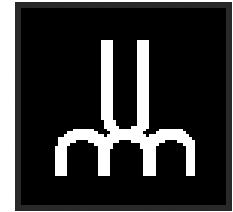


Université de Montréal

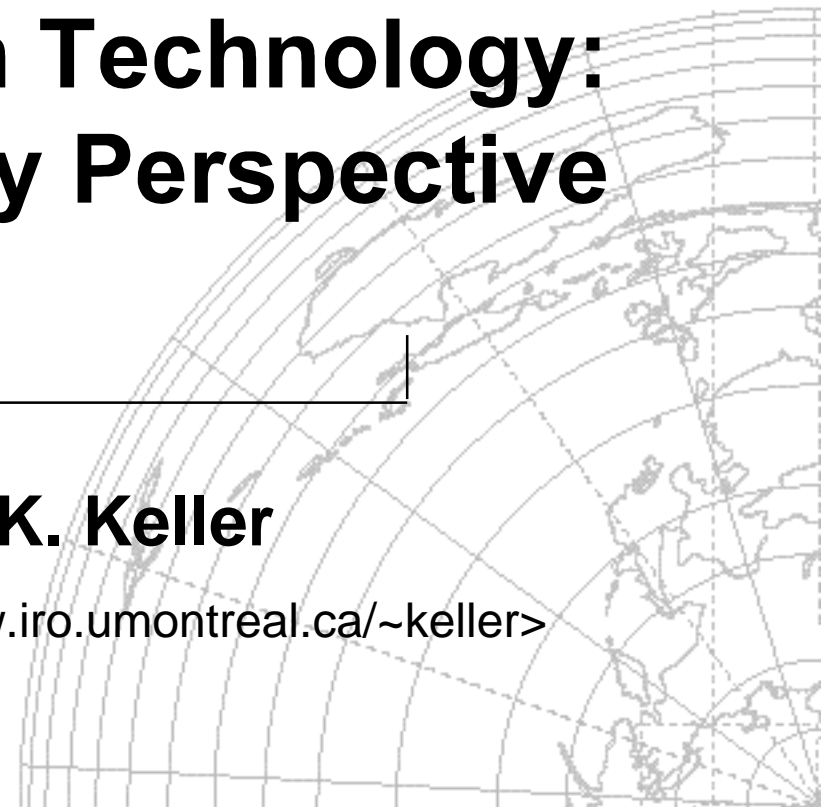


**Collaborative Research in
Information Technology:
A University Perspective**

Rudolf K. Keller

<http://www.iro.umontreal.ca/~keller>

Presentation at IMAC, April 26, 2000



Contents

- **Context: DIRO and GÉLO**
- **Reverse Engineering (SPOOL Project)**
- **E-Commerce (TEM Project)**
- **Perspective and Conclusion**

Département d'informatique et de recherche opérationnelle (DIRO)

- **Faculté des Arts et des Sciences**
- **Computer science and operations research**
- **37 faculty positions (28 in CS)**
- **Degrees awarded per year**
 - 80 B.Sc. (3% of Canadian CS)
 - 25 major, minor, certificate
 - 15-20 M.Sc. (3.5% of Canadian CS)
 - 8-12 Ph.D. (16% of Canadian CS)

DIRO

Faculty Research

- **Research areas**
 - artificial intelligence
 - computational biology
 - computer vision & graphics
 - microelectronic, systems specification & verification, VLSI
 - quantum computing, cryptography, theoretical cs
 - software engineering, telecom
- **Research grants and contracts: 5,6 M\$ (1998-99)**
 - NSERC & other federal sources: 2,7 M\$
 - provincial sources: 1,0 M\$
 - other sources: 1,9 M\$

DIRO

Research Links within Academia

- **Affiliated schools & institutions (UdeM)**
 - Centre de recherche sur les transports (CRT)
 - Centre de recherches mathématiques (CRM)
 - Laboratoire Universitaire Bell (RCM2-LUB)
 - Centre de recherche en calcul appliqué (CERCA)
 - Centre interuniversitaire de recherche en analyse des organisations (CIRANO)
 - Groupe d'étude et de recherche en anal. des décisions (GERAD)
- **Other research centers and networks**
 - Consortium for Software Engineering Research (CSER)

DIRO

Research Links with Industry

- **Bell Canada (SE, telecom, OR, comput. linguistics)**
- **Ericsson (programming languages)**
- **NEC, Discreet Logic, Taarna studio (computer graphics & vision)**
- **Nortel Networks (microelectronic, telecom, SE)**
- **UdeM hospitals (computer vision)**
- **AT&T (data mining, pattern recognition)**

Laboratoire de génie logiciel (GÉLO)

Software Engineering Lab

- **Research group**

- 3 professors
- 18 graduate students

- **Teaching SE at DIRO**

- strong baseline curriculum in CS
- *B.Sc. Option Génie Logiciel* (starting in fall 2000)

- **Research areas**

- quality estimation models
- software migration
- distributed object systems
- reverse engineering (SPOOL)
- electronic commerce (TEM)



Reverse Engineering *SPOOL Project*



Quality Engineering Group



GÉLO Group



*Consortium for Software Engineering Research
Consortium de recherche en génie logiciel*

NRC-CMRC



SPOOL

Spreading Desirable Properties
into the Design of
Object-Oriented, Large-Scale
Software Systems

SPOOL Project

Motivation & Approach

- **Acquisition of large OO real-time systems by Bell**
 - product selection, risk assessment
- **Design as key factor of influence on software quality**
- **Goal:** Identify and quantify those design properties that are significant for maintainability and evolvability
- **Approach:**
 - parse legacy C++ software
 - analyze design models
 - visualize, quantify, and interpret results

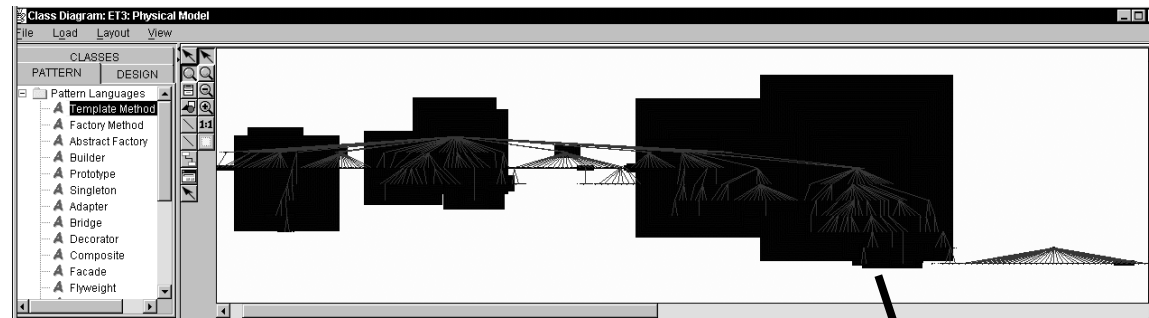
SPOOL Project

Reverse Engineering Environment

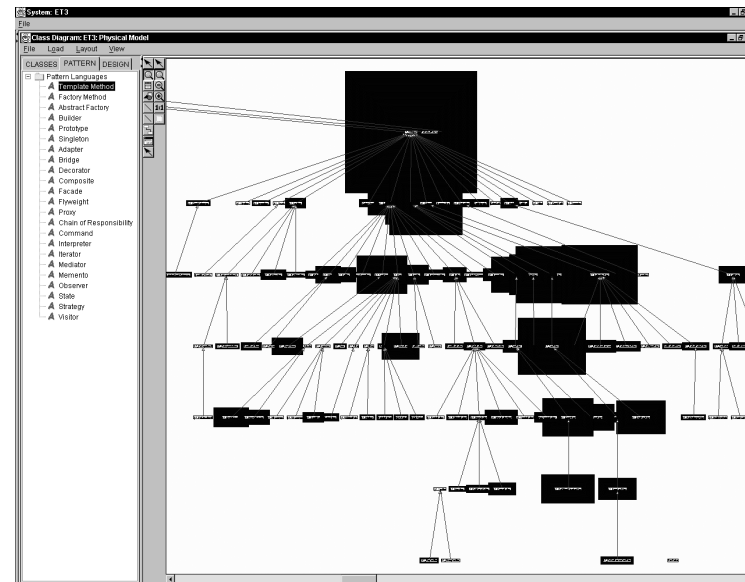
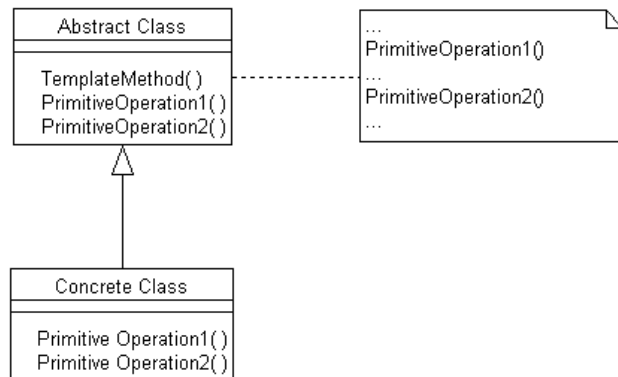


SPOOL Project

Detection of Design Patterns



Template Method:



SPOOL Project

Research Questions and Areas

- **What makes for a good object-oriented design?
How do you achieve it?**
- **Given a system that Bell considers buying...**
 - have good/bad design patterns been used?
 - how are the pattern instances distributed?
- **Research areas**
 - pattern detection techniques
 - visualization of pattern instances and distribution
 - metrics and quantitative methods
 - pattern quality assessment

SPOOL Project

Results of First Four Years

- **Scientific and technical highlights**
 - numerous publications
 - SPOOL reverse engineering environment
 - demos at IBM CASCON, ICSE'99 Los Angeles, etc.
 - technology transfer to Bell
 - **Educational impact**
 - training of 3 Ph.D., 10 M.Sc. students, 2 research associates
 - 3 new/adapted software engineering courses
 - **Interaction with Bell, CSER, research community**
 - Strong Canadian presence in reverse engineering community
-

SPOOL Project

Lessons Learned (1)

- **Industry-led research**

- industrial partner as client, increased pressure to succeed
- additional criteria of success: applicability, relevance
 - examples: SPOOL renewal proposal
- research proposal as contract with deliverables from both sides
 - example: availability of data for experimentation
- interaction culture
 - example: student presentations

SPOOL Project

Lessons Learned (2)

- **Reverse engineering research**
 - powerful tool infrastructure is essential
 - costly, long-term investment
 - charms and risks of high-tech tools and standards, e.g., JavaCC, UML metamodel
 - importance and risks of tool reuse, e.g., parsing and visualization tools
 - availability of industrial-strength case studies is essential

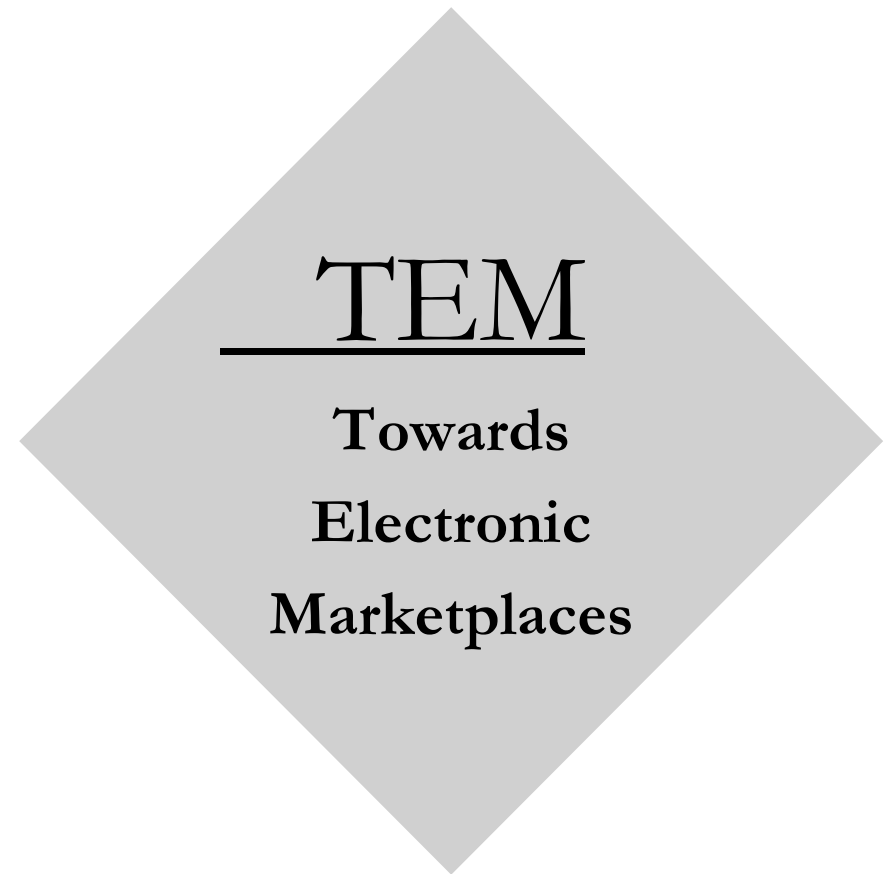
SPOOL Project

Lessons Learned (3)

- **Recruitment of quality students**
 - structural problem: limited number of available students
 - selling factors: industry-led project, practical emphasis (tools, experiments), scholarships
 - chicken and egg situation

Electronic Commerce

TEM Project



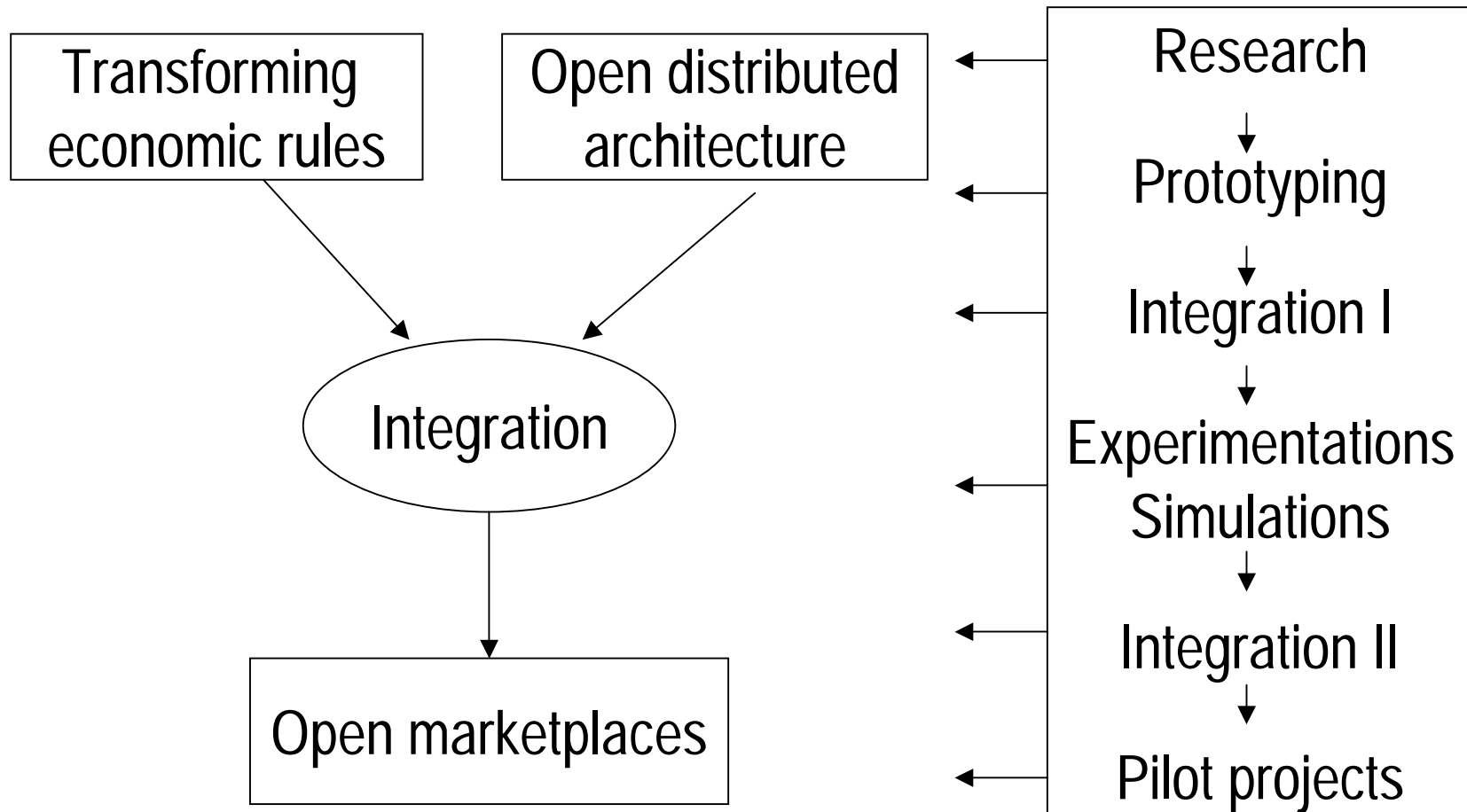
TEM Project

Structure and Build-Up

- **Networked structure**
 - Industry-university collaboration (Bell University Lab)
 - Multi-disciplinary: SE, OR, economics
 - Multi-institutional: UdeM, ULaval, CIRANO
- **Incremental project build-up (start: summer 1999)**
 - Bell University Lab
 - NSERC matching funds
 - Conseil du Trésor du Québec (Apéero project)
 - EU project (proposal as subcontractor)
 - Valorisation-Recherche Québec (proposal in preparation)
 - Networks of Centers of Excellence (GISST; not successful)

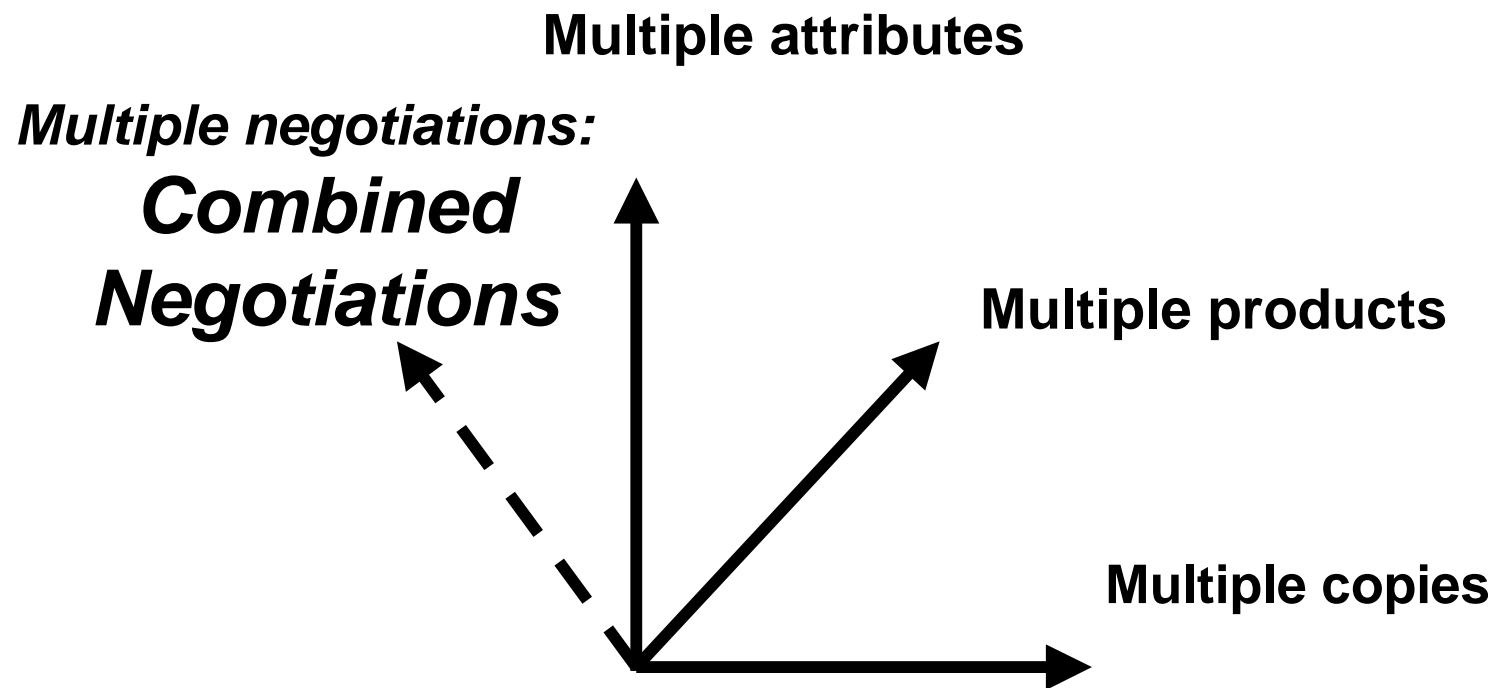
TEM Project

Goals and Added-Value Chain



TEM Project

Combined Negotiations



(adapted from Anant Jhingran, IBM TJ Watson)

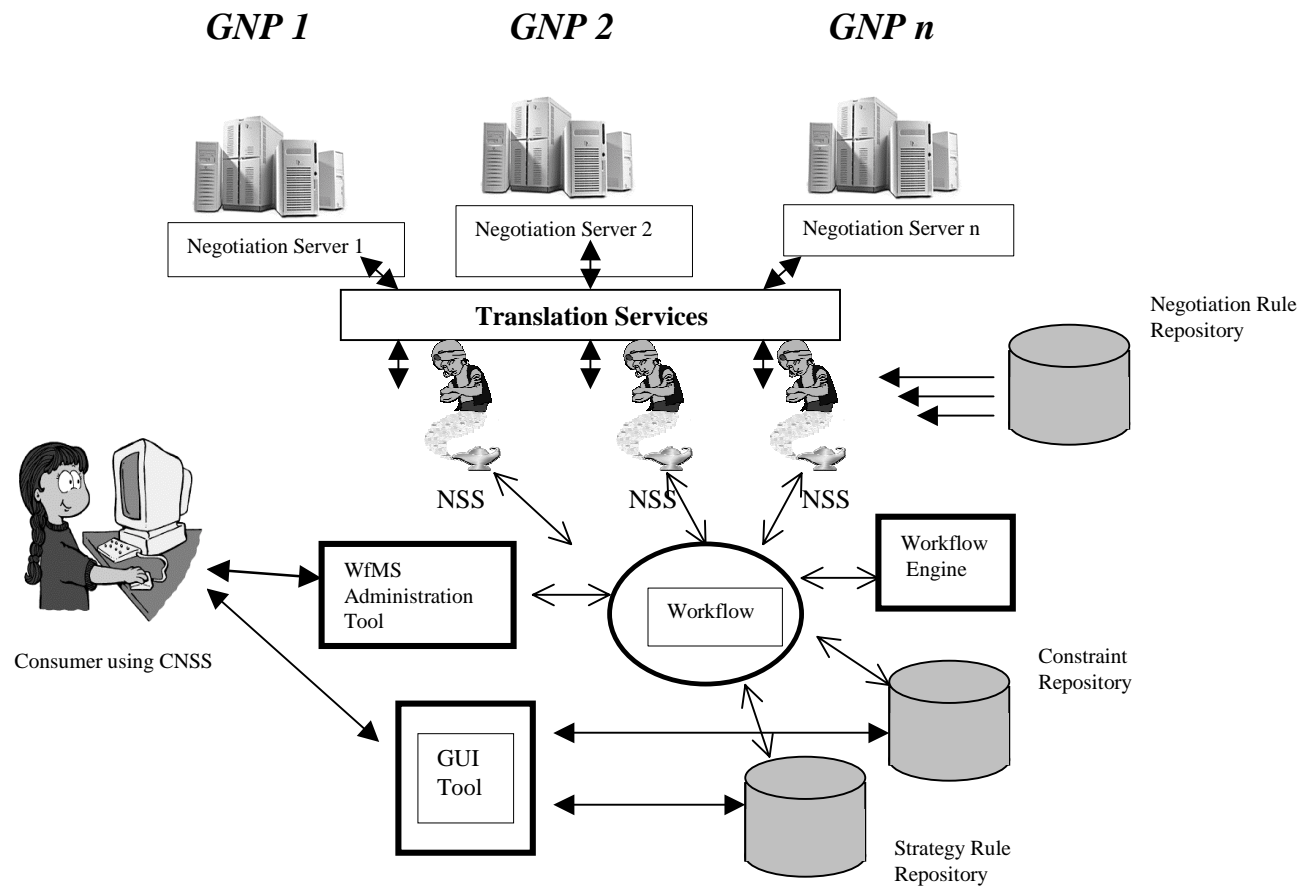
TEM Project

Combined Negotiation Support System (CNSS)

- Engage in many negotiations at the same time and respect constraints and dependencies
- Track, monitor and record the progress of the negotiations
- Support the user in taking decisions by means of software agents: negotiation support software (NSS)
- Simulation environment based on Generic Negotiation Platform (GNP)

TEM Project

CNSS Vision



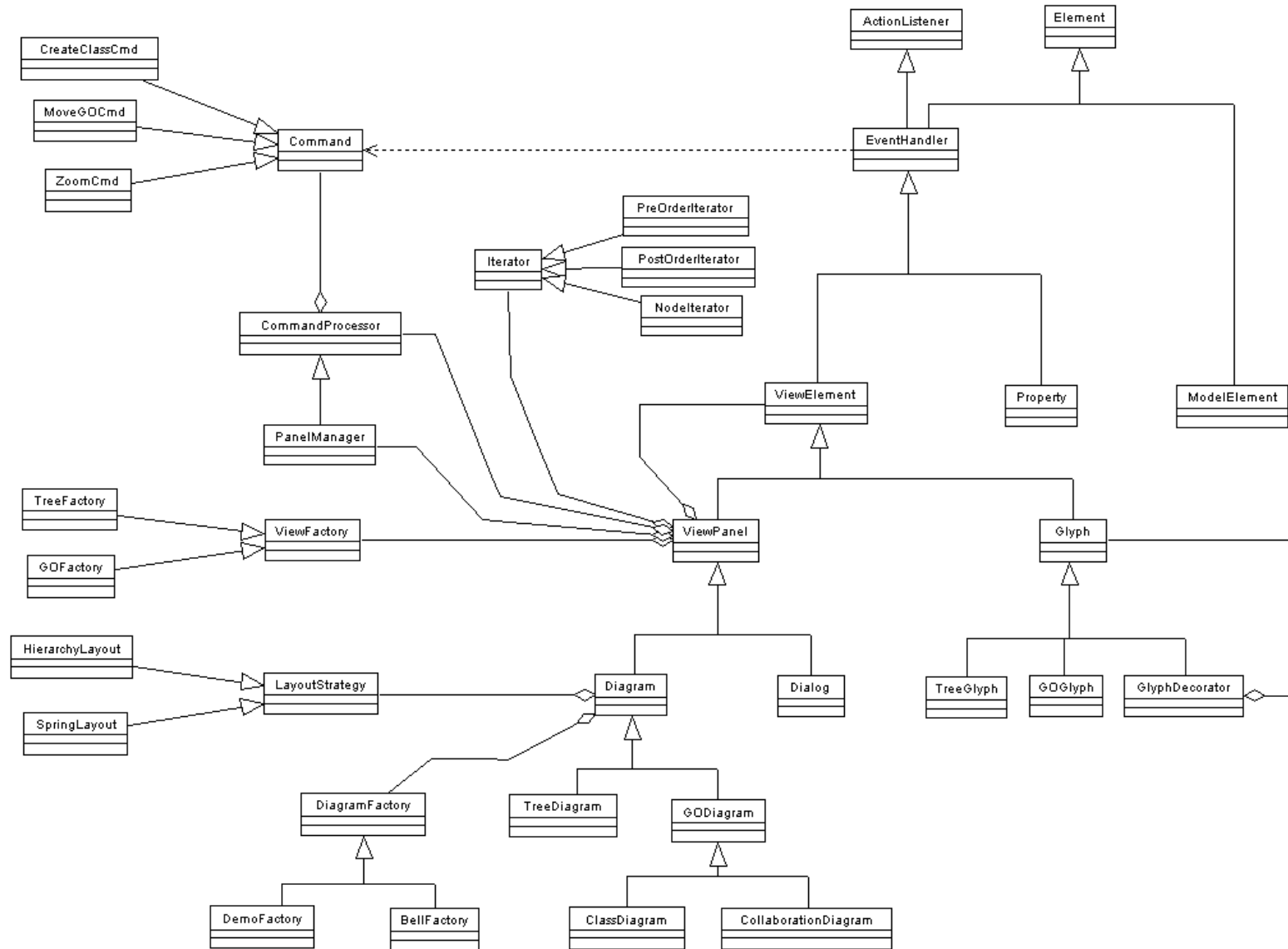
Perspective: *National Research Agenda for Canada in E-Commerce*

- **Workshop organized by Dalhousie University (J. Slonim, M. Gentleman) in December 1999**
- **Distinctive attributes of research in e-commerce**
 - multi-disciplinary in nature
 - traditional metrics for assessing research are inadequate
 - flexible and responsive research designs are needed
 - diverse knowledge incubators are needed
 - knowledge must be rapidly translated into practice
 - ongoing management and adaptation are critical
 - new management and funding model is needed

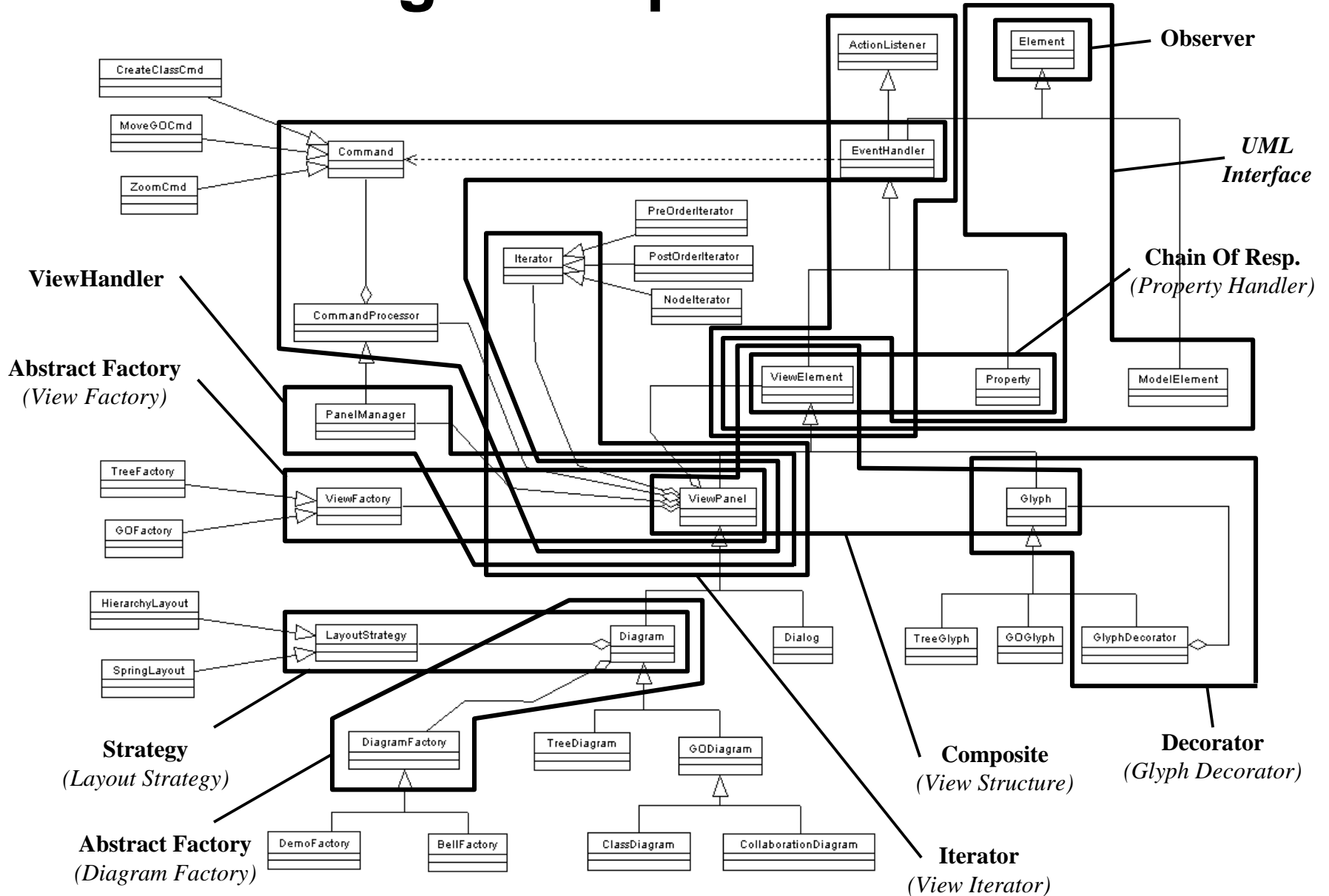
Conclusion

- **Two examples of collaborative research involving GÉLO/DIRO**
- **Reverse engineering and e-commerce as two domains of high practical and scientific interest**
- **Win-win collaborations are costly to forge but prove highly rewarding**
- **Lessons to be learned**
- **Research model requires continual adaptation in fast-moving IT sector**

Problem: Design Obfuscation



Solution: Design Components



SPOOL Project

Architecture of SPOOL Environment

