

Why Data?

The Need to Consider Other Issues for GIS-T

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GIS-T March 18, 2003

Presentation Goals

- ◆ Problem—GIS-T is flat. (“tired?”)
- ◆ Causes— Mainly due to a focus on data issues and a disregard for other issues.
- ◆ Issues—Paradigms(?) of Influence.
 - Technical. (“wired”)
 - Institutional/Cultural.
 - Cognitive/Semantic.
- ◆ Corrective Actions—What should we do now?
- ◆ I’m speaking as an implementer of GIS-T at a DOT.

After Reflecting on Dot's GIS-T Efforts...



Success!

Evidence of Success:

- ◆ Litany of studies.
- ◆ Host of data models.
- ◆ Tools, templates, GUI's, functionality.
- ◆ Standards, protocols, etc.
- ◆ Annual symposium.
- ◆ Legislation.
- ◆ Whole industries!

But After Deeper Examination...



*Has GIS-T stalled,
tempered, flattened?*

Evidence of Flatness:

- ◆ Low adoption rates in places
- ◆ Not used in mission critical activities
- ◆ Lack of awareness of GIS existence
- ◆ Pathologies remain
- ◆ Not in tune with reality (**Bullfrog Story**)
- ◆ Interoperability difficult

What Caused This?

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Possible causes (institutional):

- ◆ Value wasn't demonstrated
- ◆ Not yet realized return on investment
- ◆ Started in an obscure place like cartography
- ◆ *What is it? Where does GIS belong? Squabble*
- ◆ Lack of training, technology transfer.

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Possible causes (technical):

- ◆ Lack of creative modeling solutions
- ◆ These are not understood
- ◆ Just not dealt with

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Possible causes (abstraction):

- ◆ **Encumbrances during modeling**
- ◆ **T-Domain viewed incorrectly**
- ◆ **Abstraction process faulty**
- ◆ **Abstraction process incomplete, not deep enough**
- ◆ **Too much focus on “wired”?**

Were There Encumbrances During Modeling?

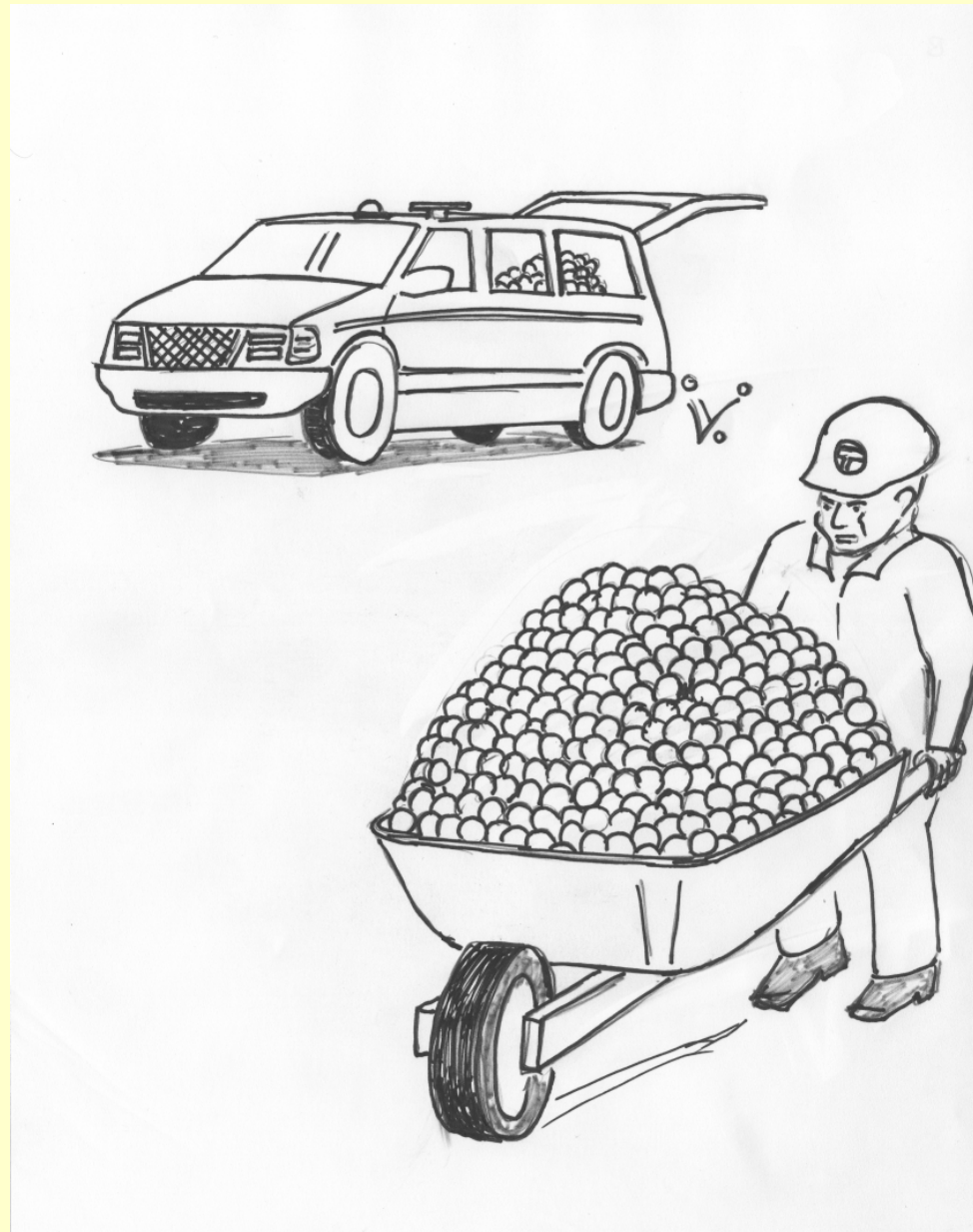


The map dominated our thinking and processes:

- ◆ A-priori view of roads
- ◆ 24K, TIGER, layer “itis”
- ◆ Road as a single centerline
- ◆ Link, node legacy
- ◆ Focus on Geometry
- ◆ Attach attributes to lines

The GIS Builder

Contribute to some confusion?

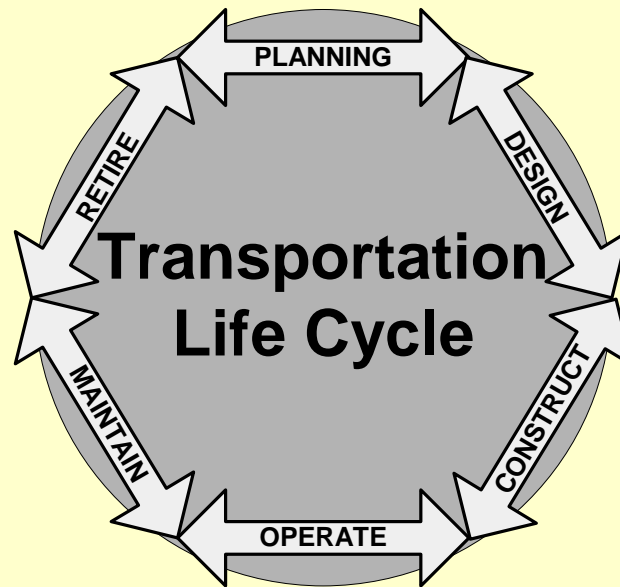


Did We Classify the T-domain Correctly?



The GIS Builder

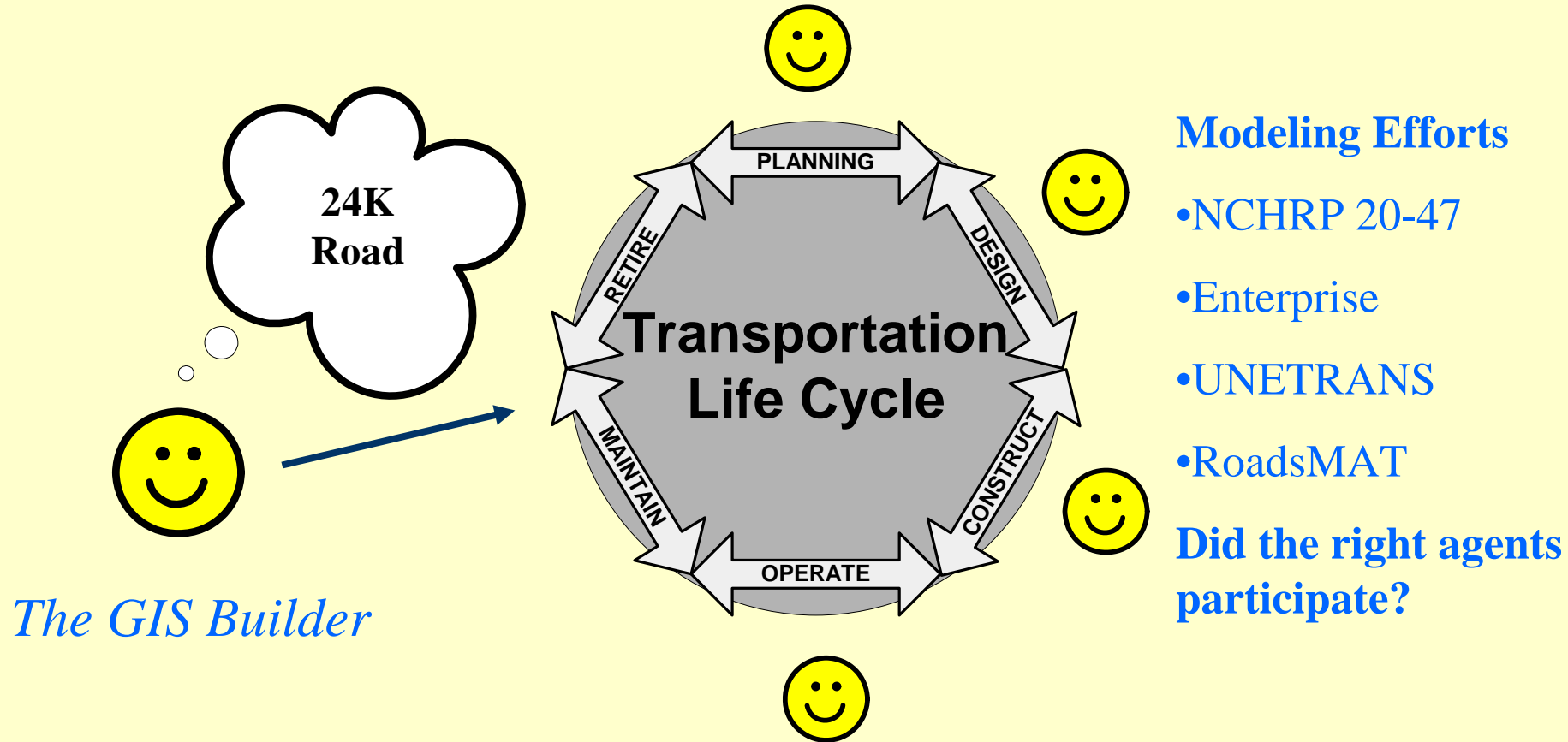
Classifications by Business Areas?



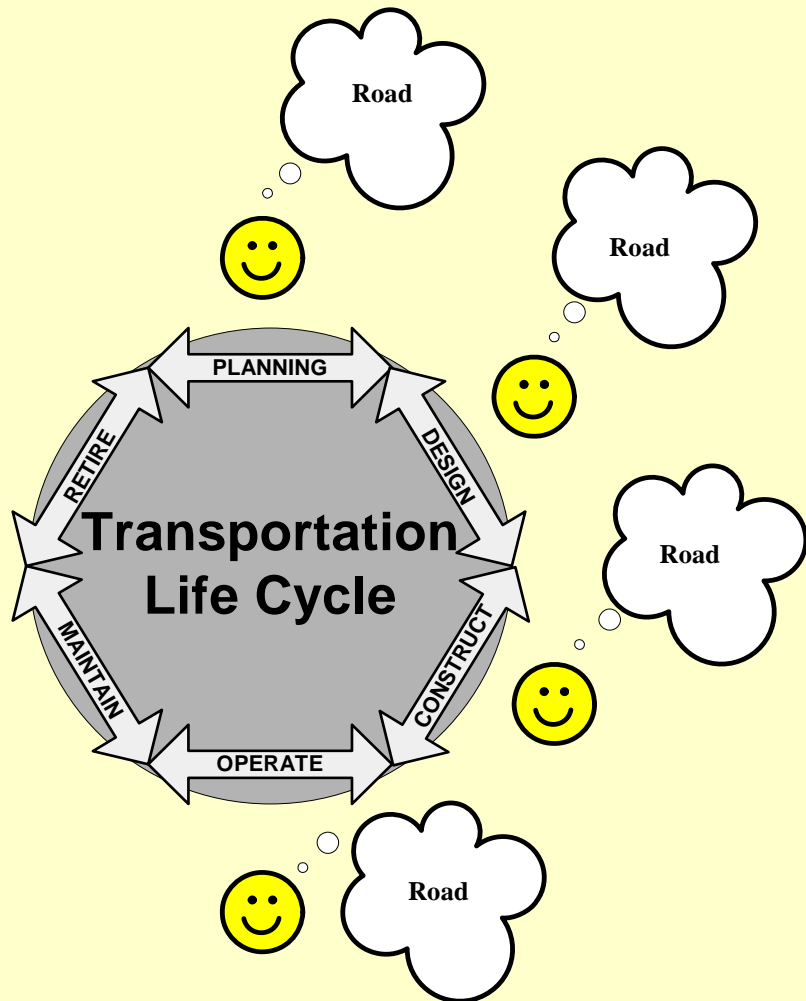
or

Classifications By Spatial Communities?

Were the Modeling Participants Truly Representative?

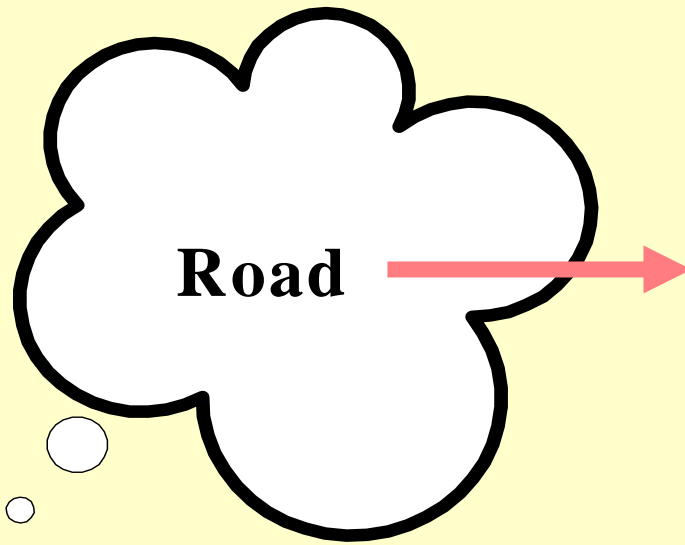


Did the Abstraction Process Go Deep Enough?

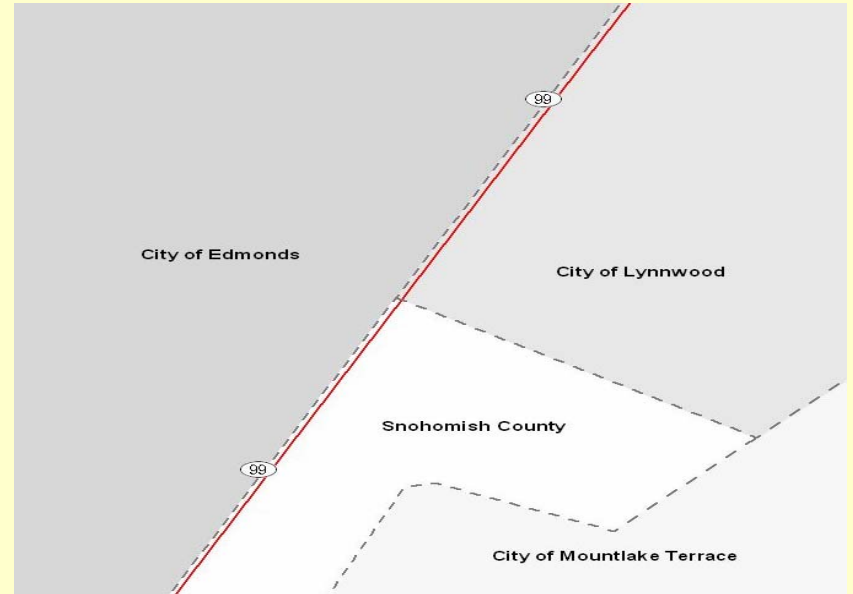


- ◆ Did we focus too much on the physical world of each domain?
- ◆ Did we focus on the representations (geometries)?
- ◆ Did we consider the cognitive aspects of the domain?
- ◆ **Did we not recognize there are semantic differences?**
- ◆ Did we recognize the granularity differences, not just scale?
- ◆ What is a road?

Example – What Is a Road?



Planning Domain Agent



The road looks like this...

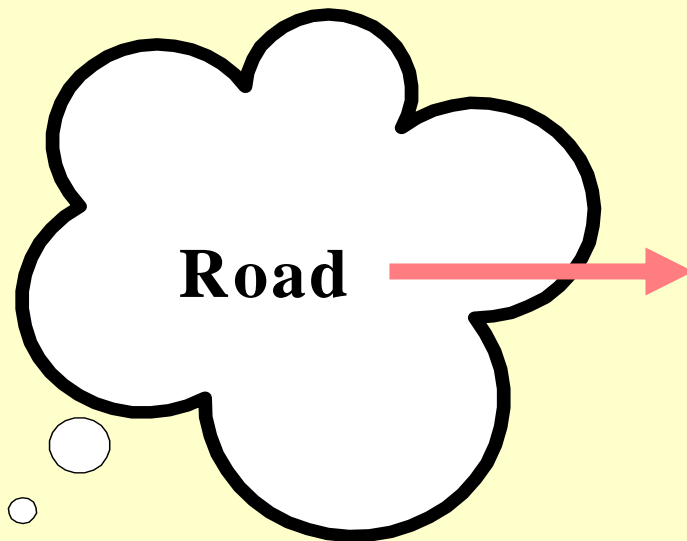
The road has these associations...

Roads are measured like this...

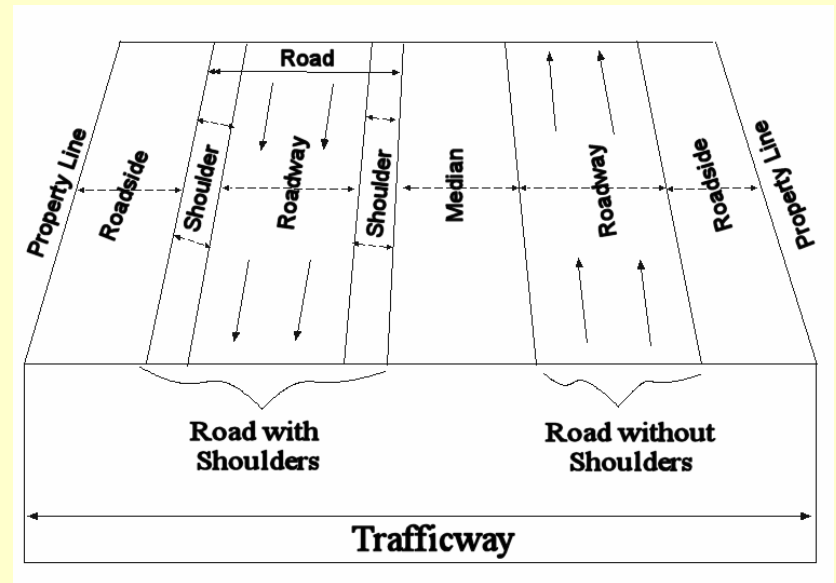
The road has these functions...

Funding Issues

Example – What Is a Road?



Operations Domain Agent



The road looks like this...

The road has these functions...

Things move over the road like this...

These events happen on the road...

Funding Issues

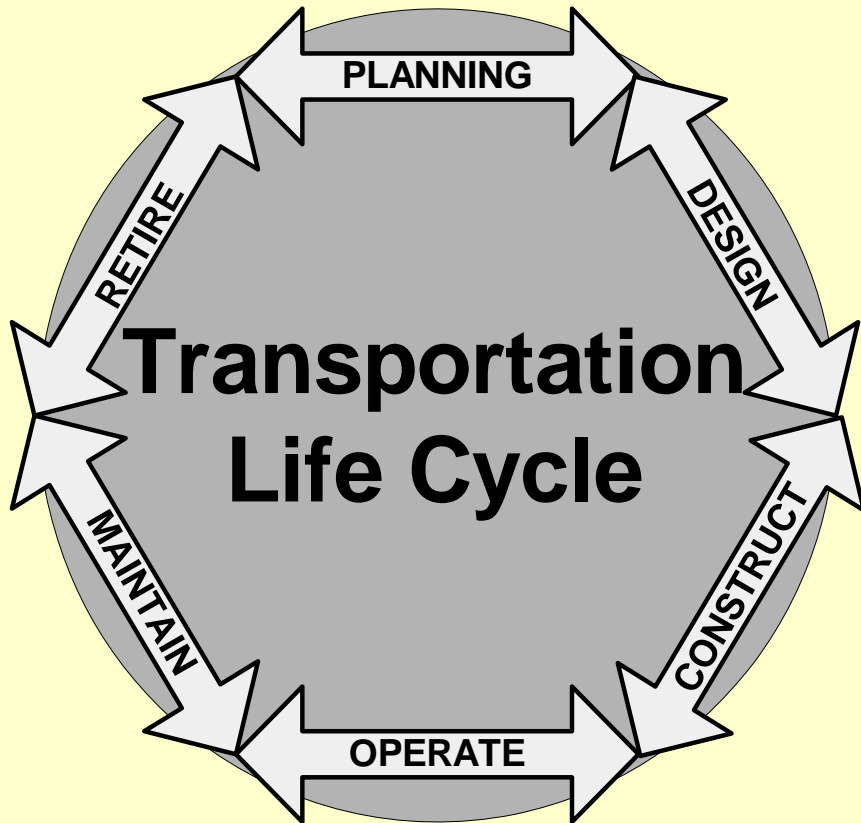
Could It Be That...

As we (GIS-T builders) went through the process of representing the physical world of transportation into a computer system (the abstraction process), we might have left out the cognitive (semantic) aspects.

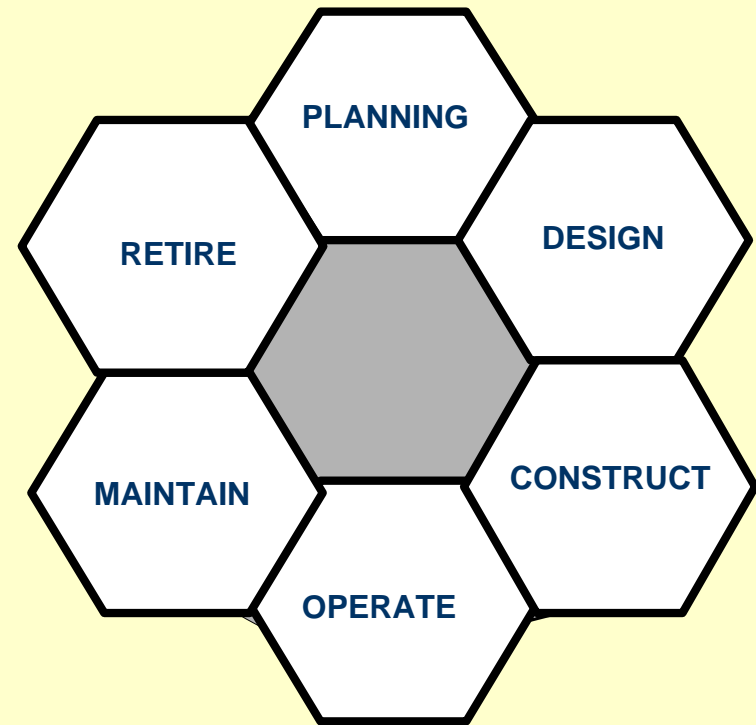
Or..

Are we looking hard enough at the institutional/cultural issues?

Are Internal Domains More Closed Than We Think?

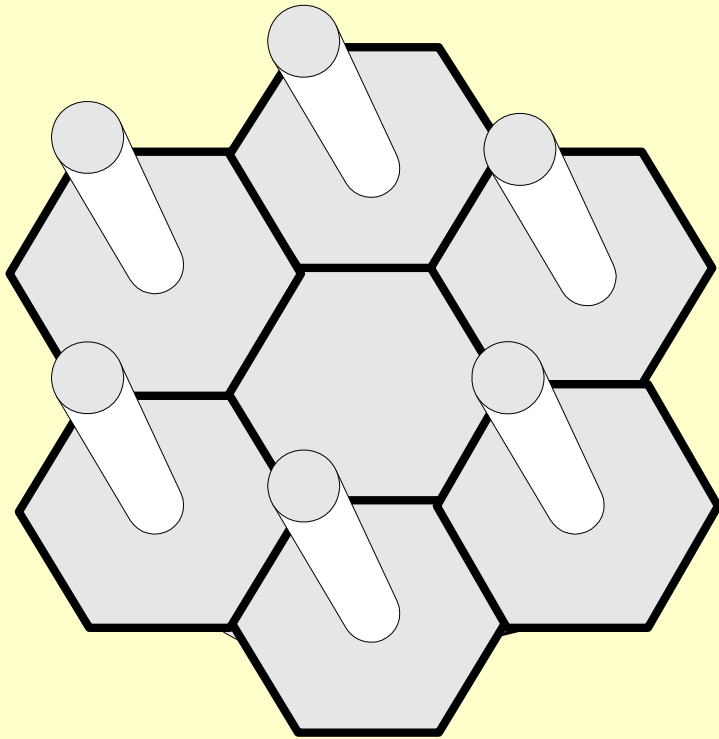


The overall transportation domain, with interior domains showing an unrestrained data, information, and knowledge flow.



Transportation domain with interior domains which have a restrained data, information, and knowledge flow because of technical, institutional/cultural, *and* semantic differences.

Closed Domains = Stovepipe Systems (Non-interoperability)

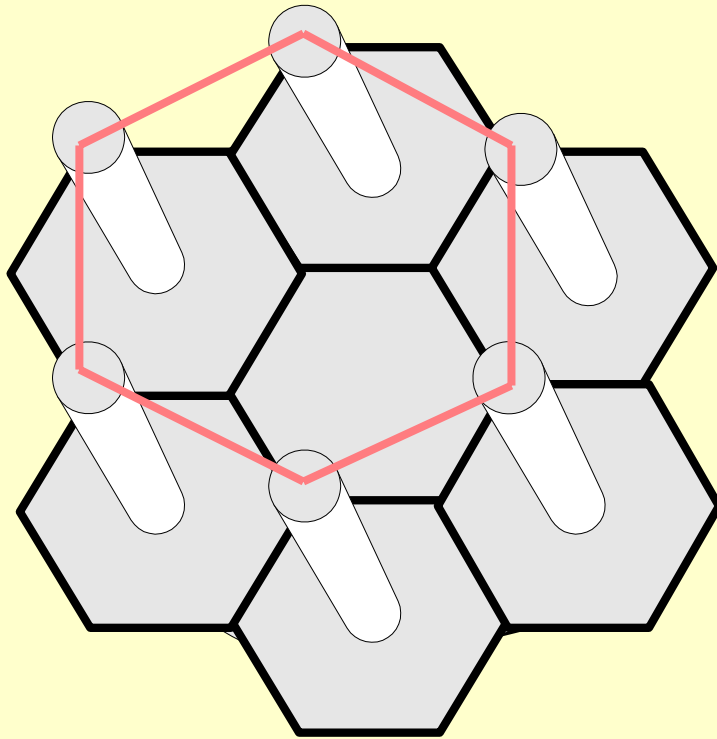


Domains foster

Heterogeneous databases:

- Because of design autonomy
- Because of design diversity
- Leads to disagreements about meanings.

We Have Focused on the Technical Solutions to System Interoperability



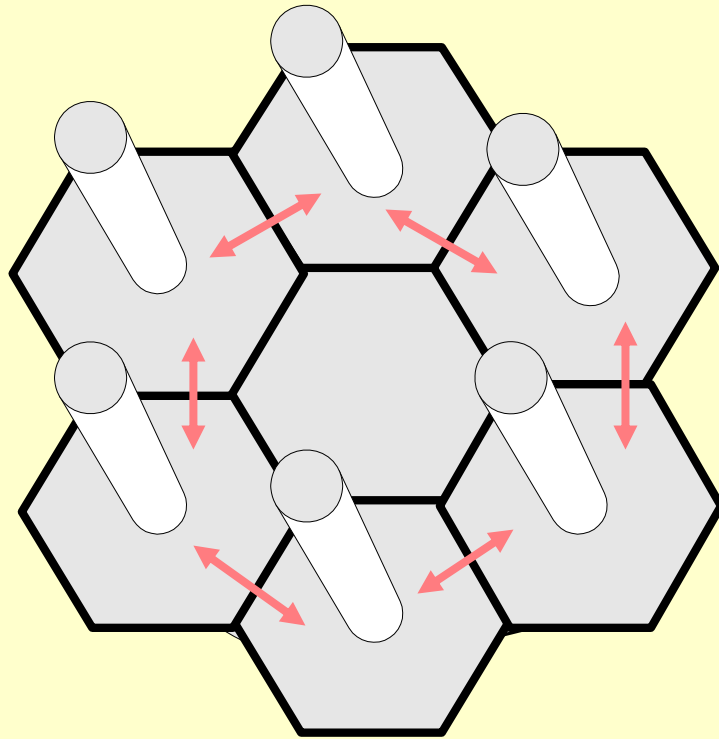
Technical solutions include:

- Rich and robust data models
- Protocols
- Standards
- Data transformations
- Frameworks
- Metadata

Machine and Data Centric

(“Wired Approach”)

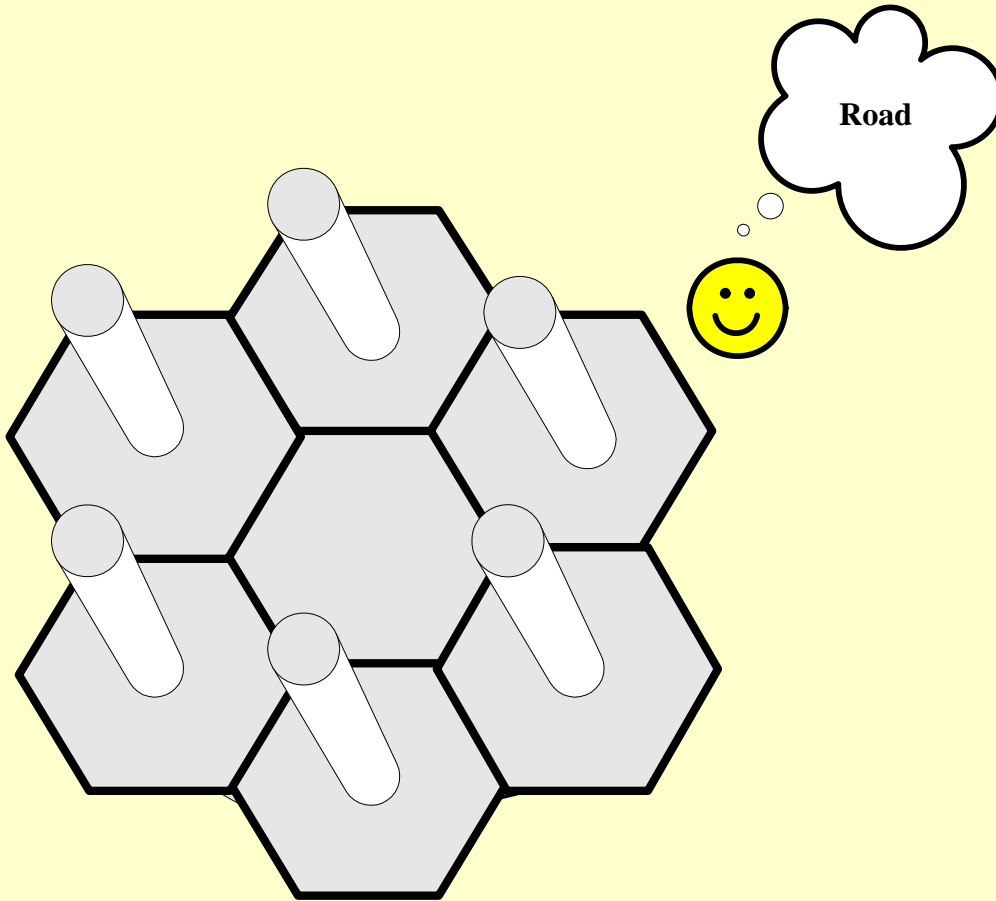
Time to Review Institutional/cultural Solutions to System Interoperability?



Institutional solutions include:

- Directives
- Agreements
- Domain boundary mitigation
- Institutional catalogs, lexicons
- Re-align the classifications
- Centralized collaboration

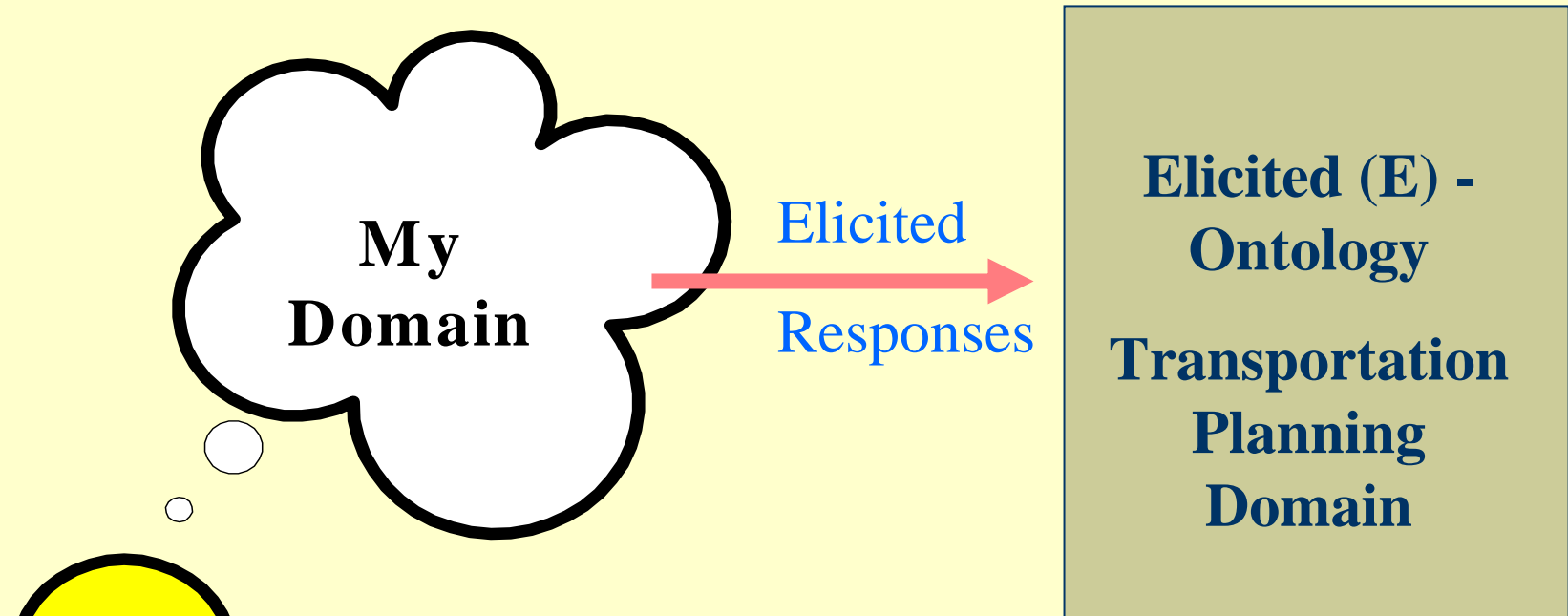
Time to Review Cognitive Solutions to System Interoperability?



Semantic/Cognitive solutions include:

- Deeper Modeling Efforts
- Domain lexicons
- Ontologies (My Favorite)

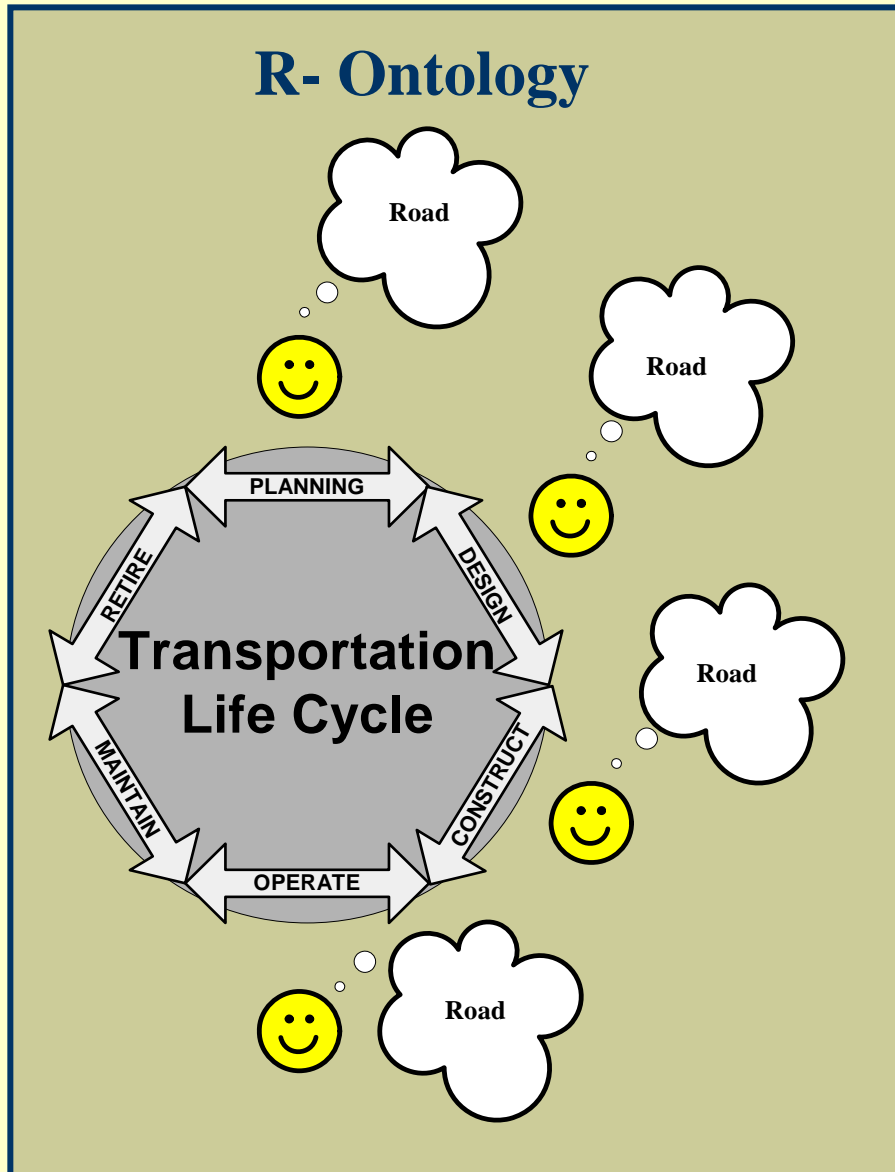
What Is An Ontology? (Elicited)



Planning Domain Agent

Formalization of the conceptualizations of the agents in the real-world (domain). From AI

Otology – The Big One

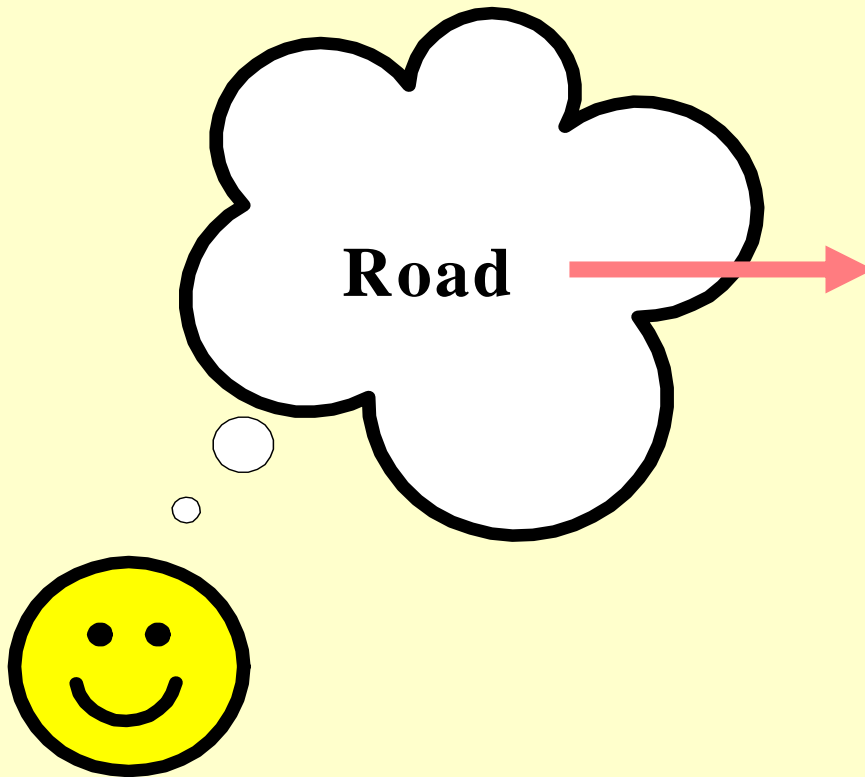


R-Ontology:

- Reality-based ontology
- “What is” before semantic interpretation
- Philosophical
- How the universe is organized
- Single ontology

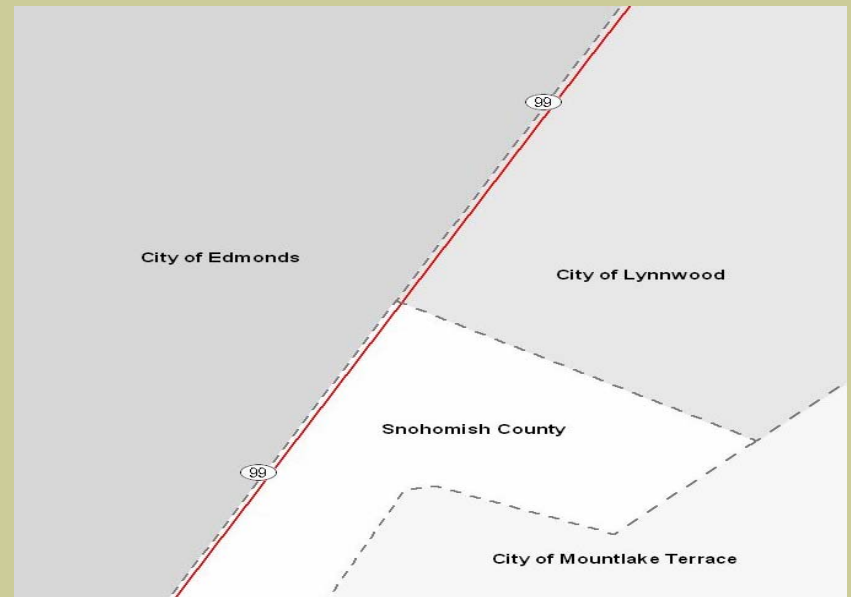
THE Ultimate Stake in the Ground

Example: T-Planning Ontology



Planning Domain Agent

Elicited - Ontology of Road



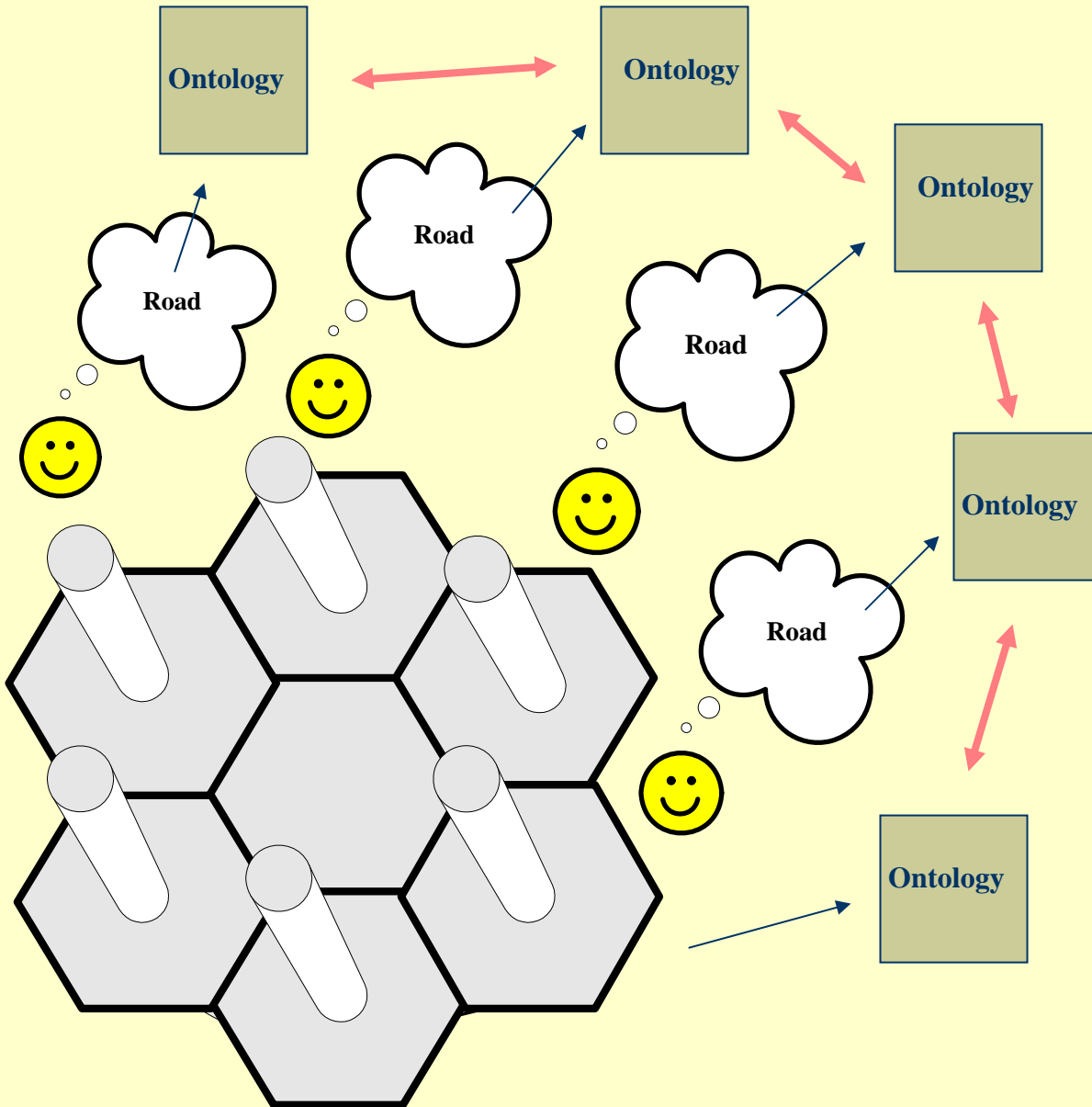
The road looks like this...

The road has these associations...

Road distance is like this...

The road has these functions...

Why Ontologies?



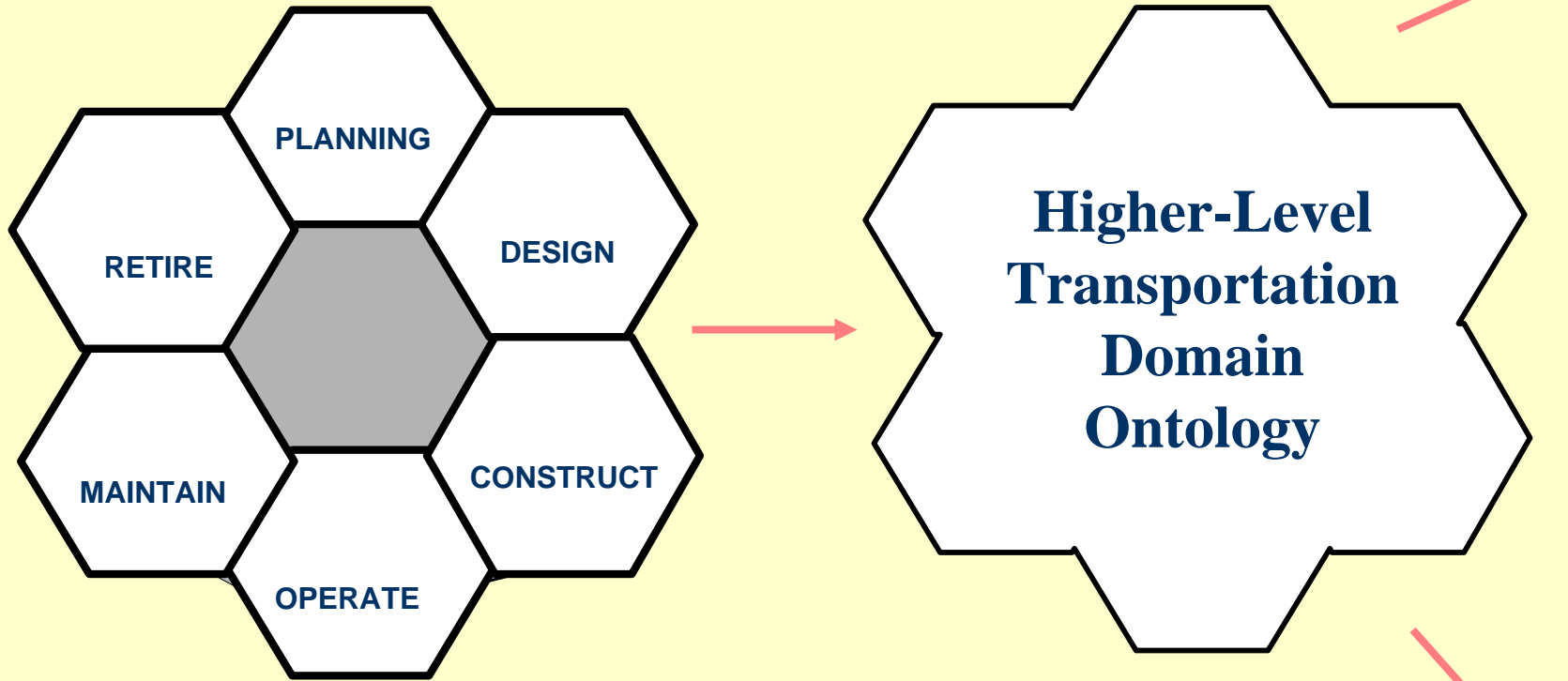
Semantic Matching

Ontologies capture the semantic richness of the domain.

Semantic translators can be built to help systems become interoperable.

Differences are minimized

Can Ontology Help With Standards?



A finer level of separate domain ontologies can be used within the institution for applications specific to that organization.

The overall transportation domain can develop an ontology at a coarser level to be shared outside the organization.

Summary

- ◆ Current state of affairs in GIS-T has some shortcomings (Interoperability problems).
- ◆ Too much Focus on data and gadgets?
- ◆ So Why Data? (This generates money)
- ◆ Time to Focus on Institutional/Cultural Issues? (This does not generate money)
- ◆ Time to capture the semantic richness and granularity of transportation domains? (Ontologies? This could generate money)

For More Info, Start With

- ◆ Simon Lewis (PhD Dissertation)
- ◆ Yaser Bisher
- ◆ Werner Kuhn
- ◆ Max Egenhofer
- ◆ David Mark

Bullfrog Story

What This All Means to the Average Joe DOT

