Challenges & Opportunities

Lessons Learned Building Large Rule-Based Systems Around the World



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Third Annual Business Rules Forum, Atlanta, GA

October 2000



Business Rule Generations



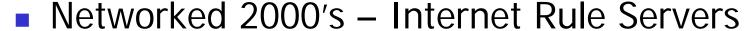


Rulebases were the application





 Rulebases integrated with mission-critical, legacy, OLTP, OLAP, & operational C/S applications



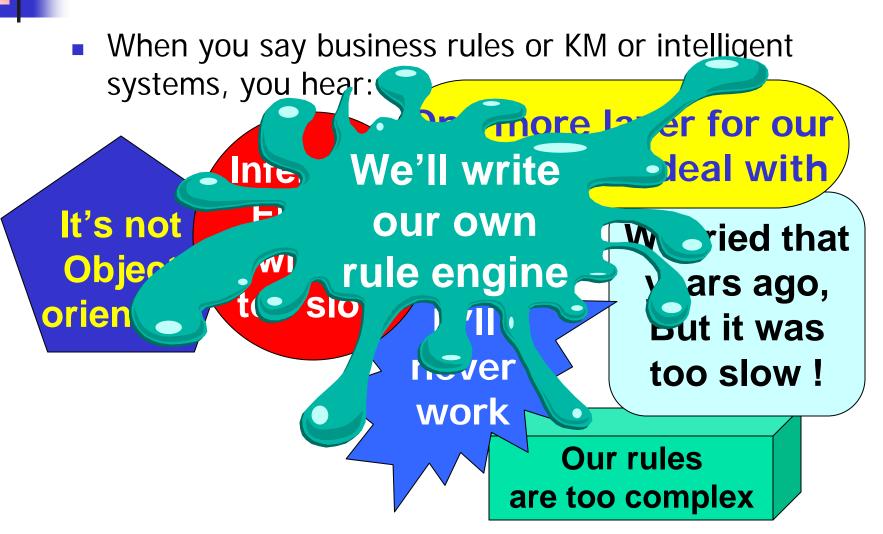


 Rulebases embedded as components of mainstream e-Commerce CRM, ERM, 121, B2B, & B2C applications

Business Rule Agenda

- What's the Problem
 - We're still dealing with many skeptics in IT and lack of business management awareness
 - What have we learned building rule-based systems in the past 20 years
 - Case studies from each generation
- What's the solution
 - It's the rules stupid
 - Treat rules as data, not code
 - How can business rules help me today
 - Why now







You'd never build a database engine – *You'd buy Oracle, right?*

- No one builds a DBMS
- You buy Oracle or SQL Server instead
- You can't beat the vendor
 - Cost, functionality, performance, support
- You're not in the DBMS business



So why do you build a rulebase engine when you can buy one?

- Why reinvent an "RBMS" for every application?
- Buy a RBMS, don't build one!
 - It's smarter to buy an enterprise-level, industrialstrength, off-the-shelf, proven, optimized, flexible RBMS than to code and maintain your own
 - You can't beat the vendor's cost, functionality, performance, support
- You're not in the RBMS business are you?
 - If you buy a RBMS and your competitors don't, you get the competitive edge!
 - If you buy and your competitors build, you get the competitive edge!



If you're still skeptical...

- What if your competitors build smart rulebased systems and you don't?
- What if they treat rules as data, not code?
 - Imagine they have smart systems that let the business CRUD their business rules in real-time....
 - Imagine you have to go thru an IT change request, spec, code, test, compile, debug, and distribution process to change business rules...
- That's the competitive edge!



If you're still skeptical...

- Remind them...
 - They need to be open to new ideas and new technologies
 - OOP evolved from AI and expert systems
 - Remind them computers were a lot slower then
- Remind them how other smart people were wrong...



"The telephone has too many shortcomings to be seriously considered as a means of communication."



Western Union internal memo, 1876



"Everything that can be invented has been invented."

Charles H. Duell, Commissioner U.S. Office of Patents, 1899



"Who the hell wants to hear actors talk?

H.M. Warner Warner Brothers, 1927



"Computers in the future may weigh no more than 1.5 tons."

Popular Mechanics, 1949



"There is no reason in the world anyone would want a computer in their home. No reason."

Ken Olsen Chairman, DEC, 1977

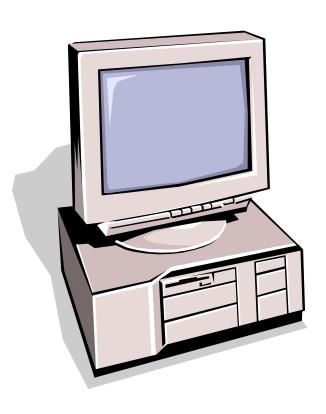


"I believe OS/2 is destined to be the most important operating system, and possibly program, of all time."

> Bill Gates 11/87



August 1990

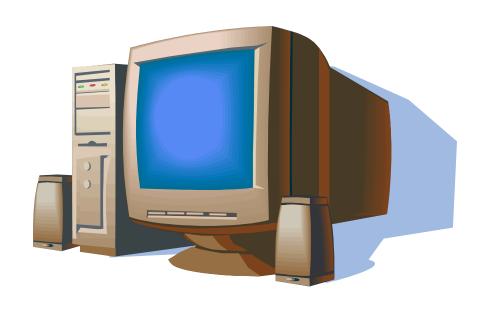


- IBM PS/1
- 10-MHz 80286
- 640K RAM
- 30MB Hard disk
- **\$1,999**

August 1990 PC Magazine



August 2000



- Dell Dimension XPS B
- 800-MHz Pentium 3
- 128MB RAM
- 30GB Hard disk
- **\$2,068**

www.dell.com





Standalone Expert Systems

Rulebases were the application



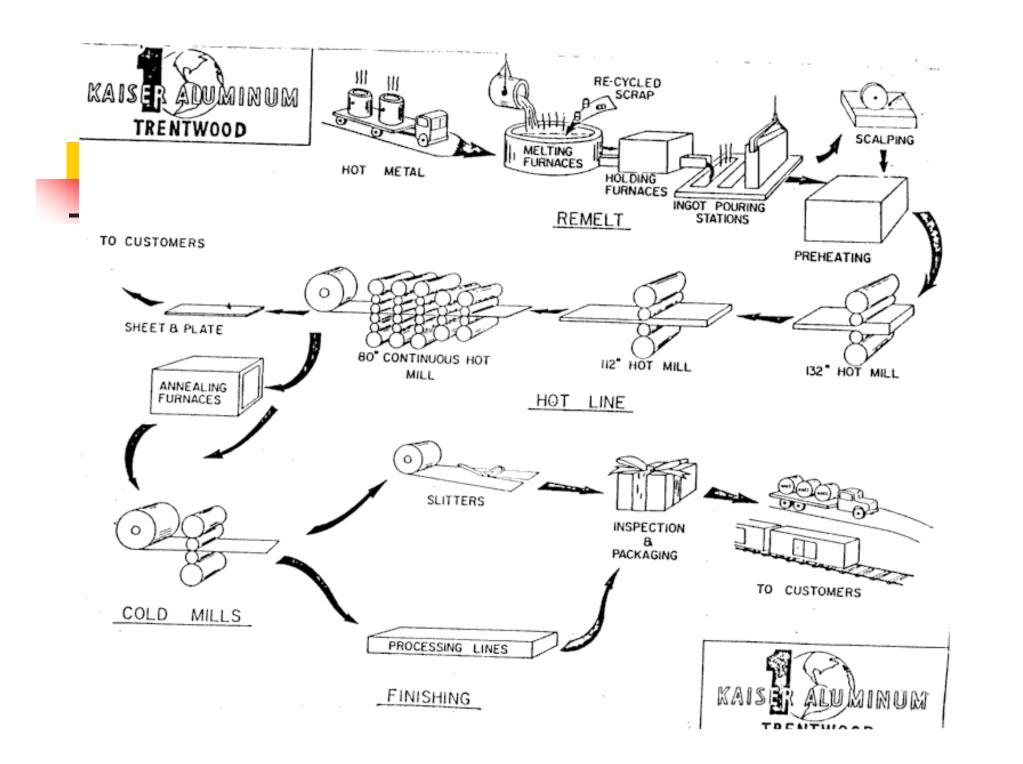


- In 1988, Mobil is a \$40 billion/year business
 - Exploration Division Finds oil
 - Marketing & Refining Division Sells Lubes & Fuels
 - US Marketing
 - Int'l Marketing
- US Marketing begins AI/Expert Systems R&D
 - Starts building small proof-of-concept applications like ALFRED



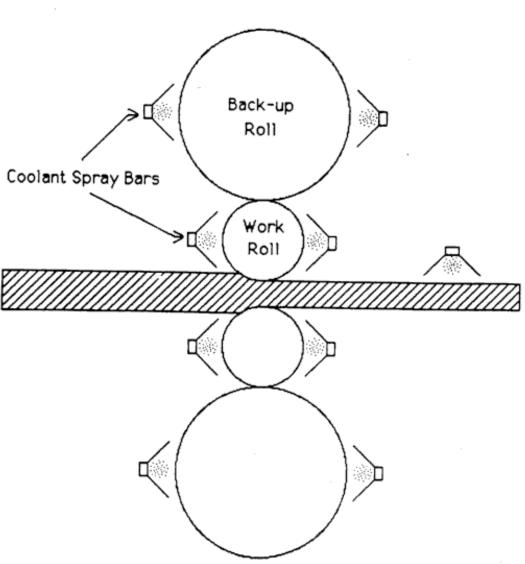
Pilot Project: ALFRED Rolling Oils Expert System

- Captures 50 years of Mobil's experience with rolling oils & metal rolling mills
- Scope
 - Problem diagnosis
 - Lab test analysis
 - Recommend corrective action
- 400 rule expert system developed using 1st Class Fusion



ALFRED: An Expert System







- One int'l expert: ALFRED
 - 30 years experience in Austria/Germany office
 - Didn't really know the market in England,
 France, Japan, etc.
- One US expert
 - Could not agree with many of Alfred's decisions/recommendations for US market



- So we decided to build a US version and an international version
- US expert was recognized and accepted by US colleagues
- But Alfred didn't really understand the different product variations and customer requirements in other countries
 - Turned out that the metal rolling process and industry was different in different countries
 - Because the int'l system did not meet their needs, other countries never really used it



- One expert is not enough for an international system
- You need a team of SME's representing major affiliates
- SME personality is key
- Must be accepted by other experts



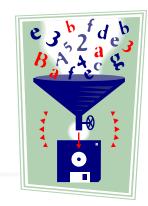


- System was not marketed correctly to all the affiliate offices
- Commercial directors & IT directors in each country knew about ALFRED, but Sales did not
 - This was seen as a technical MIS R&D project, instead of a practical business system
 - Sales depts. Didn't know this was a sales system for the sales staff
- Raised awareness across Mobil
 - US Mkting realized the value of capturing knowledge (business rules) as a corporate asset
 - This got int'l Mkting interested, and people started talking

Mobil 1989

- Mobil Lube Strategy
 - Provide value added services to customers
 - Identifies a future need: a "Lube Knowledge Base"
- The Business starts talking about the need to manage knowledge & "Intellectual Capital"
 - Radical idea back then, mainstream today
- Business rules is the new thing





- IT starts envisioning the "Lube Knowledge Base" as a laptop sales tool to support every field marketer worldwide
 - Suite of integrated Expert Advisor Systems for product recommendation, equipment troubleshooting, and training
 - CD-ROM for Mobil & Competitor Product DB & Equipment Builders DB
 - Paperless All paper files, such as product specs, MSDS, customer case studies, technical diagrams, charts, photos, etc. converted to electronic form
 - Customer database



LKB Goals

- Capture expertise from top marketers & engineers and make it available worldwide
- Train field reps
- Improve customer service & service quality
- Provide consistent solutions
- Minimize paperwork/looking through thick manuals



LKB Methodology



- We used the NIKE methodology: Just Do It
- Used an iterative JAD-RAD process
- We Listened, Designed, and Built prototypes quickly in order to refine the scope, specs, and functionality
- Once clients agreed to scope, specs, and functionality, we re-designed and rebuilt the final release

The LKB Vision Before

After

Product data

Technical memos

sheets

Technical files

Equipment

builder books

Technical

Customer

bulletins

service

Lab test

reports

reports Industry

Technical manuals

troubleshooting **Product** books

recommendation

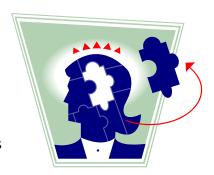
Troubleshooting charts

manuals

Expert Problem Diagnosis

Expert Advice

Expert Product Recommendations



The Lube Knowledge Base







- All data/documents are linked via hypertext links so users can click on a "hot button" and "jump" to a related page
- Related link could be another document, a glossary definition, a picture, expert tips, etc.
 - Put cursor on keyword and press F2 to "jump"
 - This was BI before the Internet and the Web
 - Radical idea back then, mainstream today
- This was before Windows
 - We didn't have JPEGs or GIFs, but we did have PCXs



- Selects AIONDS as standard ES tool
- Looked at AICorp. KBMS, Neuron Data Nexpert, Information Builders Level 5, and IBM's ESE (TIRS)



- Business & IT agree there is a need to develop a worldwide lube expert systems strategy
 - Prioritized list of candidate expert systems
 - Architecture designed to allow concurrent development, and "thunking"
 - We could build one system at a time, in any order, and they would all work separately or integrated together
 - IT strategy was aligned with Mobil's longstanding lube marketing strategy to provide value added services to customers

Mobil



- IT and the US / Intl'l business units start planning a strategic Knowledge Management Program with these goals
 - Maintain Mobil's competitive edge in the worldwide lube market
 - Provide current product and customer data to the field sales force
 - Capture individual expertise and share that knowledge throughout the Mobil system
 - Enable marketers to increase face to face selling time

Mobil



- The "Lube Knowledge Base" is born
 - A suite of expert systems and databases
 - Mobil Office instead of Microsoft Office!
 - I think this was before MS Office was released. If so, this was also a radical idea that is mainstream today
 - Approach is to build LKB modules that can be justified individually, and can stand alone
 - Consistent design and interfaces so they can be linked together to share common data
 - Reusable objects (components) such as bearings, gears, and cylinders that apply to many modules

Mobil's Lube Knowledge Base 1991



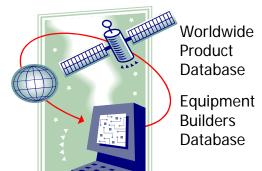
Rolling Oils Expert System

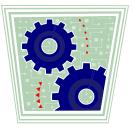
Hydraulics Expert System Compressor Expert System

Diesel Expert System Grease Expert System

Cutting Oils Expert System Environmental Health & Safety Expert System







Common Code (Gears, Bearings, Cylinders, Pistons, Seals, etc.)



Security



Library & Reference Manuals

Mobil



- Affiliates could either buy individual modules or the whole "suite"
 - Per copy charge would fund development of future LKB modules
- Similar to the approach Microsoft used to build the MS Office suite
 - Central group builds common code, designs infrastructure, and defines interfaces
 - Distributed groups build modules that plug into the suite



Mobil Lube Knowledge Base Jan 1991 - Compressor Expert System-CES

Selected as first system

 Because less complex, smaller, usable by all business units worldwide, and used many components that could be reused later

Scope

- Diagnosing and solving customers' compressor oil related problems
- Providing expert advice and reference material
- Improving the professionalism and efficiency of the field sales force
 - Just taking a PC into the customer's office was impressive back then



Mobil Lube Knowledge Base Compressor Expert System-CES



- Expert meetings were held in the US, England, and Japan
 - Experts were from England, France, The Netherlands, and Japan



- Development cost hundreds of thousands of dollars
 - Released Summer 1992; Over budget by 5 %



- That was great, given the facts that
 - This was the first of many expert systems that were envisioned for the Lube Knowledge Base
 - We were using new technology & new tools
 - We were using multiple experts, which was our new approach after ALFRED





Mobil Lube Knowledge Base Compressor Expert System-CES

- CES Hardware Requirements (1991-92)
 - 80386 processor
 - 20MHz
 - 80MB hard disk
 - 3 MB RAM
 - CD-ROM drive for Product & EB databases



Mobil Lube Knowledge Base Compressor Expert System-CES

- CES benefits
 - Improved quality and quantity of selling time
 - Reduced time looking up paper-based files
 - Paid for itself after one year



Lessons Learned: Compressor Expert System

- Building a rule-based system is a business project, not an IT project
- Business management must want this more than you do for it to succeed
- Sell the business on the idea, and IT will follow
- The business rules sharpen your competitive edge



- Clients need to be involved with the Knowledge Acquisition process, especially the initial expert meetings, in order to provide their vision, and leadership
- Get experts together first. Let them decide how to work together and divide up the work
- Train and enable the experts to document their own business rules



Lessons Learned: Compressor Expert System

- SME interview schedule (how many trips, who, when, where) needs to be finalized up front
 - To get commitment/availability
 - To estimate travel costs
- SME interviewing is a critical success factor



- Check the Holiday schedules in the other countries
 - We proposed a two-week SME meeting in Japan in August, and they accepted
 - When we arrived, we learned that both Mondays were holidays and the Tokyo office was closed
 - Our Japanese colleagues were too polite to ask us to reschedule



Tim Berners-Lee August 1991

- Releases the code for his new programs "World Wide Web", HTTP, HTML, URI via the Internet
- Posts a note on alt.hypertext
- info.cern.ch gets 100 hits/day



Tim Berners-Lee December 1991

- Submits proposal to demonstrate his new program "World Wide Web" at the Hypertext '91 Conference
- Rejected, because it "violated the architectural principles that hypertext systems had worked on up till then."

^{*} Weaving the Web by Tim Berners-Lee with Mark Fischetti, (Harper San Francisco; Hardback: ISBN:0062515861) page 50



info.cern.ch gets 1,000 hits/day



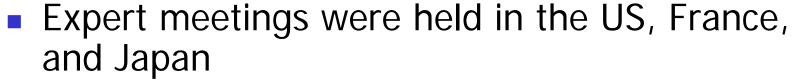
Mobil Lube Knowledge Base 1993 – Grease Expert System – GES

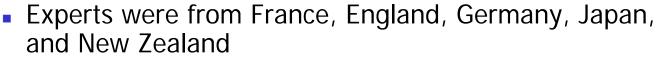
- GES was the 2nd system built as part of the Lube Knowledge Base
 - Designed to help lube marketers increase sales and profitability by providing expert advice
- Scope
 - Produce selection and recommendation
 - Problem troubleshooting
- Built to support Int'l Marketing's Worldwide Grease Sales Campaign, launched Q1 1993
 - This marked the first time Mobil released an IT system to support a major marketing campaign at the same time the marketing program was launched!



Mobil Lube Knowledge Base Grease Expert System – GES









Development cost hundreds of thousands of dollars



• Under budget by 9 %



 Even though scope was larger than CES, we cut development costs by 50 % by reusing code



 Reused CES code for equipment problem diagnosis, expert advice, help, reports, and hypertext glossary



Mobil Lube Knowledge Base Grease Expert System – GES

- This was a big success and a big deal
 - IT & Marketing worked together to develop a business strategy and computer systems to support it
- Previously, IT would learn about new business strategy after it was in effect
- GES was released March 1, 1993, the same day the global marketing campaign began
 - The Internet was still not on our radar screens



Reusing OO code really works

- To reuse is smarter than to reinvent
- We achieved significant cost/time savings by reusing components from GES
- New GES components for product selection were now available for future reuse too
- You need someone to manage the reusable code library

Demo system to users before field testing

- Got good feedback on GUI, functionality, reporting
- Got user buy in before the final product was even released!



Lessons Learned: Mobil's Experience with AIONDS

- Rulebase must handle multiple developers
- Get training & consulting
- Develop a strategy, standards, & methodology





Lessons Learned: Mobil's Experience with AIONDS

- RAD/iterative prototyping
 - Build first system
 - Build first common code library
 - You have to build it before you can reuse it
 - 3. Build next system by re-using code library
 - 4. Enhance library with new functionality
 - Repeat steps 3 & 4



Actual Results with AIONDS					
System	Compressor Equipment Troubleshooting Knowledgebase	Grease Product Recommendation Knowledgebase	EHS Safety Audit Knowledgebase		
Scope	Full-size	Full-size	Prototype		
Rules	300	300	100		
Experts	8	9	1		
Clients	2	1	1		
Users	> 200	> 200	< 20		



Actual Results with AIONDS					
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Clients	2	1	1		
Users	> 200	> 200	< 20		
IT Team	3	2	1		
Dev Days	207	112	60		
Budget	5% Over	9% Under	1% Over		





Lessons Learned: Mobil's Experience with AIONDS

 Average Task Allocations for LKB Rule-Based Expert Systems

Programming	40%
Project Mgmt	17 %
Expert Interviews	14 %
Other	12 %
Contingency	10 %
Testing	7 %



Lessons Learned: AIONDS Benefits & Disadvantages

- + Advanced development/debugging tools
- +Can interface external programs such as graphics & security
- + Can develop custom code for backup/save case/recall case
- + Easy to build reusable code library
- + User training not needed
- + HPO is essential



Lessons Learned: AIONDS Benefits & Disadvantages

- Initial learning curve, but high productivity payoff
- High runtime costs limit # of users

 When will the rule vendors eliminate runtime per copy fees? That's one of the problems preventing this from getting in the mainstream



Lessons Learned: Building Rule-Based Systems at Mobil

- Use multiple experts for international systems
- Conduct design reviews with expert consultant
- Knowledge acquisition is critical task
- AIONDS enables reuse of objects, rules, and functions
- Development costs can be cut over 50% by reusing object-oriented AIONDS code



Critical Success Factors	Issues	
Knowledge Acquisition (KA) involving	■KA Methodology	
multiple, geographically-dispersed experts	■KA technique selection	
	■KA planning/coordination	
	■KA analysis and synthesis	
■Structural and behavioral <i>Diagnostic</i>	 Diagnostic problem solving approaches 	
Problem Solving Model development	Representation of structural knowledge	
	Representation of behavioral knowledge	

Lube Knowledge Base / ES Critical Success Factors

Critical Success Factors	Issues
■Expert system software technical design	■Expert system architecture
	Knowledge base structure
	■Modular ES design strategies
	 Rule processing – forward-chaining, backward-chaining, bi-directional chaining, inference engine control
	 Object processing – class/instance data model, inheritance, demons, attached procedures, message passing
	Procedure processing – processed, functions, control structures
■Expert system and ADS ES shell	■AI programming
programming	■Modular code development
	■Efficient data structures
	■Data encapsulation / Polymorphism
	■Test and evaluation



info.cern.ch gets 10,000 hits/day



Tim Berners-Lee December 1994

- info.cern.ch gets 100,000 hits/day
- NetScape releases Navigator 1.0 WWW Browser
- Gives it away for free via Internet



Tim Berners-Lee 1995

- April Compaq ships first PCs with preload browser, Navigator
- May Sun introduces Java
- August Microsoft releases Windows95, with Internet Explorer

The WWW is finally on everybody's radar screens



Integrated 90's



Client-Server Rule Engines

Rulebases integrated with missioncritical, legacy, OLTP, OLAP, & operational C/S applications



Social Security System

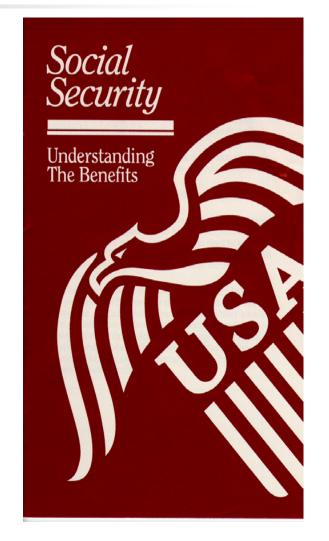
- The U.S. Social Security System is huge
 - Legislation business rules are extremely complex
- Canada's Income Security Program is similar
- In the mid-1990's Canada started reengineering their 1960's legacy system to handle Y2K
 - They decided to use a Business Rule Engine as the core technology to handle all the eligibility & entitlement business rules
 - This rulebase processes 10 million benefit checks every month



U.S. Social Security Program

\$400 Billion or
 \$400,000,000,000 in
 U.S. Social Security
 taxes collected in
 1995

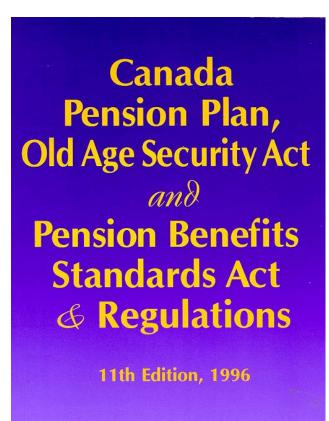
Provides half the income of most retirees



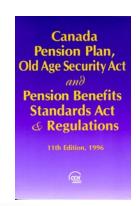


Canada Income Security Programs (ISP)

- \$39.4 Billion or
 \$39,400,000,000 in
 benefits paid in 1996 1997
- 120 million payment transactions/yr.
- 10 million checks a month



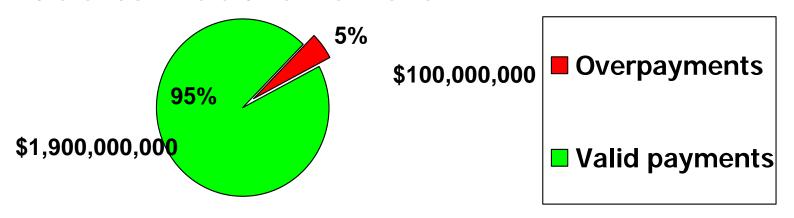






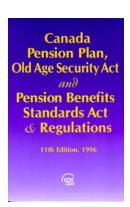
ISP Disability Payments

- Almost \$2 Billion in disability payments/year
- But \$100 Million of that was <u>overpaid</u> due to fraud or errors





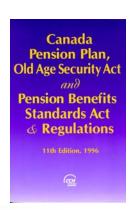
Major Crown Project: Reengineer Social Security



- Reengineer ISP & build new system: Client Services Delivery Network (CSDN)
- EDS won \$103 Million contract to build & deliver CSDN
- LESSON: EDS was selected over Arthur Anderson mainly because their proposal included a rulebase engine to handle the complex & dynamic business rules requirements



Canada Social Security CSDN Business Case

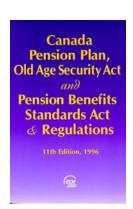


- Improved efficiency
 - \$40 Million/yr or \$683 Million/15yrs
 - 600 positions over 5 years

- Error & fraud reductions due to new rulebase
 - \$45 Million/yr or \$703 Million/15yrs



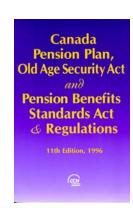
Risks controlled by new CSDN Rulebase



- Accepting applications that do not meet <u>application rules</u>
- Paying benefits to recipients that do not meet all <u>eligibility rules</u>
- Overpaying eligible recipients more than they are entitled to according to entitlement rules



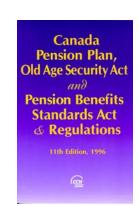
Social Security CSDN Business Rules



- Rules consist of
 - Regulations
 - Legislations
 - Policies
 - Guidelines
 - Etc.



Social Security CSDN Project Highlights



- AIONDS rule engine
- Top experts assigned to this project full-time
- 10 Knowledge engineers
- 300+ UI and Database developers
- Business rule components followed a rigorous design & methodology
 - Rules architecture was robust enough that it was reused on other Govt. of Canada projects, such as for Veterans Administration Entitlement Programs



Networked 2000's



Internet Rule Servers



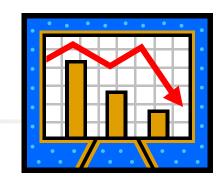
 "640K of RAM ought to be enough for anybody."

Bill Gates

2000

- Today companies are rushing into CRM, e-Commerce, 1-to-1 personalization, email personalization, B2C, B2B, P2P, etc.
- Yet "Business Rules" are still missing
 - Are business rules in your strategic architecture or IT Blueprint?
 - You have data people (DBAs) and code people
 - But do you have any rule people?
 - Do you have Business Rules Analysts, Rulebase Architects, Chief Knowledge Officers?
 - Shameless plug

2000



- It's the rules stupid
 - If you are not managing business rules, you're dead
 - If you're competitors are and you aren't, you're dead
- What's different today?
 - All of a sudden, Consumers and Competitors have access to your previously-internal IT systems
 - Do you want your competitors to see what shape your mission-critical systems are in?



What's wrong with CRM/personalization today?

- Companies are not focused on the business rules
- Business Managers don't know how to manage business rules
- We have never trained the Business to create or manage business rules
- Business Analysts are not trained in finding, simplifying, or documenting business rules
- IT is great at automating data and information - - But we are not trained in automating business rules or knowledge



What's wrong with CRM/personalization today?

- IT doesn't deal with business rule automation because the business isn't asking for it
- The Business isn't asking because they don't even know it's doable...
 - Business executives do not know that business rules can be automated
 - They do not know the benefits of business rule automation
 - They do not know the RISKS of not automating business rules and letting competitors do it
- We need to educate IT & the Business



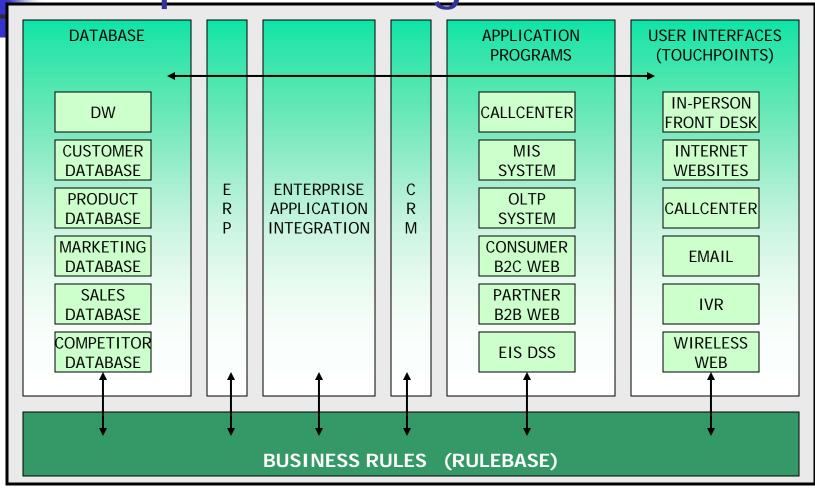
- Business rules ultimately determine how you manage customer relationships across all touchpoints
 - What are best practices for writing business rules?
 - Does the company with the best rules (or most customer-friendly rules) win?
- What happens when everyone in an industry buys BroadVision, Siebel or Art Dynamo?
 - Then we're all back to the same level again...
 - We're Just Staying in Business



Business Rules Differentiate you from the Competition

- As technology evolves, all the players in an industry buy the same technology just to stay in business...
 - DP, MIS, RDBMS, OOP, OLTP, OLAP, EIS, DSS, DW, ERP, SMS, WEB, CRM, ERM, EAI, B2C, B2B, P2P, 121, PERSONALIZATION, TBD...
- There's no edge if the enemy has the same technology

Business Rules Sharpen Your Competitive Edge



- 1. Store business rules in a RuleBase so all applications can share the same rules
- 2. Separate business rules from the program code, database, and user interface



Business Challenges in 2000

Need to provide personalized, one-to-one service to Consumers and Partners

Managing knowledge, especially business rules

Need ability to change business rules instantly

Need to re-engineer and simplify the Business Rules



Dealing with Rapid **Business** change And Increasing

complexity

Time to Market

> **Increasingly** Complex rules

Business logic mixed with program logic

Changing or adding business logic can break existing logic documented

Business Rules aren't **Properly**

Business logic Duplicated across systems



IT Challenges in 2000

- Moving to component-based development of UI, Rule, and Data objects
- Building flexible systems that can support unknown future requirements
 - Today our systems limit what the business can do



IT Challenges in 2000

- We don't know the rules in our systems, yet they run the business
- Existing rules may actually be inherited system constraints
- Different IT units document rules differently, if at all
- Business people speak business rules, yet IT speaks data and code
- Managing knowledge, especially business rules



IT Opportunities in 2000

- Build a component Rulebase or Rule Repository that can be shared across the enterprise
- Create a shared rules team to develop shared business rule components and to promote reuse
- Use data-driven and goal-driven rule chaining technology to simplify development of complex business rule applications
- Separate business logic from program logic, and centralize rules on servers



IT Opportunities in 2000

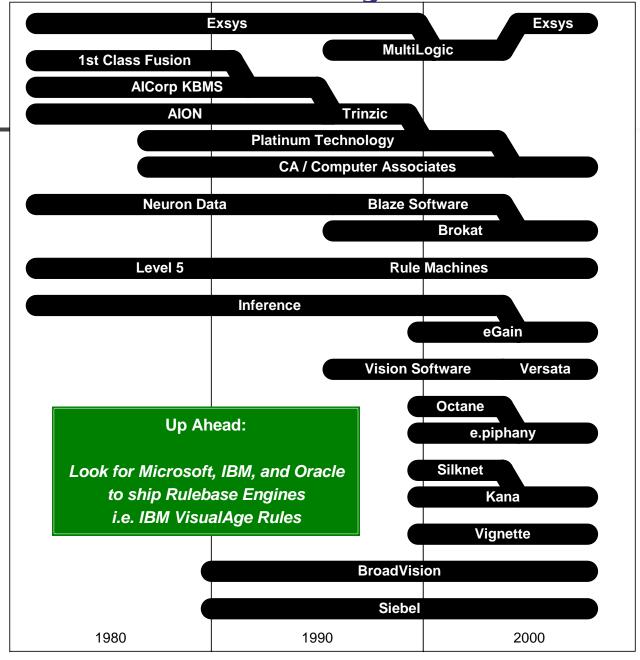
- Changing or adding rules should not break existing rules
- Re-engineer and simplify the rules that run the business
- Standardize how we elicit, document, and program rules
- Create a Knowledge Management group to refine & implement the KM Strategy



IT Opportunities in 2000

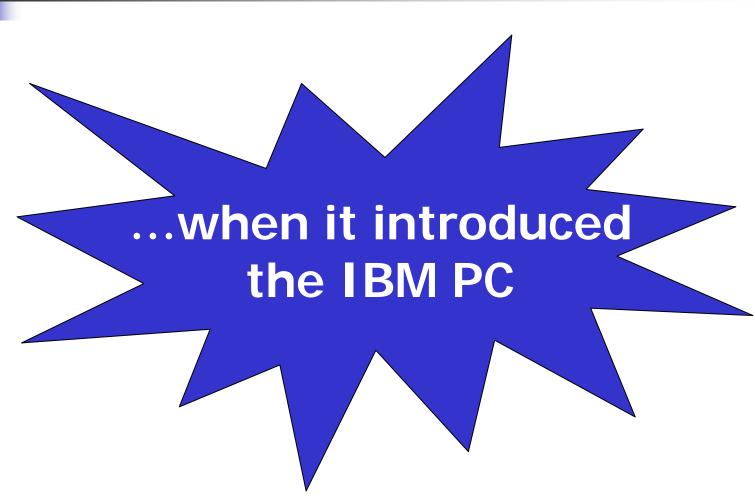
- Rules can give you these benefits:
 - Eliminate redundancy, improve effectiveness, and cut costs
 - Turn your company's knowledge and expertise into a valuable corporate asset
 - IT and Business people finally speak a common language: Business Rules
 - Use rules metrics to estimate time & effort, and to track progress
 - Sharpens your competitive edge

Rulebase Family Tree





IBM legitimized the personal computer business...



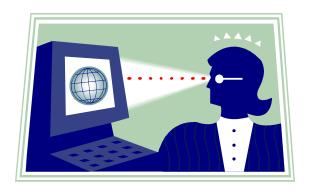


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"The best way to predict the future is to invent it"

Alan Kay





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