business terms, facts, and rules
  - PIM models
    - Information invariant, static, and dynamic schemata
    - Computational model
  - PSM models
    - Engineering model
    - Technology model

#### Summary





#### **MDA and Business Rules Introduction**

#### **MDA Model Architecture:**



- **CIM** is the provenance of business rules
- Business rules build on business facts, which are expressed in business terms in a natural language
- Business rules, facts, and terms in CIM have corresponding elements in PIM and PSM, obtained through transformations
- Mapping the correspondences provides traceability of business rules between origin and implementation





#### **Reference Model of Open Distributed Processing**



- Specifies architectural concepts and structuring rules in order to focus on the particular concerns within a system that make up each of the RM-ODP viewpoints.
- International standard for specification languages.
  - ▶ ISO/IEC 10746 | ITU-T X.900
- Referenced by MDA and other OMG specifications.





#### **RM-ODP Viewpoints and MDA**

RM-ODP	MDA	Audience	Content
Enterprise Viewpoint	CIM	Business Owners, Planners, Managers, Users	Business model. System requirements.
Information Viewpoint	PIM	System Analysts	Information model. Information processing model.
Computational Viewpoint	PIM	Software Architects	Object model. Object interaction model.
Engineering Viewpoint	PIM or PSM	Systems Architects System Administrators	Distribution model.
Technology Viewpoint	PSM	Programmers, Component Vendors	Program code. API's.





#### **Case Study: Consumer Credit**

Consider the business rules used in processing a personal application for credit

RM-ODP	MDA	Audience	Content
Enterprise Viewpoint	CIM	Business Owners, Planners, Managers, Users	Personal credit application business rules in natural language.
Information Viewpoint	PIM	System Analysts	Static and dynamic schemata.
Computational Viewpoint	PIM	Software Architects	Object model. Rules model.
Engineering Viewpoint	PIM or PSM	Systems Architects System Administrators	Distribution model.
Technology Viewpoint	PSM	Programmers, Component Vendors	Executable rules and objects.





### **Business Terms (CIM) – Consumer Credit Example**

- **Ioan application** a document containing a request for a loan
- **applicant** a person who is applying for a loan
- credit score a positive whole number taken as a measure of credit worthiness. The higher the credit score, the greater the credit worthiness.
- employment a person's trade or profession
- **purpose** the use to which loan proceeds will be put
- amount [of a loan application] the amount of money requested to be loaned
- **payment plan** a plan for repayment of a loan
- **rate** an interest rate, in percent per year
- **reject reason** a reason given for possibly rejecting a loan application





# **Business Facts (CIM) – Consumer Credit Example**

- Loan application has applicant
- Loan application has purpose
- Loan application has amount
- Loan application has payment plan
- Loan application has credit score
- Loan application has low income census tract flag
- Loan application has reject reason
- Applicant has credit score
- Applicant has current employment
- Applicant has previous employments
- Employment has monthly salary
- Employment has number of months of employment
- Payment plan has rate
- Payment plan has number of payments
- Payment plan has name





### **Business Rules (CIM) – Consumer Credit Example**

- **Each loan application has at least one applicant**
- Each loan application has one purpose
- Each loan application has one amount
- Each loan application has one payment plan
- **Each loan application has zero or one credit score**
- **Each loan application's default low income census tract flag is FALSE**
- **Each loan application has zero, one, or more reject reasons**
- **Each applicant has zero or one credit score**
- **Each applicant has zero or one current employment**
- Each applicant has zero, one or more previous employments
- Each employment has one monthly salary
- Each employment has one number of months of employment
- Each payment plan has one rate
- Each payment plan has one number of payments
- **Each payment plan is uniquely identified by its name**





# Business Rules (CIM) – Consumer Credit Example, cont'd.

- A credit score must be determined independently for each applicant of a loan application
- The credit score of a loan application must be the greatest credit score of any applicant of the loan application
- Assume an applicant has good credit; the credit score of an applicant must initially be set at 25
- The credit score of an applicant is incremented by an amount determined by the number of months in the current employment, according to the following table:

>= 60 months	+5
24 to 59 months	+3
< 24 months	+1

The credit score of an applicant is incremented by an amount determined by the number of months in the previous employment, according to the following table:

>=60 months	+3
< 60 months	+1

OBJECT MANAGEMENT GROUP





### Business Rules (CIM) – Consumer Credit Example, cont'd.

For loan applications whose purpose is 'Home Loan', the applicant's credit score for a particular payment plan is incremented by an amount based on the applicant's payment-to-income ratio, according to the following table:

increment	reject reason
+5	-
+4	
+3	
+0	Debt service is too high.
	<i>increment</i> +5 +4 +3 +0

For loan applications whose purpose is 'Home Loan', the applicant's credit score for a particular payment plan is incremented by an amount based on the total debt service ratio, plus an additional increment if the application is in a low income census tract, according to the following table:

increment	additional LICT increment	reject reason
+10	+3	
+8	+8	
+5	+2	
+0	+1	Debt service is too high.
	<i>increment</i> +10 +8 +5 +0	increment additional LICT increment +10 +3 +8 +8 +5 +2 +0 +1





### Business Rules (CIM) – Consumer Credit Example, cont'd.

- If a loan application's credit score is >= 65, the loan application must be accepted
- If a loan application's credit score is >= 58 and < 65, the loan application requires evaluation by a Loan Officer
- ▶ If a loan application's credit score is < 58, the application must be rejected
- If a loan application is accepted, determine if the applicant also qualifies for additional products for the same purpose





#### Information Model (PIM) – Static Schema

- UML Class Diagram
- Normal form
- Corresponds to Terms and Facts in the CIM (Enterprise Viewpoint).
- Corresponds to certain Computational Viewpoint classes.
- Corresponds to database schema in the PSM (Technology Viewpoint).







#### Information Model (PIM) – Dynamic Schema

- UML State Chart of the LoanApplication class
- Corresponds to the application processing decision rules in the Enterprise viewpoint
- May correspond to other Technology objects in PSM

C_LAT: process application	C_LA2: contine	C_LAZ continue	C_LA3: processed
1. CollectApplicationDate 2. WillingnessToPay	3. ApplicationScore	4. AbilityToPay	5. Processed
entry/ self_status = "PENDING"; MillingRS"; penessite C_LA2 continue to self;	t. *AppScoreR5*1: generate C_LA2continue to selt:	entry/ self.credifScore=self.credifScore + self.evaluateRules(juleSet'XbleRS'); if ( self.oredifScore >= 60 ) celf.status = "XPPROVED"; generate C_LA3processed to self eff (self.credifScore >= 50) celf.status = "EVALUATE"; generate C_LA4.evaluate to self; ebs self.status = "REJECTED"; generate C_LA3processed to self end it;	C_LA4: encelorie C_LA4: encelorie C_LA3: processeor 6. Review entry/ sell.noilly(who.'Loan Office'', mgr'E valuate''):
	C_LA6: revise		
	C_LAG: and	24	



**Computational Model (PIM)** 

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- Consider UML Collaboration
  - and Class Diagrams
- Shows the architectural classes of the system and their interactions
- Fact Repository contains facts based on the Static Schema
- Rule Repository contents correspond to Business Rules & Dynamic Schema







#### **Computational Model – Corresponding Business Rules**

```
ruleset AbleRS for {application: a LoanApplication, monthlyPayment: a real}
    returning an integer is
```

```
Income is a real initially computeIncome(application).
otherPayments is a real initially computeOtherPayments(application).
score is an integer initially 0.
applicant is any Applicant in application.applicant.
```

For loan applications whose purpose is 'Home Loan', the applicant's credit score for a particular payment plan is incremented by an amount based on the total debt service ratio, plus an additional increment if the application is in a low income census tract, according to the following table:

debt ratio	increment	additional
		LICT increment
> .10 and < .28	+8	+8
>= .28 and < .41	+5	+2



### **Engineering Model (PIM or PSM)**

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Consider UML Deployment Diagram, interface specifications as Class Diagrams or IDL

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Shows all hardware nodes, peripherals, network protocols, network components, especially edge routers, as well as system backup, fail-over, load balancing, and transaction management design, etc.





#### **Technology Model (PSM)**







#### Summary

- 1. MDA CIM (RM-ODP Enterprise viewpoint)
  - Business rules
  - Business facts
  - Business terms
- 2. MDA PIM (RM-ODP Information viewpoint)
  - Information model
  - Information processing definitions (ruleflows)

#### 3. MDA PIM (RM-ODP Computational viewpoint)

- Computational object model
- Rule services
- Rulesets
- Rules

#### 4. MDA PSM (RM-ODP Engineering viewpoint)

- Distribution model
- Rule service specifications for target middleware architecture
- 5. MDA PSM (RM-ODP Technology viewpoint)
  - Rule service implementation for target middleware architecture
  - Associated implementation code; e.g., EJB

Correspondences

Implementationindependent Business Rules

Rule Server Implementation