Using Language to Gain Control of Enterprise Architecture

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SIL International

Partners in Language Development

A little known fact

◆ How many different languages are used throughout the world today?

- Answer: **6,912**

- Source: *Ethnologue,*
                15th edition
www.ethnologue.com

- 95% of the languages have a population under a million; spoken by 6% of the world's population.
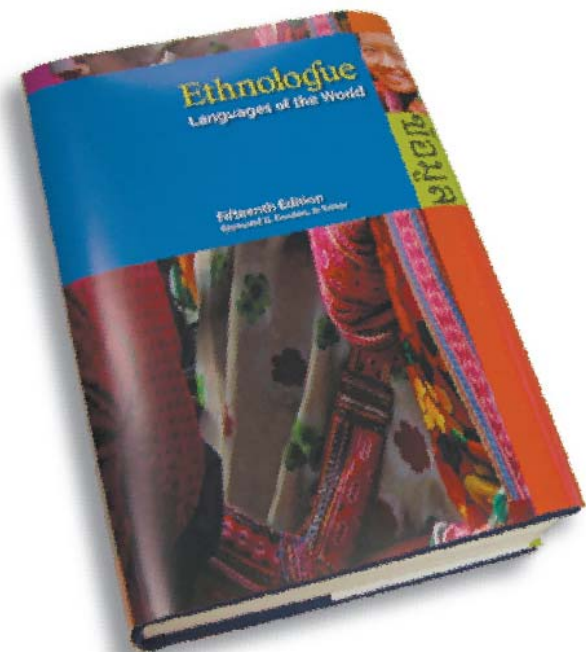
About SIL International

"By facilitating language-based development, SIL International serves the peoples of the world through research, translation, and literacy."
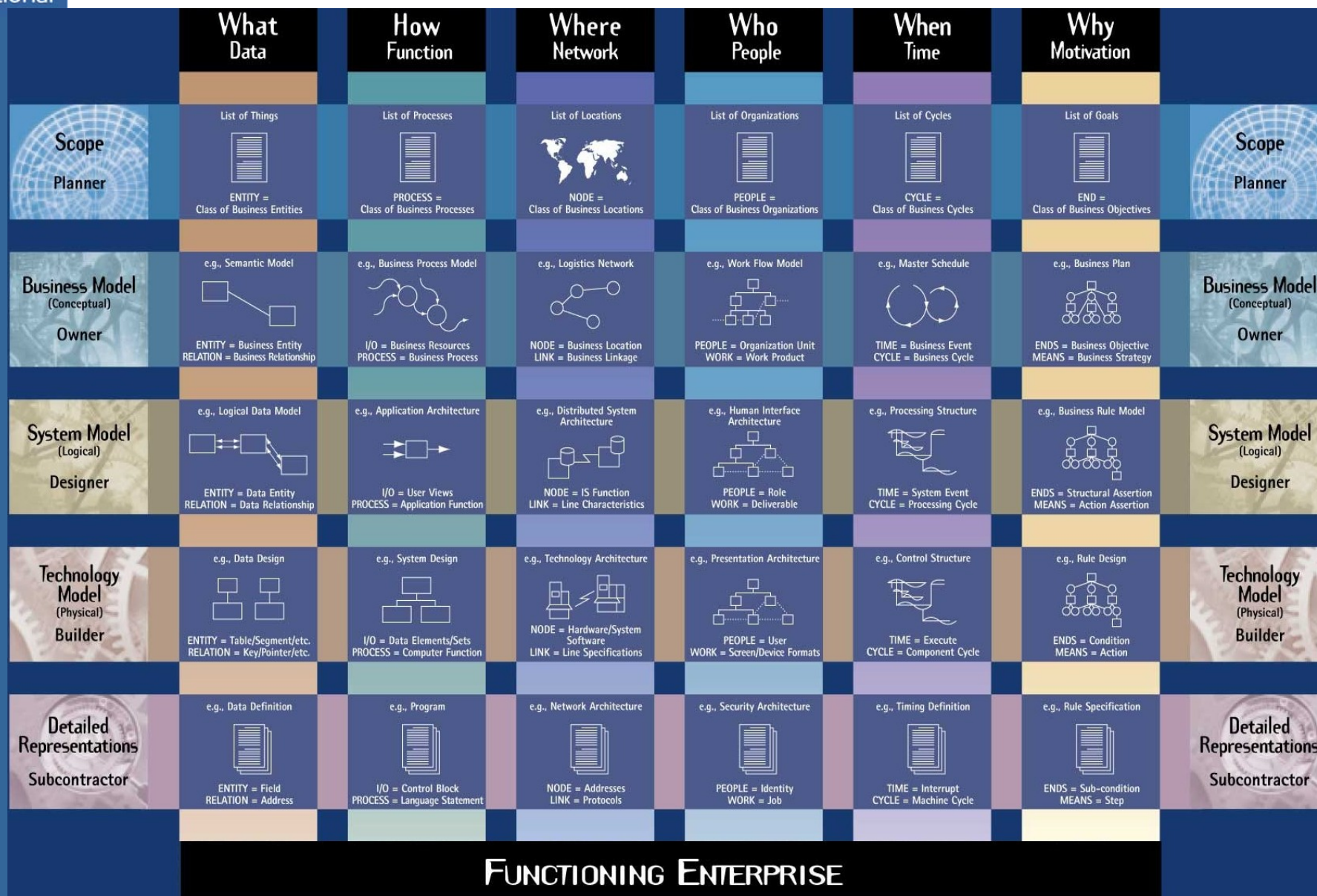
— www.sil.org

◆ We are a hybrid:
- faith-based organization
- academic organization
- development organization

◆ Since our founding in 1934
- Worked in 1,800 languages in 70 countries
- Grown to 5,000 members from 60 countries

In need of Enterprise Architecture

- Status quo at SIL International as we faced the new millennium:

    - Mission critical IT systems were almost 20 years old and verging on obsolescence

    - Our IT landscape was dotted with dozens of silo systems

    - Commitments to new strategic directions demanded major business re-engineering

- 1999: Our IT leadership discovered Zach-man Framework for Enterprise Architecture

The Zachman Framework

	What — Data	How — Function	Where — Network	Who — People	When — Time	Why — Motivation
Scope — Planner	List of Things ENTITY = Class of Business Entities	List of Processes PROCESS = Class of Business Processes	List of Locations NODE = Class of Business Locations	List of Organizations PEOPLE = Class of Business Organizations	List of Cycles CYCLE = Class of Business Cycles	List of Goals END = Class of Business Objectives
Business Model (Conceptual) — Owner	e.g., Semantic Model ENTITY = Business Entity RELATION = Business Relationship	e.g., Business Process Model I/O = Business Resources PROCESS = Business Process	e.g., Logistics Network NODE = Business Location LINK = Business Linkage	e.g., Work Flow Model PEOPLE = Organization Unit WORK = Work Product	e.g., Master Schedule TIME = Business Event CYCLE = Business Cycle	e.g., Business Plan ENDS = Business Objective MEANS = Business Strategy
System Model (Logical) — Designer	e.g., Logical Data Model ENTITY = Data Entity RELATION = Data Relationship	e.g., Application Architecture I/O = User Views PROCESS = Application Function	e.g., Distributed System Architecture NODE = IS Function LINK = Line Characteristics	e.g., Human Interface Architecture PEOPLE = Role WORK = Deliverable	e.g., Processing Structure TIME = System Event CYCLE = Processing Cycle	e.g., Business Rule Model ENDS = Structural Assertion MEANS = Action Assertion
Technology Model (Physical) — Builder	e.g., Data Design ENTITY = Table/Segment/etc. RELATION = Key/Pointer/etc.	e.g., System Design I/O = Data Elements/Sets PROCESS = Computer Function	e.g., Technology Architecture NODE = Hardware/System Software LINK = Line Specifications	e.g., Presentation Architecture PEOPLE = User WORK = Screen/Device Formats	e.g., Control Structure TIME = Execute CYCLE = Component Cycle	e.g., Rule Design ENDS = Condition MEANS = Action
Detailed Representations — Subcontractor	e.g., Data Definition ENTITY = Field RELATION = Address	e.g., Program I/O = Control Block PROCESS = Language Statement	e.g., Network Architecture NODE = Addresses LINK = Protocols	e.g., Security Architecture PEOPLE = Identity WORK = Job	e.g., Timing Definition TIME = Interrupt CYCLE = Machine Cycle	e.g., Rule Specification ENDS = Sub-condition MEANS = Step

FUNCTIONING ENTERPRISE

EA at SIL International

- ◆ 2000: Our executive leadership embraced it
  - ■ A VP-level team trained in the Framework began leading business reengineering.
  - ■ This team owns the Row 2 models.
  - ■ Their departments own the Row 3 models for domain-specific slivers.
- ◆ 2003: First slivers went into production
- ◆ 2004: We saw it wasn't fully under control
- ◆ 2007: Going strong; coming under control

Overview of presentation

- ◆ What is out of control

- ◆ Why it is a problem of language

- ◆ How we have developed an enterprise modeling language by elaborating the Enterprise Architecture Standards

- ◆ A demonstration of results to date

The big idea behind EA

- ◆ What we learned from Zachman's visit:
  - ▪ Architecture is the age-old discipline that makes it possible to build and change complex systems.

- ◆ Corollaries:
  - ▪ In order to build something complex, you've got to create blueprints.
  - ▪ In order to change something complex, you've got to have its blueprints.

The holy grail of EA

"Someday, you are going to wish you had
all those models,
enterprise wide,
horizontally and vertically integrated,
at excruciating level of detail."

— *John Zachman*

Good News and Bad News

◆ We've enjoyed excellent buy-in and participation by senior leadership.

But ...

◆ We've not been delivering all the models:

- Column 1 is under control; Entity-Relationship models in Rows 2, 3, 4 are visible to leaders, domain specialists, and developers and are staying aligned.

- We had nothing comparable in the other five columns.

10

What's the problem?

◆ Succeeded in C1 because we found a tool that understood the E-R metamodel

◆ Never found such tools for the other five columns. What about Visio?

- It's too hard and too time-consuming to create all the models with tools that don't understand the metamodels.

- Once created, it's virtually impossible to keep them maintained and aligned.

The crux of the problem

- ◆ Modeling is about expressing ideas, not about drawing pictures.
- ◆ The solution to the problem is even older than architecture:
  - ▪ What is the age-old discipline that makes it possible for humankind to express ideas with precision?

    Language!

Language …

- ◆ Is the fount of our creativity
- ◆ Gives power to wield ideas
- ◆ Uses constraint to unleash freedom to express
  - ▪ In any one language, all the sounds that are possible are constrained to just a few score.
  - ▪ Syllable patterns constrain what could possibly be a word.
  - ▪ Conventional associations of meaning constrain what sequences actually are words.
  - ▪ Rules of grammar constrain the order in which words combine to express larger thoughts.

The paradox of freedom through constraint

- Other examples:
  - 17th cent., William Penn: "Obedience without liberty is slavery." But, "Liberty without obedience is confusion."
  - 18th cent., Rousseau: "The mere impulse of appetite is slavery, while obedience to a law which we prescribe to ourselves is liberty."
- If we use Visio or unconstrained modeling tools are we more likely to get:
  - The freedom and liberty we are looking for, or
  - Impulse to appetite and confusion?

14

EA as a language problem

- Basic thesis
  - In order to unleash the creativity, power, and free-dom that are inherent in true EA, an enterprise needs a constrained language for enterprise modeling.

- By design, the metamodel of the Zachman framework is too generic to support detailed engineering
  - It's a classification system, not a methodology.

- Therefore, an enterprise needs to add detail and constraints to the generic standard in order to develop a methodology appropriate for itself.

The GEM system

♦ SIL International has done this by creating the GEM system for Generic Enterprise Modeling:

  ▪ The GEM language

  ▪ The GEM methodology

  ▪ The GEM repository

  ▪ The GEM workbench

♦ The GEM language is formally an elaboration of the Zachman Framework metamodel as defined in the Enterprise Architecture Standards published by Zachman International

Elaborating the standard

◆ An enterprise makes the framework its own by translating the Enterprise Architecture Standards into its specific context. Allowed elaborations:

- Alias a standard thing or relationship.

- Add named subtypes of standard things and relationships.

- Name the supported integrations between columns.

- Add named attributes to a type of thing or relationship or integration.

◆ Dumb-down rule: When these changes are reversed in an elaborated model, the result must be a model that conforms to the generic standard.

The basic design of GEM

- ◆ Implemented as an XML application.
- ◆ By analogy to a programming language:
  - ▪ The architect writes XML source code to express the R2 and R3 perspectives — including things, relationships, integrations, transformations, added detail, prose definitions.
  - ▪ The system compiles the XML source into the graphic primitive models for each cell.
  - ▪ The system compiles the XML source into HTML "textual models" for each cell.

Expressing things

◆ Each type of *thing* is its own XML element.

◆ Each thing element has an *id* attribute.

◆ Each thing element contains a <name> and <description> element for human-readable documentation.

For example

```
...
<columnTwo>
  <businessProcesses>
    <inventory id="c2.WorldLang">
      <name>World Language Inventory</name>
      <description>The process that
        maintains the most up-to-date
        information about the existence
        and status of every known
        language.</description>
    </inventory>
    ...
```

Expressing relationships

◆ Each type of relationship is its own XML element embedded in the thing it originates from.

◆ The relationship element has an IDREF attribute to express the target thing.

◆ The reverse relationship is always inferred by the compiler and never expressed, thus avoiding redundancy and update anomaly.

For example

```
<publication id="c2.edition">
  <name>Ethnologue Edition</name>
  <description>The process that
    produces a particular, published
    edition of the catalog of all known
    living languages of the world.
    </description>
  <fedBy process="c2.WorldLang"/>
</publication>
```


World
Language
Inventory

Ethnologue
Edition
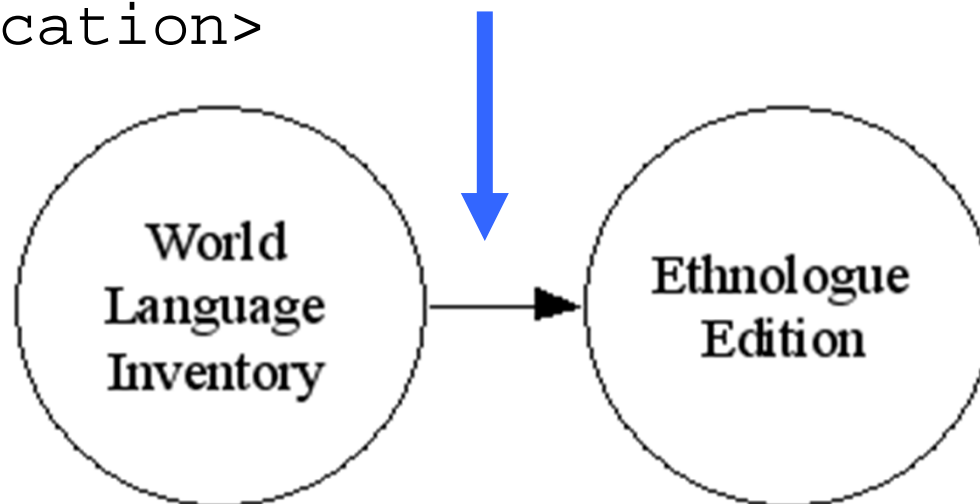
Integrations (textual representation)

Ethnologue Edition

A publication process. The process that produces a particular, published edition of the catalog of all known living languages of the world. The edition encompasses what is common among the products published in various formats.

Relationships

Fed by:	Language Map Inventory
Fed by:	World Language Inventory

Integrations

Produced at:	International Headquarters
Consumed by:	Public
Produced by:	VP Academic Affairs Office
Timing:	Ethnologue Edition Cycle
Motivation:	Publish Ethnologue

XML elements for Row 2 models

	Things	Relationships	Integrations
C1	Object Association	associatedWith hasMembers hasStructure	
C2	Inventory Publication	fedBy	tracks C1 producedAt C3 hasTiming C5
C3	Site	linkedTo	
C4	OrgUnit	administeredBy	produces C2 consumes C2 locatedAt C3
C5	BusinessCycle	spawns intersects	monitoredBy C4
C6	Goal Objective	meansFor	reasonFor C1,C2, C3,C4,C5

Repository of enterprise models

- ◆ Modeling on an enterprise scale
  - Each XML source file models a single sub-system under the "stewardship" of a VP
  - Any system model can import a thing defined in another, creating a contiguous enterprise model
  - An internal web application allows all stakeholders to see "all those models"
- ◆ Coping with change over time
  - The things and relationships in models are assigned to the stages of a build sequence
  - Each stage passes through a life cycle of: *proposed, planned, development, testing, adopted*
  - Repository shows each system in each stage

25

Repository of Enterprise Models

Systems	As is	About to be	Will be	Should be	Could be	Metrics*				
Associate ED for Administration										
IPR	Adopted	Testing	Development	Planned	Proposed	12	1	0	3	0
Organizational Structure	Adopted	Testing	Development	Planned	Proposed	18	0	1	9	0
VP Academic Affairs										
Ethnologue	Adopted	Testing	Development	Planned	Proposed	24	21	1	13	8
Language Strategy	Adopted	Testing	Development	Planned	Proposed	24	0	0	2	0
Training Programs	Adopted	Testing	Development	Planned	Proposed	23	0	0	2	0
Training Roles	Adopted	Testing	Development	Planned	Proposed	8	0	1	4	0
VP Corporate Communications										
Corporate Communications	Adopted	Testing	Development	Planned	Proposed	25	0	1	3	0
Publicity Guidelines	Adopted	Testing	Development	Planned	Proposed	3	0	0	2	0
VP Finance										
PMC	Adopted	Testing	Development	Planned	Proposed	13	3	1	8	1
Vehicle Coverage	Adopted	Testing	Development	Planned	Proposed	6	2	1	4	0

* The metrics give a rough indication of the size and depth of the model. The five columns give a count of the "things" in the Row 3 models for the first five columns: (1) data entities,

Repository of Enterprise Models

Ethnologue System (Development state)

Powered by Gem

Scope	Summary scope lists
Business	Integrated business model: Metrics Integraton matrix
System	Integrated system model: Metrics Integration matrix

Primitive models by Zachman Framework cell

	Inventory (What?)	Process (How?)	Network (Where?)	Organization (Who?)	Timing (When?)	Motivation (Why?)
Scope	list	list	list	list	list	list
Business	model G	model G	model G	model G	model G	model G
System	model G	model G	model G	model G	model G	model G

Implementation

- Each artifact is dynamically generated on demand from the single GEM source file
  - Built on Apache Cocoon — an XML-based web development framework
  - Uses XSLT to transform from the XML source to the graphic and HTML artifacts
  - Graphs rendered by AT&T Graphviz
- Example
  - Ethnologue: the XML source is 85K
  - Acrobat capture = 35 artifacts in 100 page PDF
  - Following slides show first pages across Row 2:
    - Metrics, Integration matrix, 6 cell models (textual + graphical)

Row 2 Model Metrics for Ethnologue

State: development, **Date:** 2006-04-14

	c1 Inventory	c2 Process	c3 Network	c4 Organization	c5 Timing	c6 Motivation	Totals
Number of things*	8	4	0	5	3	8	28
Number of relationships	20	7	0	20	6	14	67
Number of integrations	8	28	7	17	6	2	68
Relationships per thing	2.50	1.75	--	4.00	2.00	1.75	2.39
Integrations per thing	1.00	7.00	--	3.40	2.00	0.25	2.43
Things without relationships	0	0	0	0	0	0	0%
Things without Integrations	0	0	0	0	0	6	21%

Row 2 Integration Matrix for Ethnologue

State: development, **Date:** 2006-04-14

1	Dialect in Country					R		+										+	
1	Ethnologue Country				R	R		+										+	
1	Ethnologue Map					R			+										
1	Identified Language	R	R	R			+												
1	Linguistic Subgroup						+												
1	Language Contact	R					+												
1	Language in Country						+												
1	Map for Country							+											
2	World Language Inventory		R	R	+				+	+	+	+			+			+	
2	Language Map Inventory		R		+				+		+				+				
2	Ethnologue Edition				+				+			+	+						+
2	Language Survey Report					+	+	+		+									
3	International Headquarters								+	+	+								
3	Field Office																		
4	Executive Director's Office			R															
4	Area Ofice				R														
4	Partner Organization Ofice				R														
4	VP Academic Affairs Office		R	R			R	+											
4	Office of the Ethnologue		R	R			+												

Row 2 Inventory Model for Ethnologue

Architect: Gary Simons
Contributors: Maggie Frank, Ray Gordon, Ray Uehara
Revision date: 2006-04-14
Coverage: Development stage (and all successive stages)

The items in this model are:

Focal entities: Ethnologue Country
                   Ethnologue Map
                   Identified Language
                   Linguistic Subgroup

Member entities: Dialect in Country

Associations: Language Contact
                   Language in Country
                   Map for Country

Alphabetical listing of entities

Dialect in Country

A member entity. A single dialect of the language in a particular country. [Add at Phase 3]

Relationships
 Member of: Language in Country as Owner (required). The language of which this is a dialect.
Integrations
 Tracked in: World Language Inventory
Transformations
 From: Dialect in Country in the scope list
 To: Dialect in Country in the system model

Row 2 Inventory Model for Ethnologue
(development, 2006-04-14)
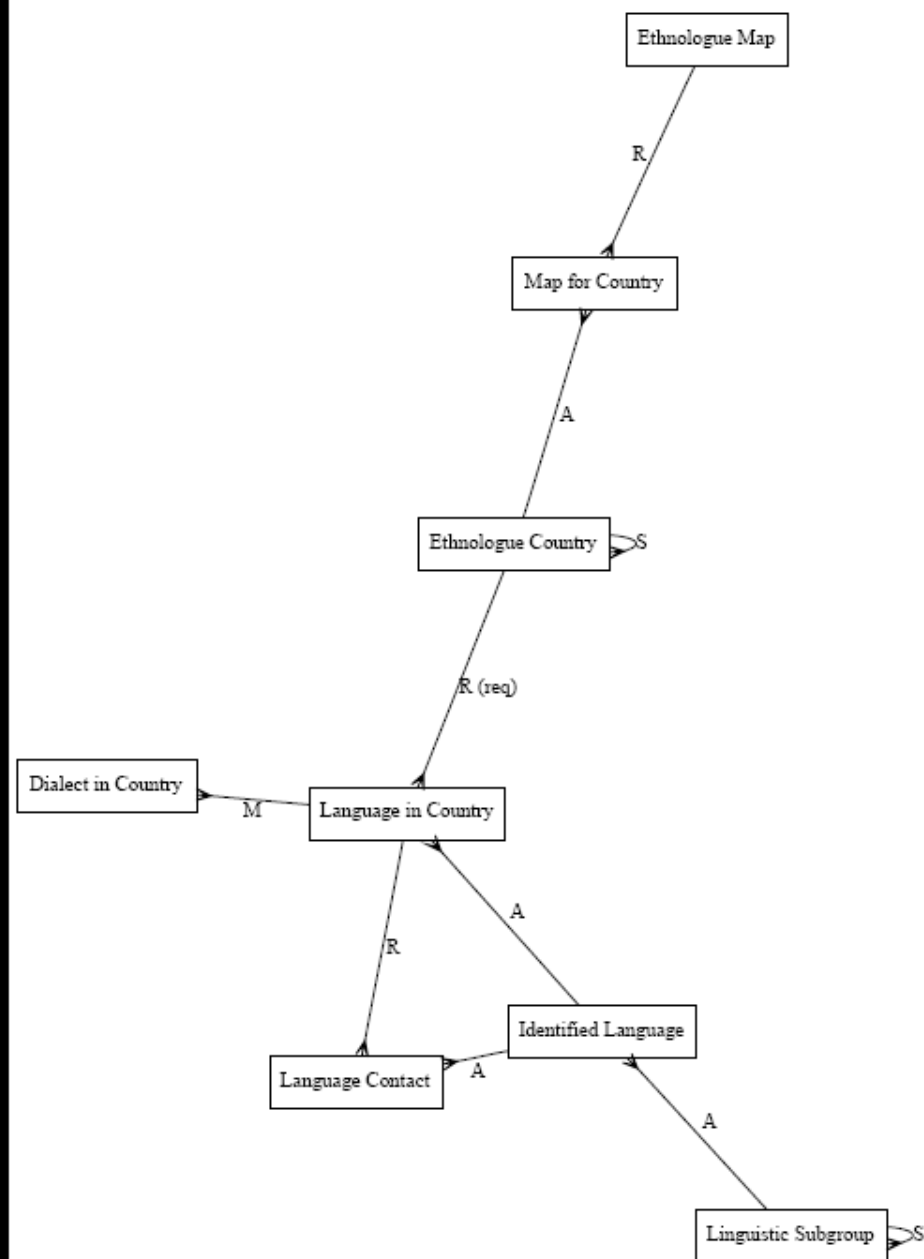
Row 2 Process Model for Ethnologue

Architect: Gary Simons
Contributors: Maggie Frank, Ray Gordon, Ray Uehara
Revision date: 2006-04-14
Coverage: Development stage (and all successive stages)

The items in this model are:

Inventory processs: Language Map Inventory
                        World Language Inventory

Publication processs: Ethnologue Edition
                        Language Survey Report

Alphabetical listing of processes

Ethnologue Edition

A publication process. The process that produces a particular, published edition of the catalog of all known living languages of the world. The edition encompasses what is common among all the products published in various formats.

Relationships
Fed by: Language Map Inventory
Fed by: World Language Inventory
Integrations
Produced at: International Headquarters
Consumed by: Public
Produced by: VP Academic Affairs Office
Timing: Ethnologue Edition Cycle
Motivation: Publish Ethnologue
Transformations
From: Ethnologue Edition in the scope list

Row 2 Process Model for Ethnologue
(development, 2006-04-14)
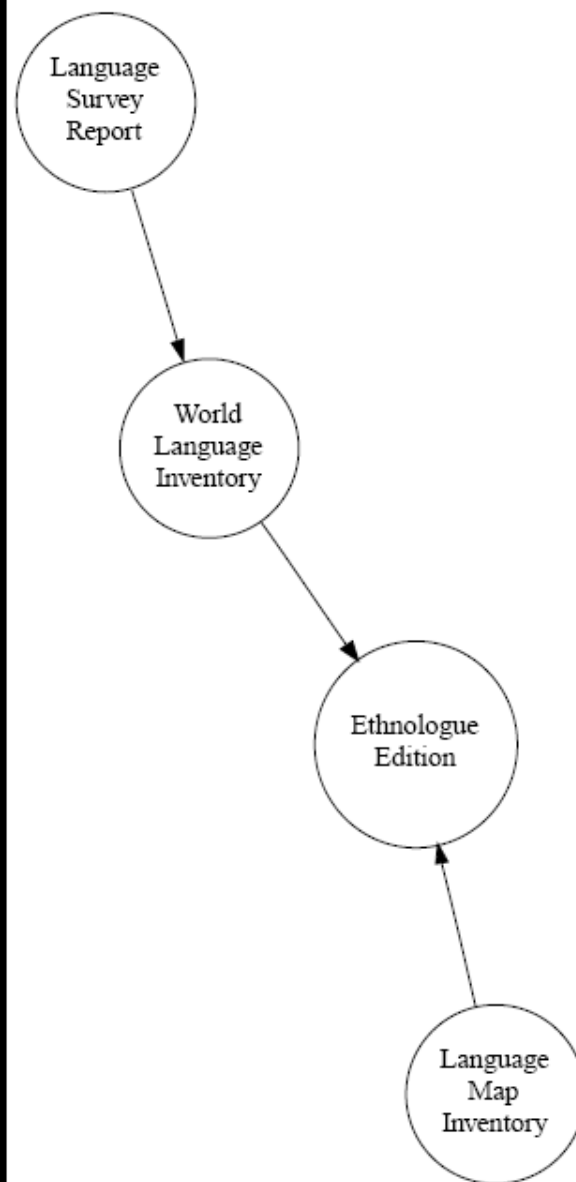
Row 2 Network Model for Ethnologue

Architect: Gary Simons
Contributors: Maggie Frank, Ray Gordon, Ray Uehara
Revision date: 2006-04-14
Coverage: Development stage (and all successive stages)

The items in this model are:

Work sites: Field Office
               International Headquarters

Alphabetical listing of locations

Field Office

A work site. A site somewhere in the world where a national or regional administration is located.

Relationships
 Same as: Field Office in Organizational_Structure
Integrations
 Produced here: Language Survey Report
Transformations
 From: Field Office in the scope list

International Headquarters

A work site. The centralized site (in Dallas, TX) where most of the international administraton is located.

Relationships
 Same as: International Headquarters in Organizational_Structure
Integrations
 Produced here: Ethnologue Edition

Row 2 Network Model for Ethnologue
(development, 2006-04-14)
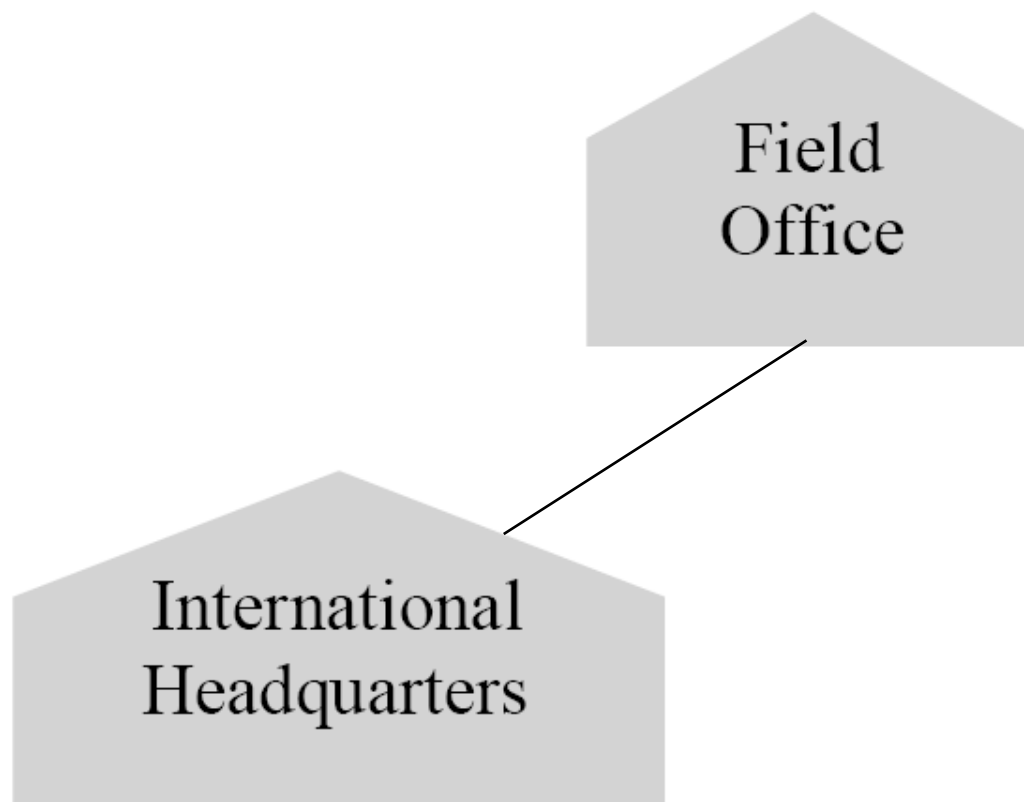
Field Office

International Headquarters

Row 2 Organization Model for Ethnologue

Architect: Gary Simons
Contributors: Maggie Frank, Ray Gordon, Ray Uehara
Revision date: 2006-04-14
Coverage: Development stage (and all successive stages)

The items in this model are:

Org units: Cartography Unit
              Executive Director's Office
              Office of the Ethnologue
              VP Academic Affairs Office

Groups: Area Ofice
              Every Office
              Partner Organization Ofice
              Public

Alphabetical listing of units

Area Ofice

A group. The office of a Parnter Administration Area.

Relationships
 Has client: Office of the Ethnologue. (via Language Survey Report)
 Same as: Area Ofice in Organizational_Structure
Integrations
 Produces: Language Survey Report
Transformations
 From: Area Ofice in the scope list

Row 2 Organization Model for Ethnologue
(development, 2006-04-14)
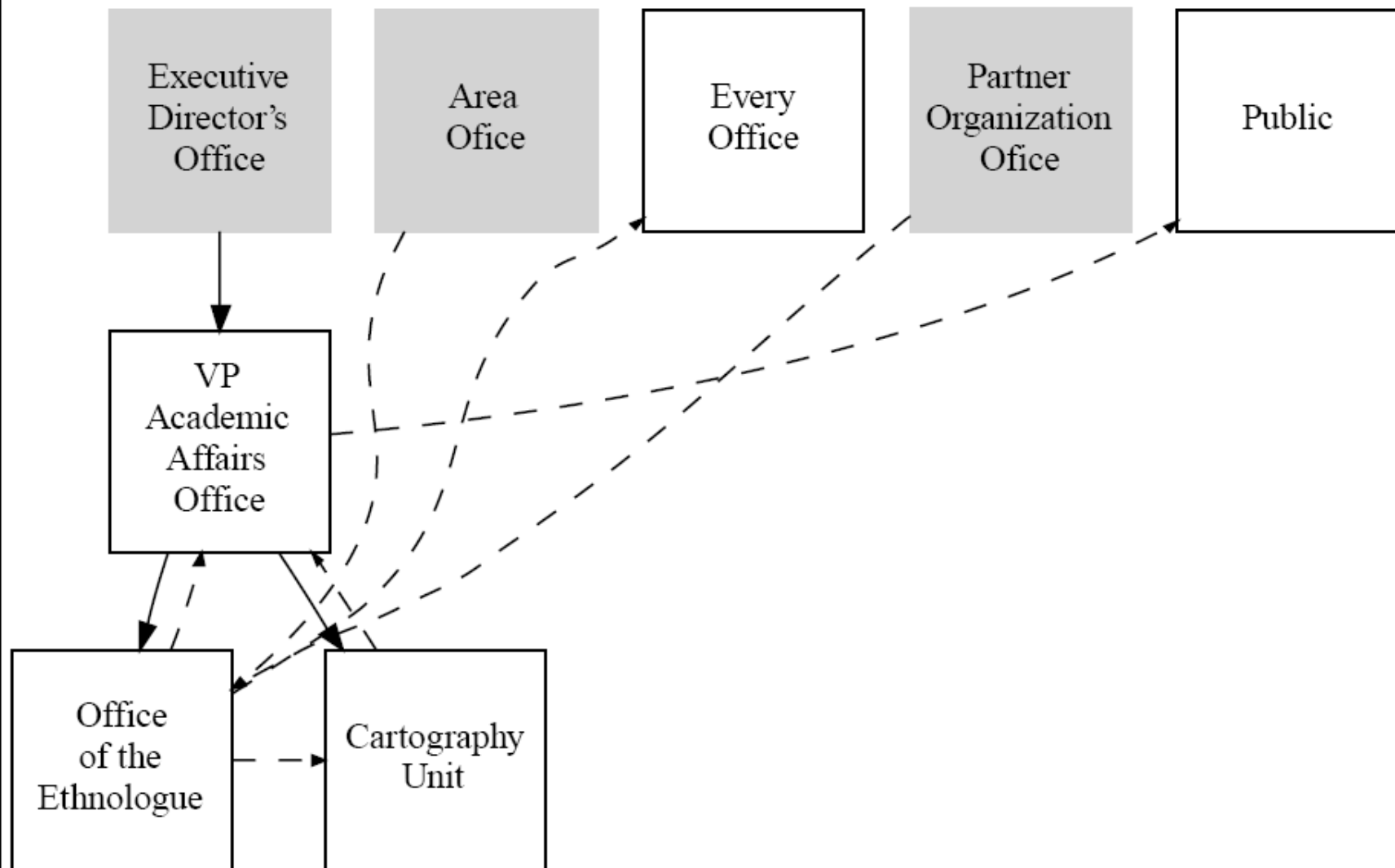
Row 2 Timing Model for Ethnologue

Architect: Gary Simons
Contributors: Maggie Frank, Ray Gordon, Ray Uehara
Revision date: 2006-04-14
Coverage: Development stage (and all successive stages)

The items in this model are:

Main cycles: Ethnologue Edition Cycle
               Language Information Update Cycle
               Language Map Update Cycle

Alphabetical listing of cycles

Ethnologue Edition Cycle

A main cycle. The cycle for producing a new edition of the Ethnologue family of products.

Relationships

Intersects: Language Information Update Cycle. These cycles interact because at some point in the edition cycle, the text content must be frozen which means that the text update cycle must cease.

Intersects: Language Map Update Cycle. These cycles interact because at some point in the edition cycle, the map content must be frozen which means that the map update cycle must cease.

Integrations

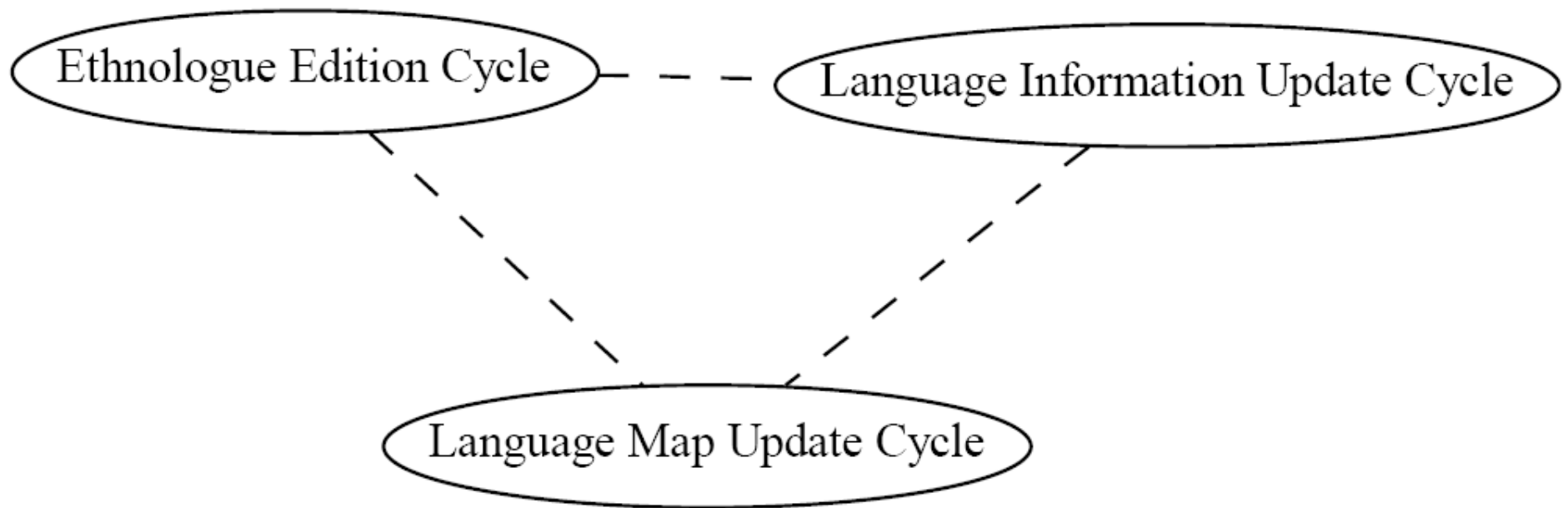Results in: Ethnologue Edition

Monitored by: VP Academic Affairs Office

Transformations

From: Ethnologue Edition Cycle in the scope list

To: Ethnologue Edition Cycle in the system model

Language Information Update Cycle

Row 2 Timing Model for Ethnologue
(development, 2006-04-14)

Ethnologue Edition Cycle — — — Language Information Update Cycle

Language Map Update Cycle

Row 2 Motivation Model for Ethnologue

Architect:	Gary Simons
Contributors:	Maggie Frank, Ray Gordon, Ray Uehara
Revision date:	2006-08-10
Coverage:	Adopted stage

[Full model | Things only | With relationships | With elaborations | Graphic model]

The items in this model are:

Purposes: Corpoate Purpose Statement

Goals: End A
End B
End C
Vision 2025

Objectives: Language Identification
Language Interoperation
Publish Ethnologue

Alphabetical listing of ends

Corpoate Purpose Statement

A purpose. The purpose of the SIL International is to work with language communities worldwide to facilitate language-based development through research, translation and literacy.
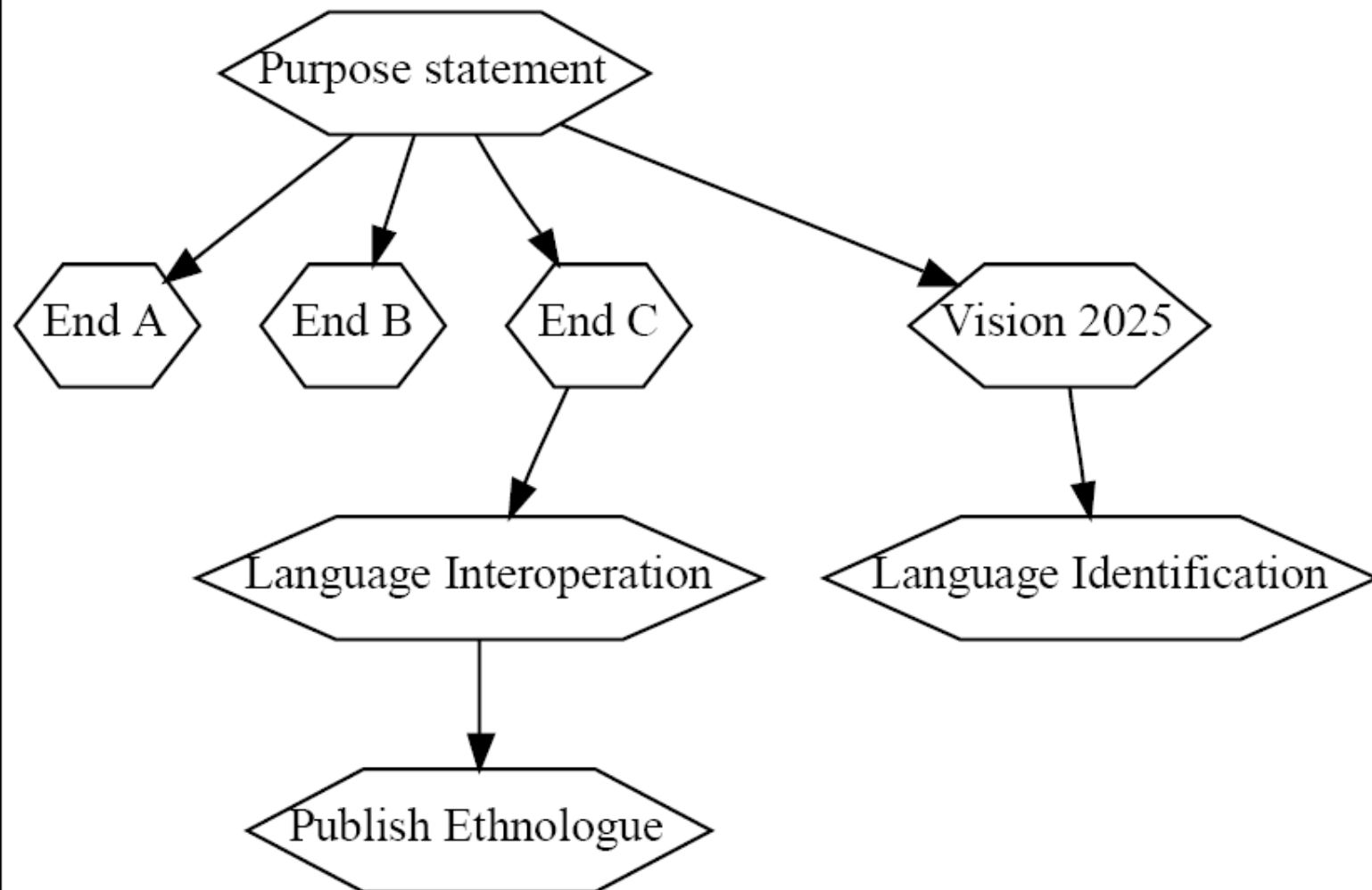
Relationships

Means: End A

Means: End B

Means: End C

Means: Vision 2025

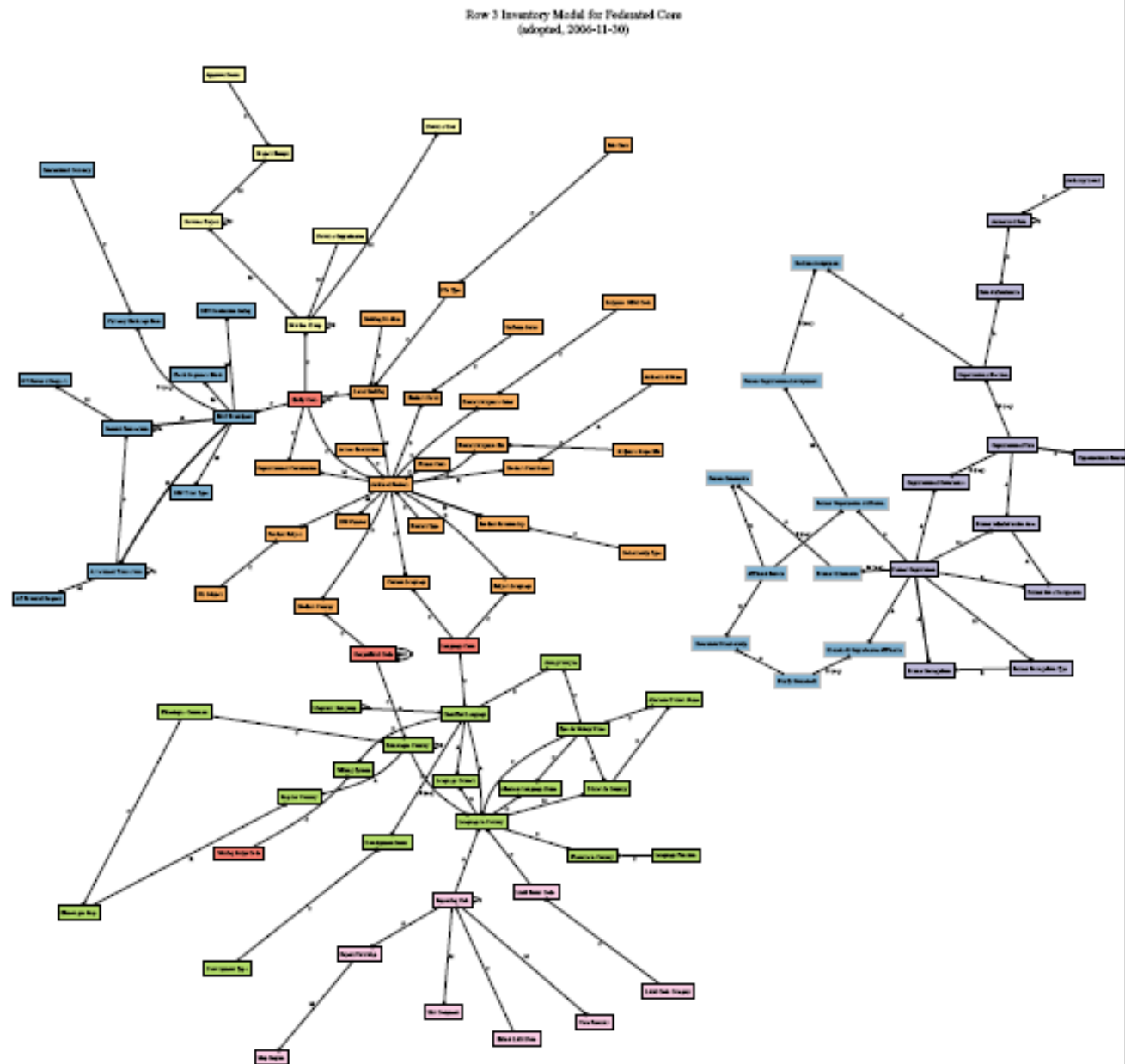*Transformations*

From: Corpoate Purpose Statement in the scope list

Row 2 Motivation Model for Ethnologue
(development, 2006-04-14)

- GEM also aggregates all system models into a single enterprise model
- E.g., Row 3 data model for all eight systems in production

Conclusions

- Having "all those models" is doable if they are automatically generated from a single source.

- "All those models" stay in sync if they are generated on demand from a single source.

- A constrained formal language:

  - Allows novice modelers to be productive
  - Ensures all produce comparable results

- Elaborating the framework standards to create a custom modeling language allows an enterprise to gain control of its architecture.