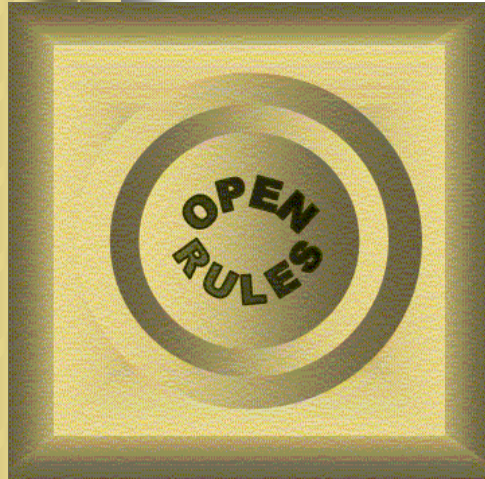




Dynamic Decision Models

Activation/Deactivation of Business Rules in Real-Time

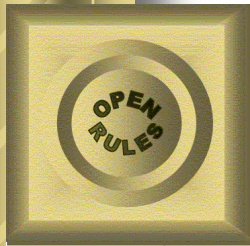
Dr. Jacob Feldman, CTO, OpenRules Inc.

Specification Lead for JSR-331

jacobfeldman@openrules.com

www.OpenRules.com

www.JSR331.org



www.OpenRules.com



Business Rules - Time to Excel

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Business Rules and Decision Management System

= Open Source =



OpenRules® is a general purpose Business Rules and Decision Management System available as an Open Source product. It allows subject matter experts and software developers to create, test, execute, and maintain enterprise-class decision support applications.



Business Rules for Business Analysts

Open Source



Rule Repository

Enterprise-class Repository
Maintained by Business Analysts with
Excel® or Google Docs®



Rule Engine

Executing Decisions with Inter-Related
Decision Tables



Rule Learner

Discovering Rules
Predictive Analytics



Rule Solver

Constraint Satisfaction
Solving Optimization Problems



Rule Dialog

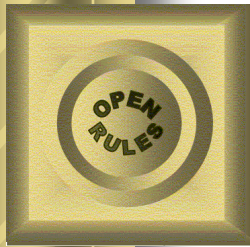
Developing dynamic rules-based Web
Questionnaires



Finite State Machines

Event Processing
Connecting the Dots

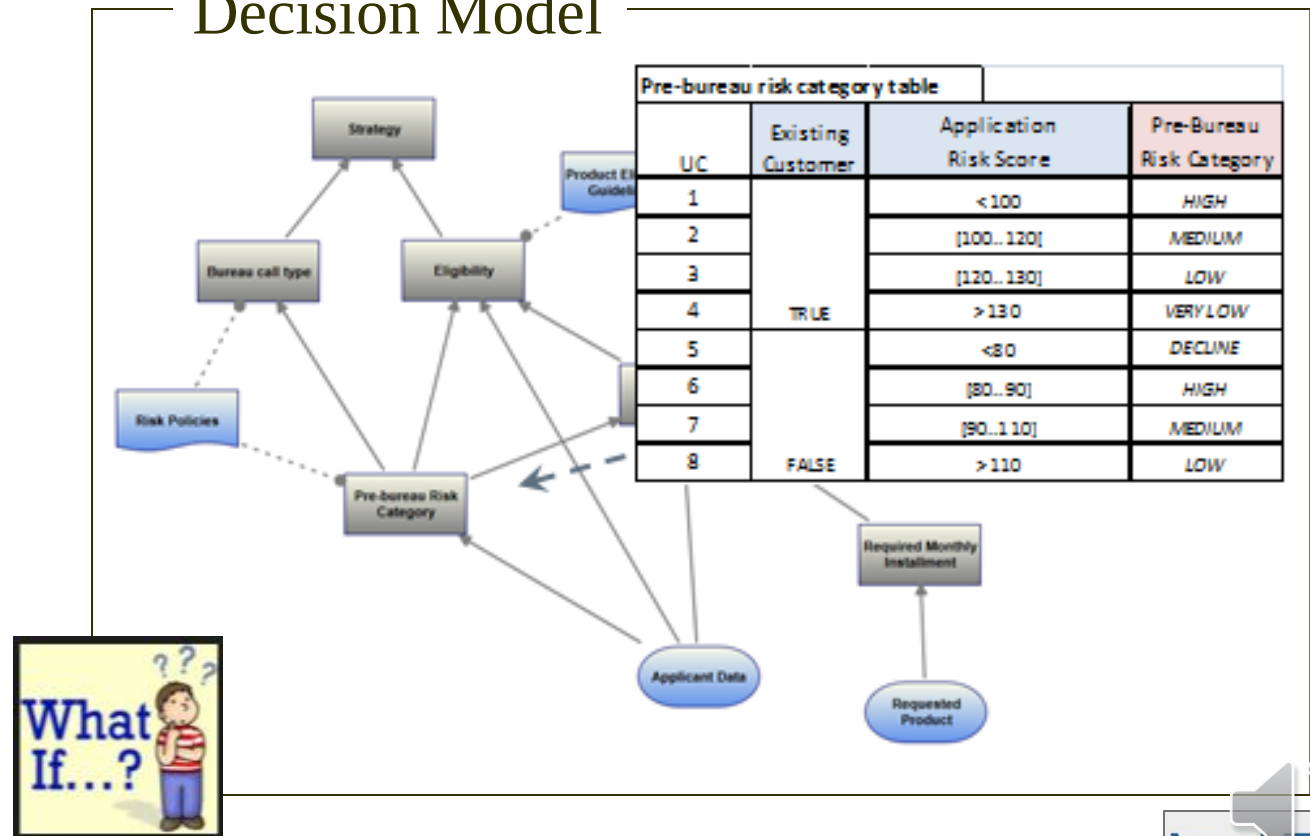


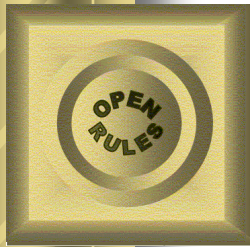


DMN Standard

● Decision Model and Notation

Decision Model





DMN Support Grows



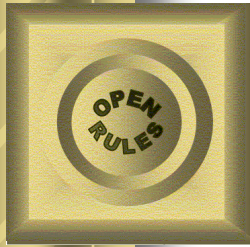
www.DMCommunity.org



Decision Model
Interchange

Decision Model and Notation (DMN) Supporting Tools

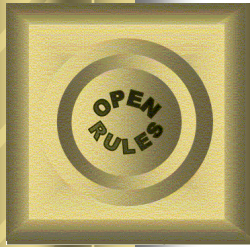
#	Product	Select
1	Avola	☐
2	BiZZDesign	☐
3	Blueriq	☐
4	Camunda	☐
5	DecisionsFirstModeler	☐
6	FICO	☐
7	FlexRule	☐
8	IDIOM	☐
9	OpenRules	☐
10	Sapiens	☐
11	Signavio	☐
12	Sparkling Logic	☐
13	Trisotech	☐



Static vs. Dynamic Decision Models

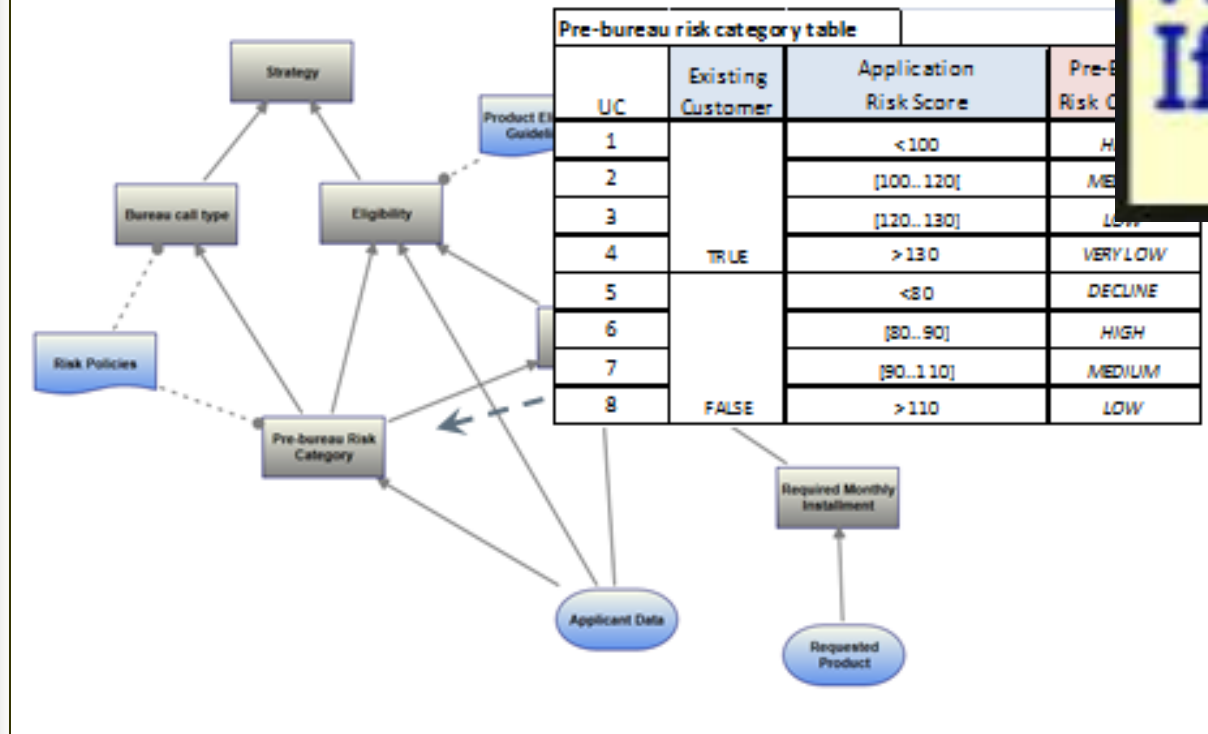
- Traditional Business Decision Models
 - *static by nature*
 - all business rules are already defined and activated
- Modern Decision Models
 - should be *dynamic*
 - changes in rules propagated in real time
- Sample applications:
 - product configuration
 - optimal pricing
 - scheduling and resource allocation

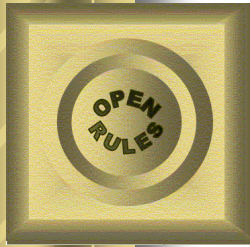




Decision Models need Real-Time What-If Analysis

Decision Model

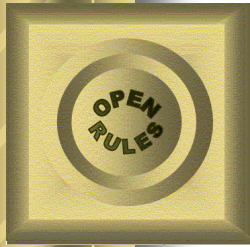




Example: “Flash Sales”

- A large online retailer offers various fashion collections using a flash sale model
- Their Pricing Decision Model requires daily changes for different “**deals-of-the-day**”
- Objective: finding the optimal set of prices for a flash sale under different business rules and preferences

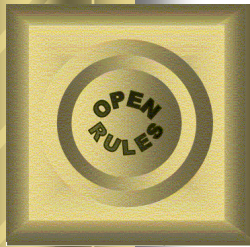




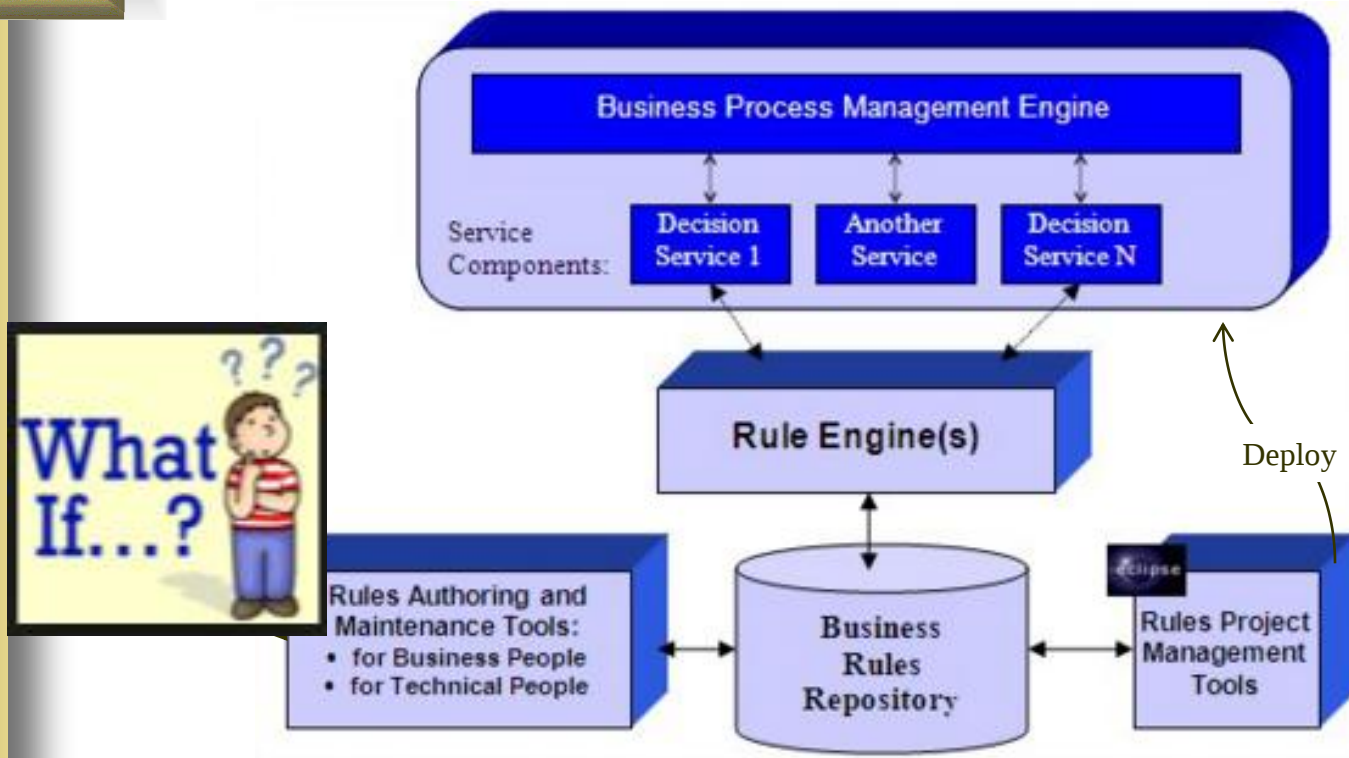
Example: “Flash Sales”

The rules may define various thresholds for expected revenue, margin, sell-through, availability of cheap and more expensive items with different looks

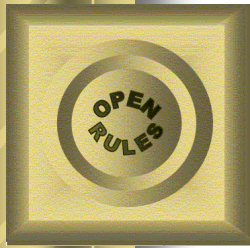




Traditional Architecture



- Rule Change => Test => Deploy => Run
- Difficult to do What-If Analysis for Decision Models
- Decision modelers cannot see immediate results of rule changes



Dynamic Decision Modeling

- A business friendly web interface:
 - Allow a user to activate or deactivate business rules with a simple click
 - Show right away how these actions modified all related decision variables

What-If Analyzer for Decision Modeling
Activate/Deactivate Business Rules, Find, Optimize, and Analyze Different Decisions

Selected Decision Model: Equations and Inequalities

This simple decision model allows you to activate/deactivate various arithmetic constraints on integer decision variables

Solution Next Prev Minimize Maximize Activate All Rules Deactivate All Rules

Decision Variables ([Glossary](#))

Variable Name	Possible Values
X	4
Y	5
Z	9
Objective	11

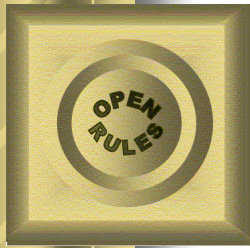
Business Rules ([Original Rules](#))

Rule	Decision Table	Active	Conflict
$X+Y=Z$	XplusYeqZ	☒	-
Objective = $X*Y-Z$	DefineObjective	☒	-
$X < Y$	BinaryConstraints	☒	-
$Z > 5$	BinaryConstraints	☒	-
$Z < 5$	BinaryConstraints	☐	-
$X > 4$	BinaryConstraints	☐	-
$Y < 6$	BinaryConstraints	☒	-
$Z < 8$	BinaryConstraints	☐	-

Maximized solution #4 found

OpenRules Release 6.3.4





What-If Analyzer: Major Features

Shows Changes
in Decision
Variables

Decision Variables (Glossary)

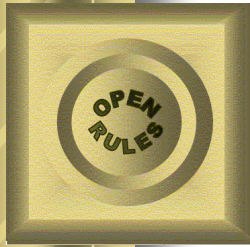
Variable Name	Possible Values
X	1..4
Y	2..5
Z	3..9
Objective	5..17

Business Rules (Original Rules)

Rule	Active	Conflict
$X+Y=Z$	☒	-
Objective = $X*Y-Z$	☒	-
$X < Y$	☒	-
$Z > 5$	☐	-
$Z < 5$	☐	-
$X > 4$	☒	Yes
$Y < 6$	☒	-
$Z < 8$	☐	-

Activate/
Deactivate
Rules

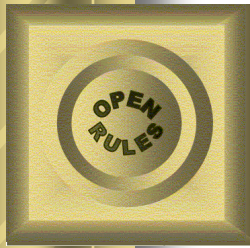
Diagnose
Possible
Conflict



Decision Optimization

- Real-world decision models not always produce one solution but rather many alternative solutions
- When DMN specifies an **optimization objective**, a decision model will find a solution that optimize it





What-If Analyzer: Optimization Features

Solution Next Prev Minimize

Decision Variables ([Glossary](#))

Variable Name	Possible Values
X	3
Y	5
Z	8
Objective	7

Found solution #2 out of 3

Generate
Alternative
Solutions

Solution Next Prev Minimize

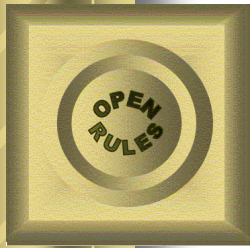
Decision Variables ([Glossary](#))

Variable Name	Possible Values
X	3
Y	4
Z	7
Objective	5

Minimized solution #2 found

Find
Optimal
Solution





What-If Analyzer for DMN

DMN Decision Model

OPEN RULES **What-If Analyzer for Decision Modeling**
Activate/Deactivate Business Rules, Find, Optimize, and Analyze Different Decisions

Selected Decision Model:

This simple decision model allows you to activate/deactivate various arithmetic constraints on integer decision variables

Decision Variables ([Glossary](#))

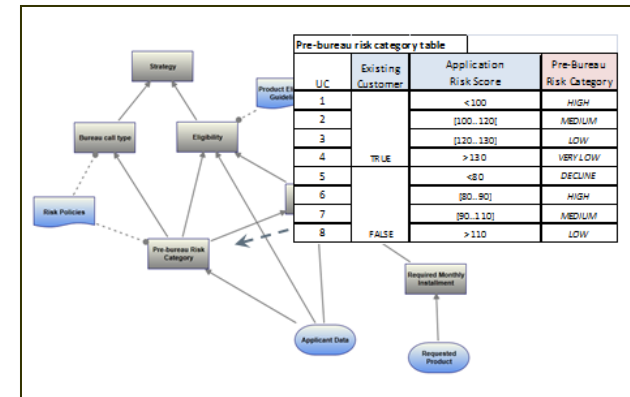
Variable Name	Possible Values
X	4
Y	5
Z	9
Objective	11

Business Rules ([Original Rules](#))

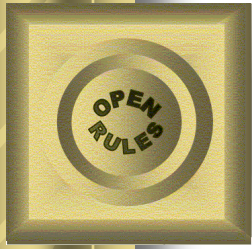
Rule	Decision Table	Active	Conflict
$X+Y=Z$	XplusYeqZ	☒	-
Objective = $X*Y-Z$	DefineObjective	☒	-
$X < Y$	BinaryConstraints	☒	-
$Z > 5$	BinaryConstraints	☒	-
$Z < 5$	BinaryConstraints	☐	-
$X > 4$	BinaryConstraints	☐	-
$Y < 6$	BinaryConstraints	☒	-
$Z < 8$	BinaryConstraints	☐	-

Maximized solution #4 found

OpenRules Release 6.3.4



Import
using DMN XML



How It's Implemented

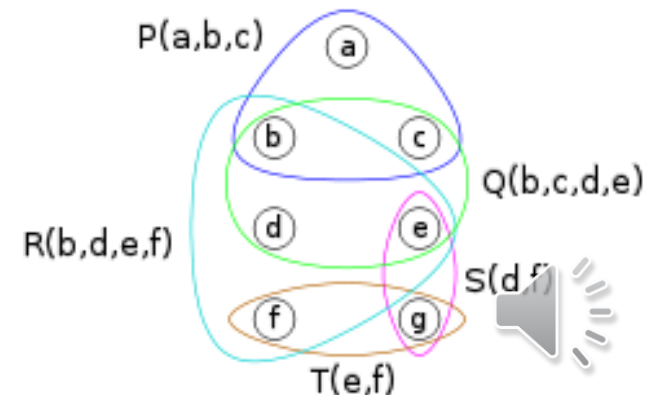
- OpenRules Solver:

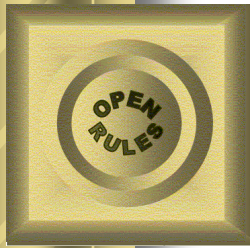
Decision Model $\Rightarrow$ Constraint Satisfaction Problem

- JSR-331 - compliant constraint solver:

Rules Activation = Constraint Propagation

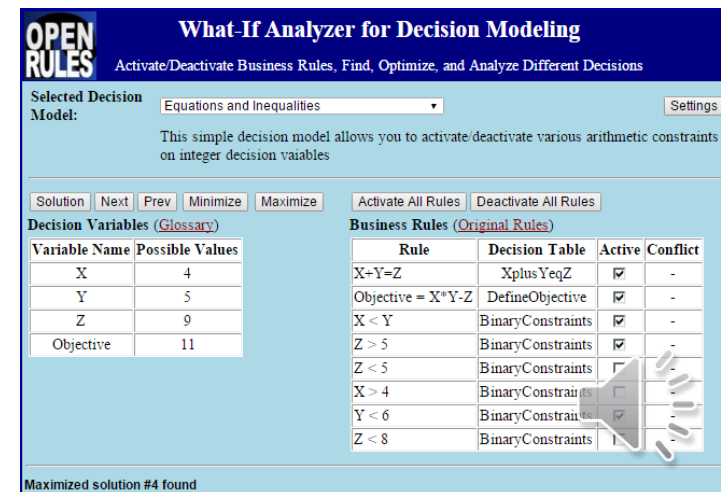
Finding Decisions = Finding Feasible and Optimal Solutions

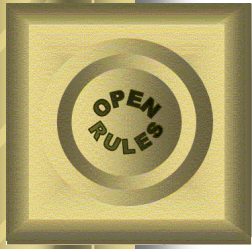




What-If Analyzer GUI

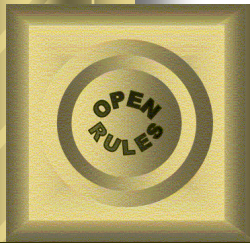
- Real-world decision models may require specialized Graphical User Interfaces
- What-If Analyzer designed as a framework for development of different analyzers:
 - GUI can be easily modified using OpenRules Dialog
 - Underlying logic remains the same





Live Demonstration

- Demonstration Decision Models:
 - Loan Approval Application
 - How to Make a Good Burger
 - Several Scheduling Problems



Loan Approval Application

Solution Next Prev Minimize Maximize Activate All Rules Deactivate All Rules

Decision Variables [\(Glossary\)](#)

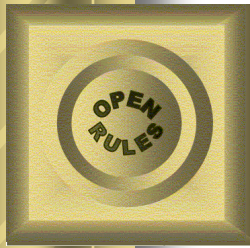
Variable Name	Possible Values
Monthly Income	4100
Monthly Debt	2600
Loan Amount	50000
Loan Term	24
Total Income	98400
Total Debt	62400
Accumulated Debt	112400
Income Validation Result	UNSUFFICIENT

Business Rules [\(Original Rules\)](#)

Rule	Active	Conflict
Total Debt = expression	☒	-
Total Income = expression	☒	-
Accumulated Debt = expression	☒	-
Loan Amount = 50000	☒	-
Loan Amount >= 35000	☒	-
Loan Amount <= 75000	☒	-
Loan Amount >= 40000	☐	-
Loan Amount >= 50000	☐	-
Loan Amount >= 60000	☐	-
Loan Term = 24	☒	-
Loan Term = 36	☐	-
Loan Term = 72	☐	-
Loan Term <= 36	☐	-
IF Total Income > Accumulated Debt THEN Income Validation Result = SUFFICIENT	☒	-
IF Total Income <= Accumulated Debt THEN Income Validation Result = UNSUFFICIENT	☒	-
Income Validation Result = SUFFICIENT	☒	-

Loan Amount
\$50,000 produces
UNSUFFICIENT
Income Validation
Result

 Yes



Decision Model

“Make a Good Burger”

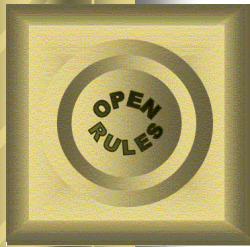


- Offered as a DMCommunity.org Challenge
- Burger ingredient list:

Item	Sodium (mg)	Fat (g)	Calories	Item cost (\$)
Beef Patty	50	17	220	\$0.25
Bun	330	9	260	\$0.15
Cheese	310	6	70	\$0.10
Onions	1	2	10	\$0.09
Pickles	260	0	5	\$0.03
Lettuce	3	0	4	\$0.04
Ketchup	160	0	20	\$0.02
Tomato	3	0	9	\$0.04

- **Question:** What is the most or least expensive burger you can make?



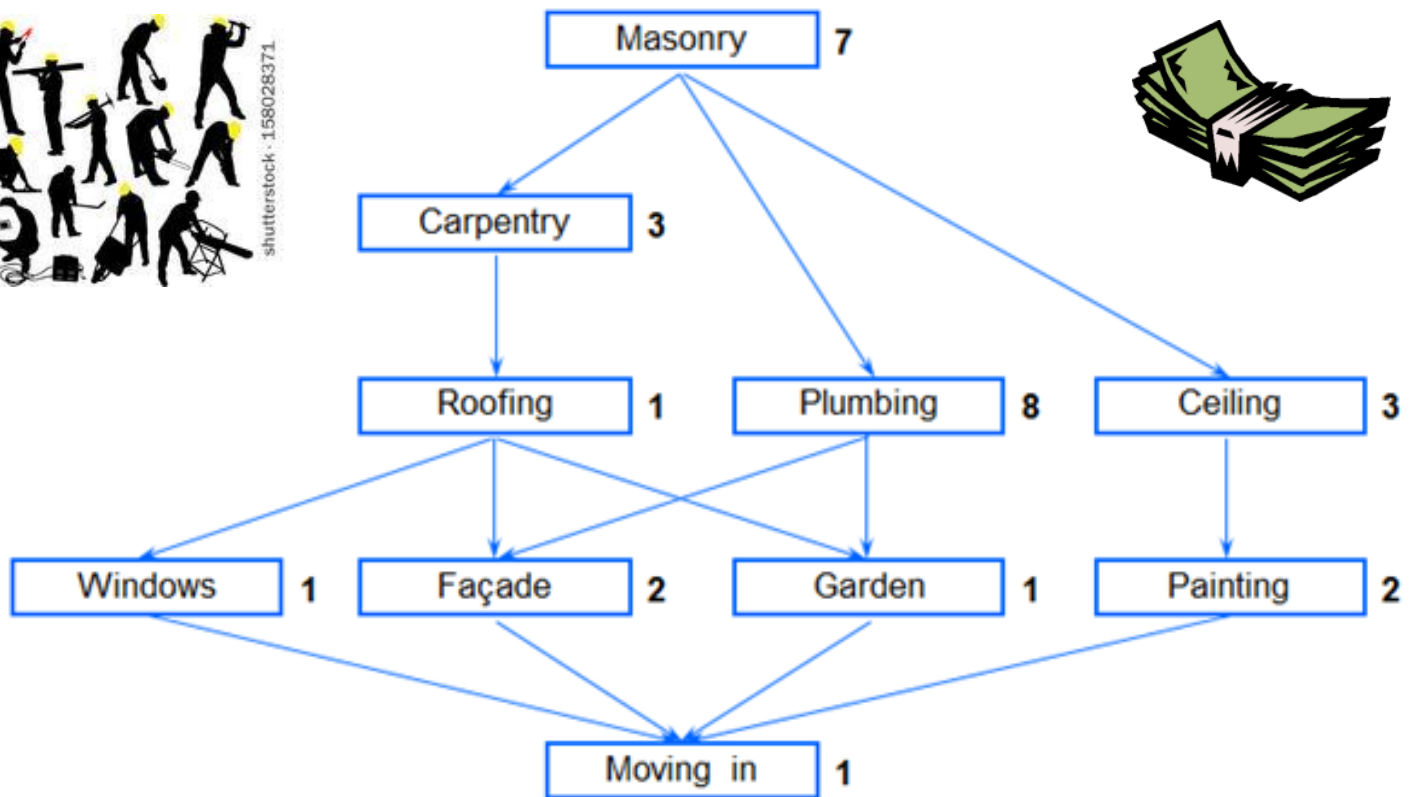


House Construction Problems

Resources:
Workers w/Skills

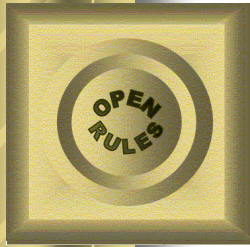


Activities:



Resource:
Limited Budget





References

- Open Source Business Rules and Decision Management System “OpenRules”:
www.OpenRules.com
- Representing and Solving Rule-Based Decision Models with Constraint Solvers, Jacob Feldman, RuleML 2011 - America, LNCS 7018, pp. 208-221, 2011, Springer-Verlag Berlin Heidelberg 2011
- JSR-331 Standard “Constraint Programming”
www.JSR331.org
- Contact: jacobfeldman@openrules.com