Financial Information Integration in the Presence of Equational Ontological Conflicts

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Is there a better way…

- No single international accounting standard exists
  - "90 per cent of institutional investors favored a single international accounting standard, but they differed over what it should be" McKinsey
- Standards and preferences change over time
  - e.g. Worldbank is gradually moving from 1968 System of National Accounts (SNA) to 1993 SNA
  - WorldCom Causes Analysts To Evaluate Ebitda's Role **(WSJ)**
- Local practices are hard to change
  - US adopted(!) the metric standards for length and mass in 1893

… to access disparate financial information?

Roadmap

- Key Concepts
- Solution Methodology
- Prototype
- Concluding Remarks

Equational Ontological Conflicts

Key Concepts

# of customers = # of end_customers + # of distributors	# of customers = # of end_customers + # of prospective customers
Gross Profit = Net Sales – Cost of Goods	Gross Profit = Net Sales – Cost of Goods – Depreciation
P/E Ratio = Price / Earnings(last 4 Qtr)	P/E Ratio = Price/ [Earnings(last 3 Qtr) +Earnings(next quarter)]
Price = Nominal Price + Shipping	Price = Nominal Price + Shipping + Tax

" heterogeneity in the way data items are *calculated* from other data items *in terms of definitional equations*"

EOC between standards

Key Concepts

"Change in Terminology [http://www.worldbank.org/data/changinterm.html]

Following current statistical practice, the World Bank has recently adopted the new terminology in line with the 1993 System of National Accounts (SNA).
In general, the definitions under the 1993 SNA guidelines remain as before, and only the terminology has changed. **Exceptions are**: GNI in constant prices, which differs from GNP in that it also includes a terms of trade adjustment; and gross capital formation which now includes a third category of capital formation: net acquisition of valuables. Included in gross capital formation under the 1993 SNA are capital outlays on defense establishments that may be used by the general public, such as schools, airfields, and hospitals. These expenses were treated as consumption in the earlier version of the SNA. "

(I) GNI in constant prices = GNP – Trade Adjustment Term

(II) Gross Capital Formation(New) = Gross Capital Formation(Old) + Net Acquisition of valuables + Capital outlays on defense establishments

EOC in Primark Databases

Key Concepts

Top 25 US Co. by Net Sales (Disclosure)

Rank	Company	Net Sales (000's)		Date
1	General Motors Corp	168,828,600	?	12/31/95
2	Ford Motor Co	137,137,000		12/31/95
3	Exxon Corp	121,804,000	?	12/31/95
4	Wal Mart Stores Inc	93,627,000		01/31/96
5	AT&T	79,609,000		12/31/95
6	Mobil Corp	73,413,000	?	12/31/95
7	International Business M	71,904,000		12/31/95
8	General Electric Co	70,028		
...	...	...		

Top 25 International Co. by Net Sales (Worldscope)

Rank	Company	Net Sales (000's)	Date
1	Mitsubishi Corporation	165,848,468	03/31/96
2	General Motors Corp	163,861,100	12/31/95
...	...	...	...
8	Exxon Corp	107,893,000	12/31/95
...	...	...	...
16	International Business M	71,940,000	12/31/95
17	General Electric Co	69,948,000	12/31/95
20	Mobil Corp	64,767,000	12/31/95
...	...	...	...

Primark was a company that owned:

- Disclosure
- Worldscope
- DataStream

Information services

Approach: ECOIN

Solution Methodology

- Context-based loosely-coupled integration

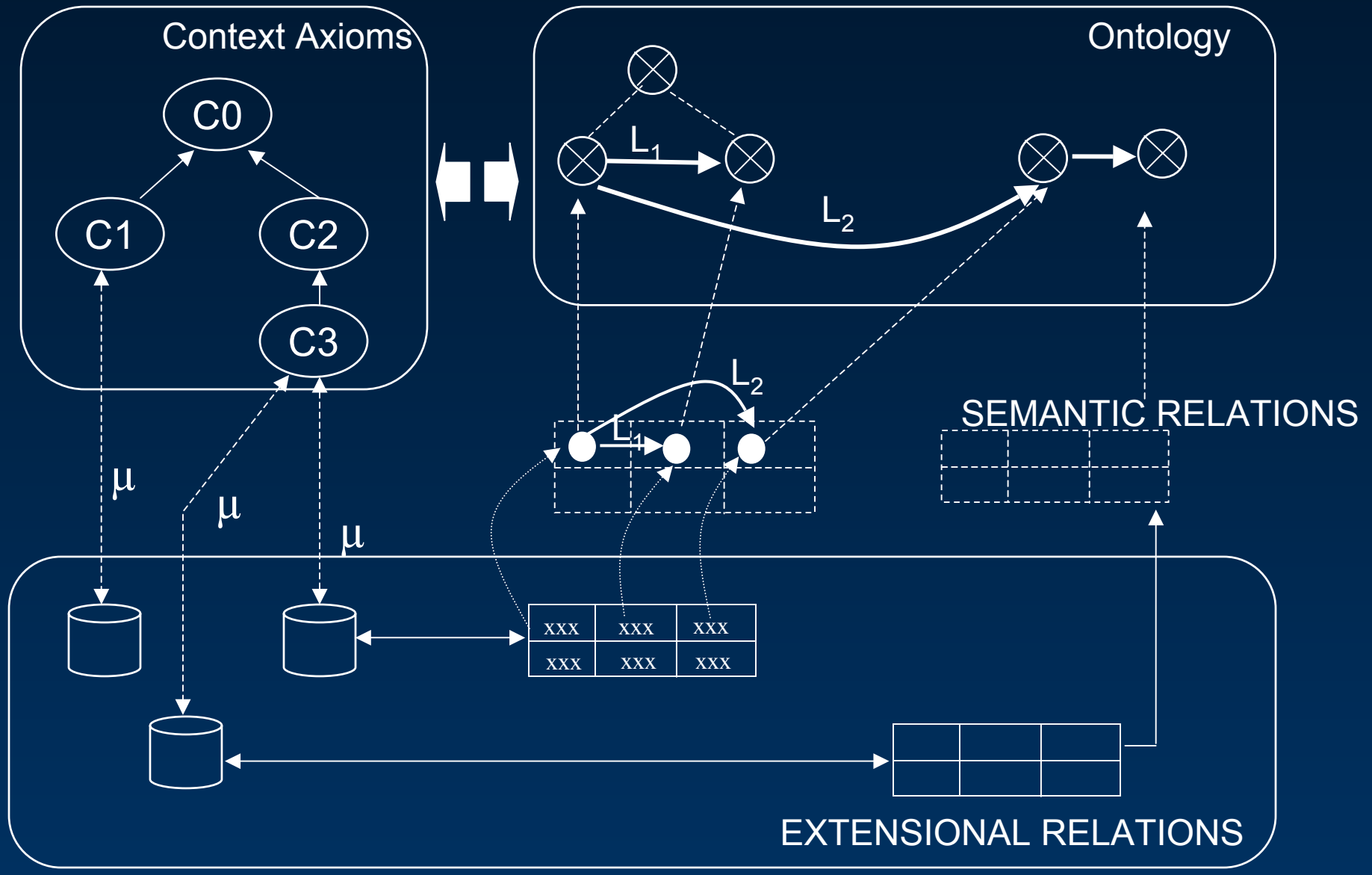
  Extends the Context Interchange (COIN) framework developed at MIT

- Symbolic Equation Solving using Constraint Logic Programming

  Integrates symbolic equation solving techniques with abductive logic programming

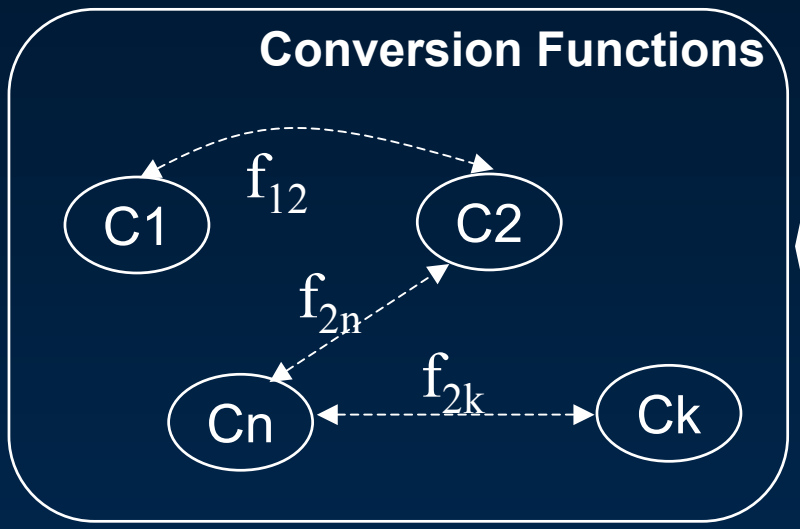
ECOIN Framework

Solution Methodology



ECOIN Framework

Solution Methodology



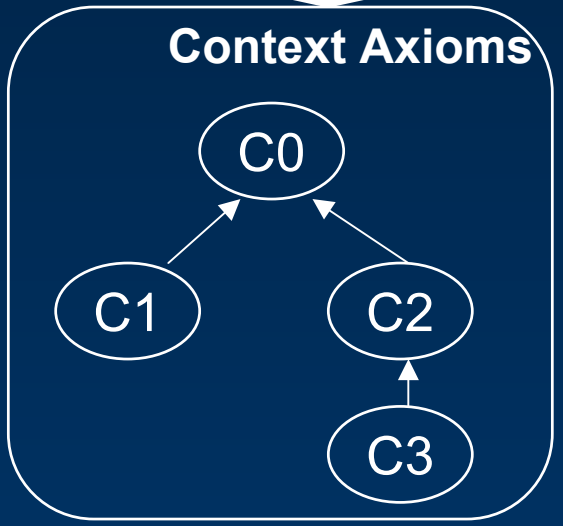
Constraint Handling Rules

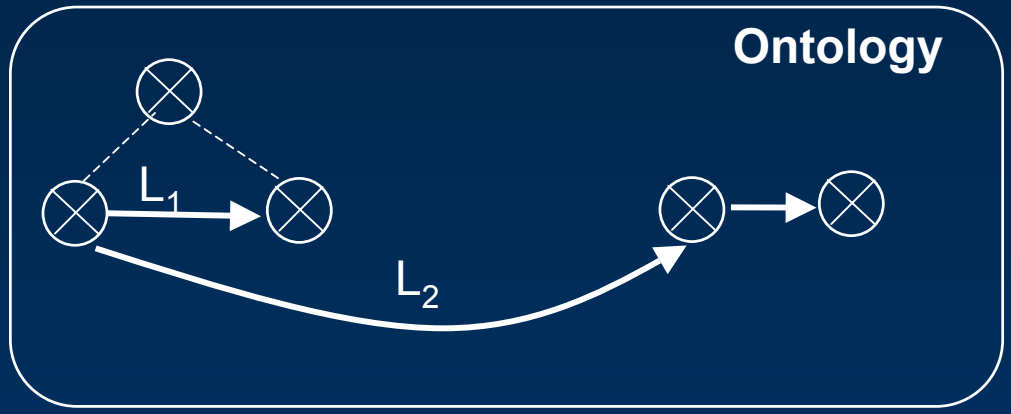
sum(X,Y,Z), bound(Z) ⇔ sub(Z,Y,X), bound(Z).

mul(X,Y,Z), bound(Z) ⇔ div(Z,Y,X), bound(Z).

div(X,A,Y), sub(B,Y,X) ⇔ ground(A), A~=-1| mul(A,B,N1), sum(1,A,N2), div(N1,N2,X).

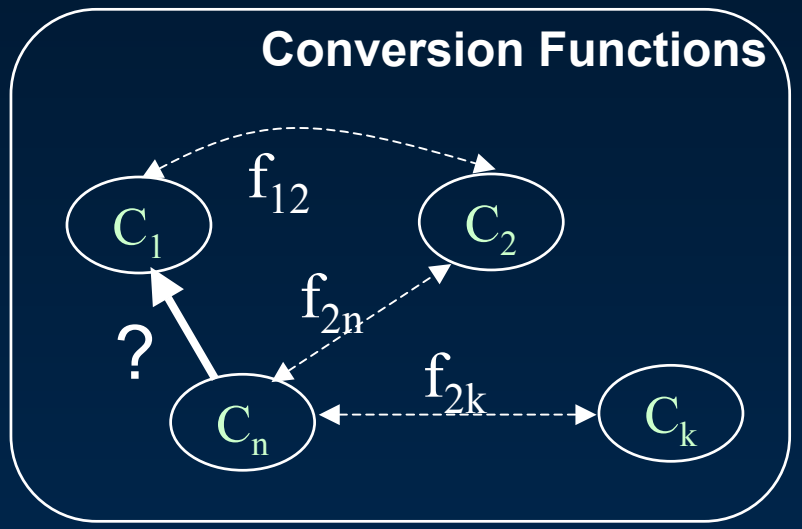
…





ECOIN Framework

Solution Methodology



C_1: Gross profit

C_2: Gross profit depreciation subtracted

C_n: Profit tax subtracted

Profit(c_n) ➔ Gross Profit(c_1) ?

f_{12}: Gross Profit(c_1) = Gross Profit(c_2) + Depreciation(c_2)

f_{2n}: Gross Profit(c_2) – Tax(c_2) = Profit(c_n) & Tax(c_2) = Gross Profit(c_2) * Tax Rate(c_2)

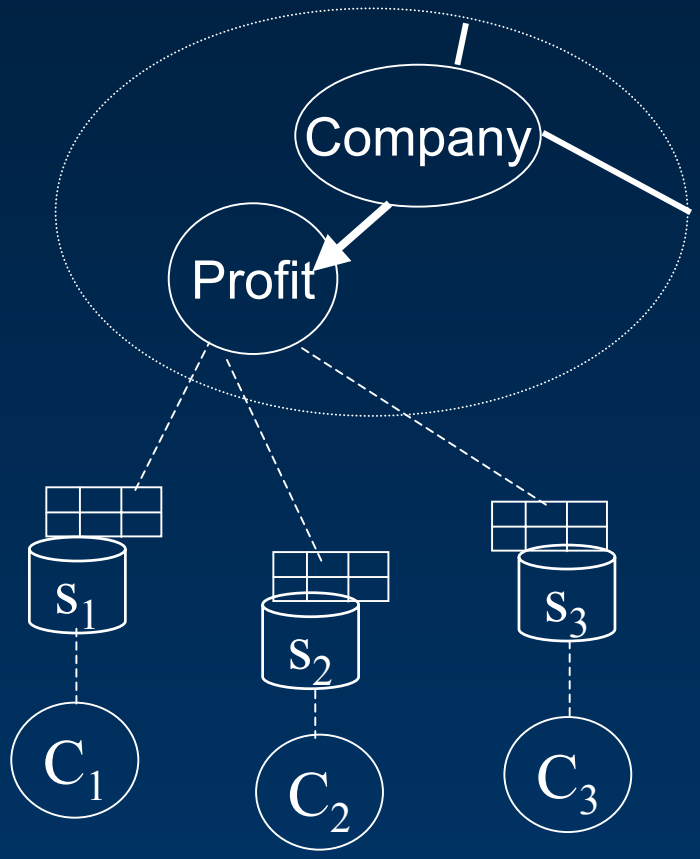
f_{12}, f_{2n} ⇒ Symbolic Equation Solver (+ Dijkstra's shortest path algorithm) ⇒ f_{n1}

f_{1n}: Profit(cn) + Gross Profit(c2) * Tax Rate(c2) + Depreciation(c2)

ECOIN Framework

Solution Methodology

- Treats equational ontological conflicts as contextual differences…



C_1: Gross profit

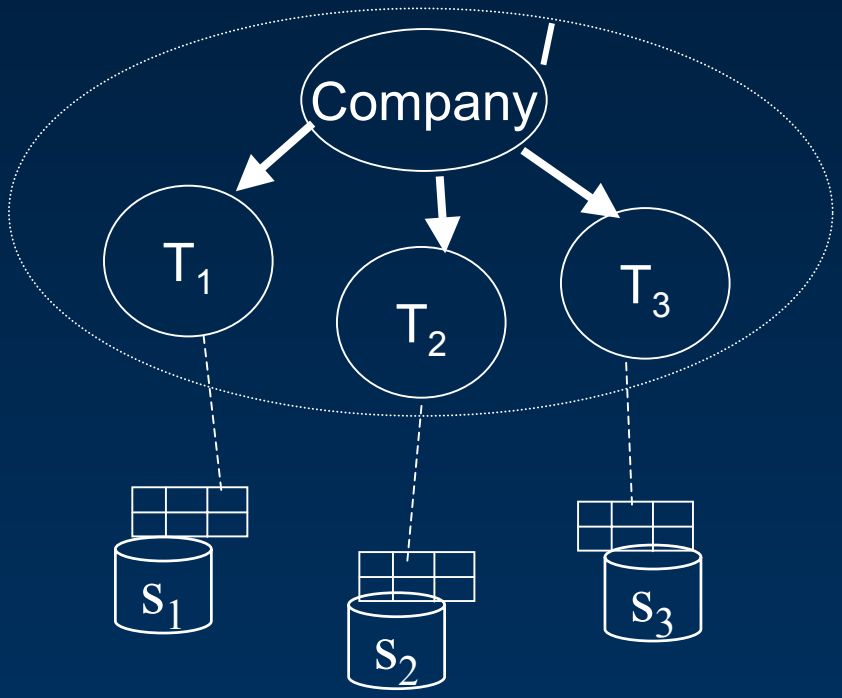
C_2: Gross profit depreciation subtracted

C_3: Profit tax subtracted

ECOIN Framework

Solution Methodology

- …as opposed to introducing new terms in the ontology



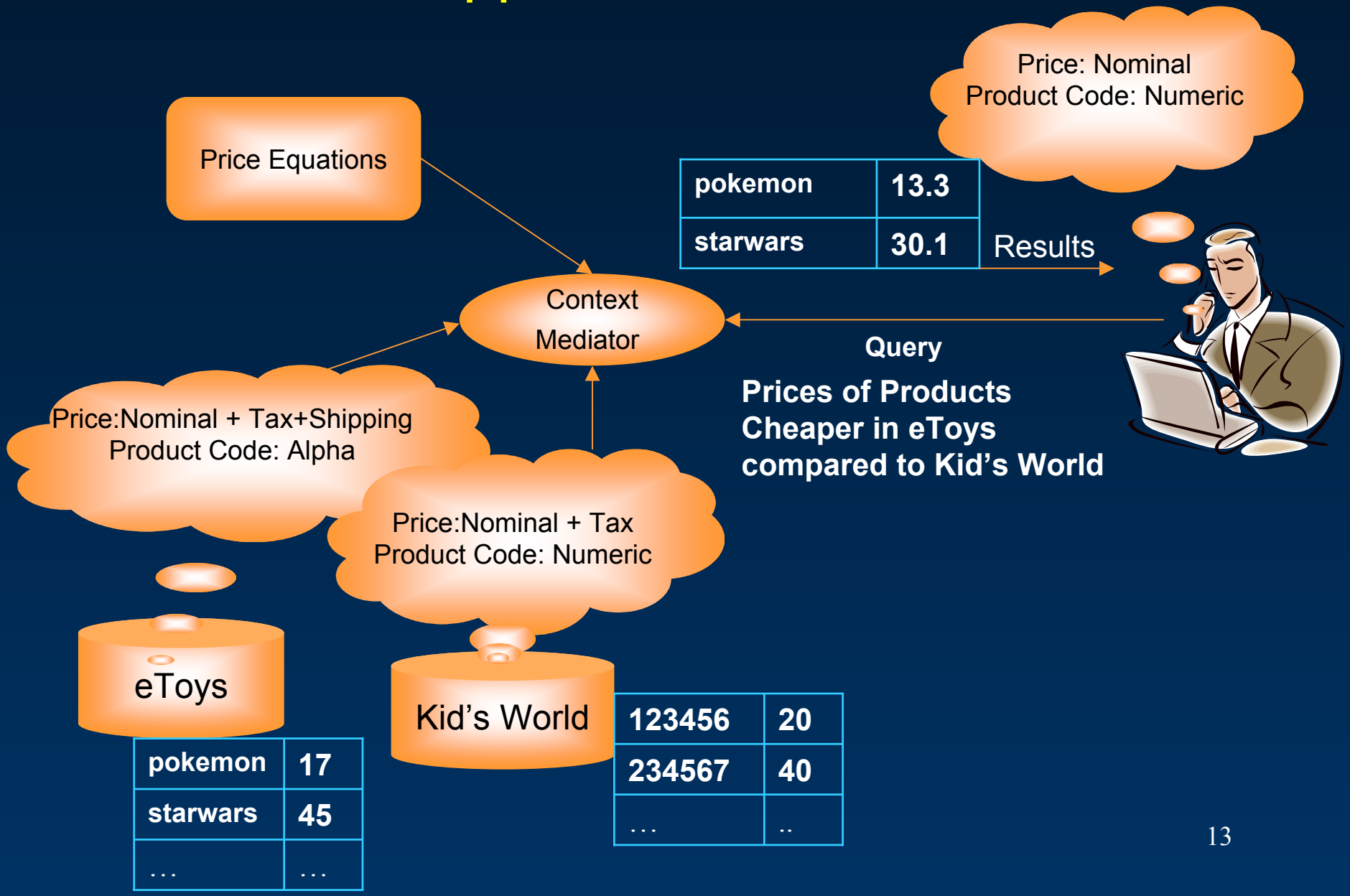
T_1: Gross profit

T_2: Gross profit depreciation subtracted

T_3: Profit tax subtracted

E-Business Application

Prototype



Concluding Remarks

- Equational Ontological Conflicts are widespread in financial information systems
- ECOIN provides a loosely-coupled approach to handling EOC with a logical context-based framework
- ECOIN does not require ontologies to be changed immediately, which is a costly process
- It can be also be used to understand the requirements of a standard