



The MAIA Methodology

Applied to Informal Ewaste Recycling Sector

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Some social systems are just too complex...

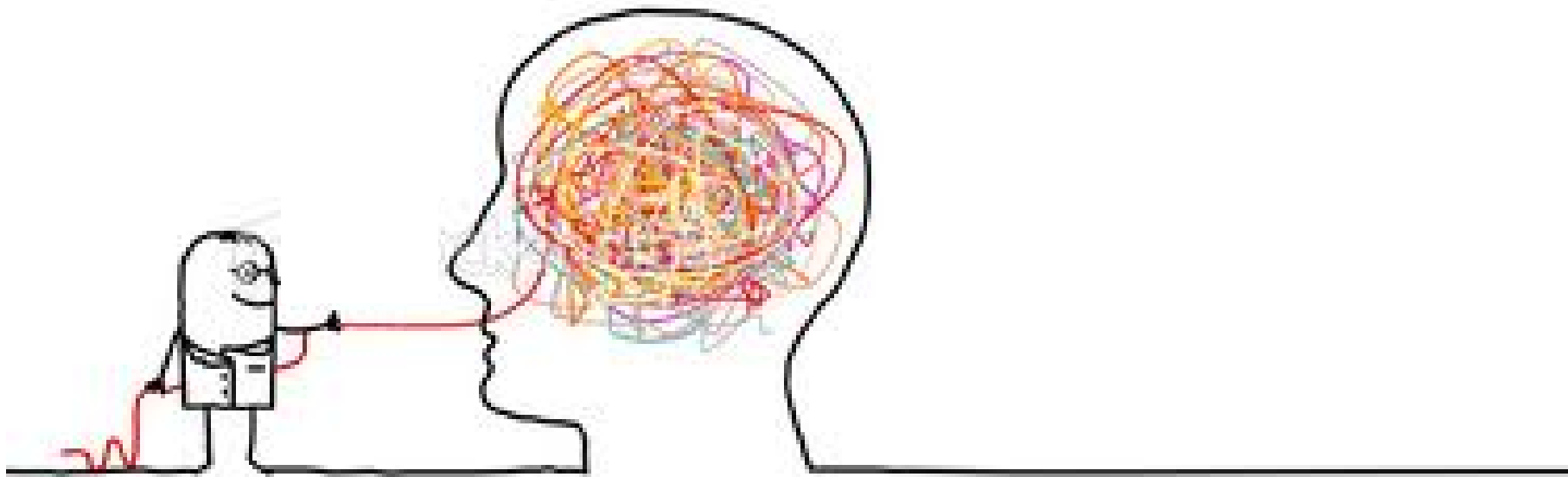


What happens in computer waste recycling?

50% - 80%
of our
computers
goes to
third world
countries



Untangle and decompose the system
to be put in an agent-based model

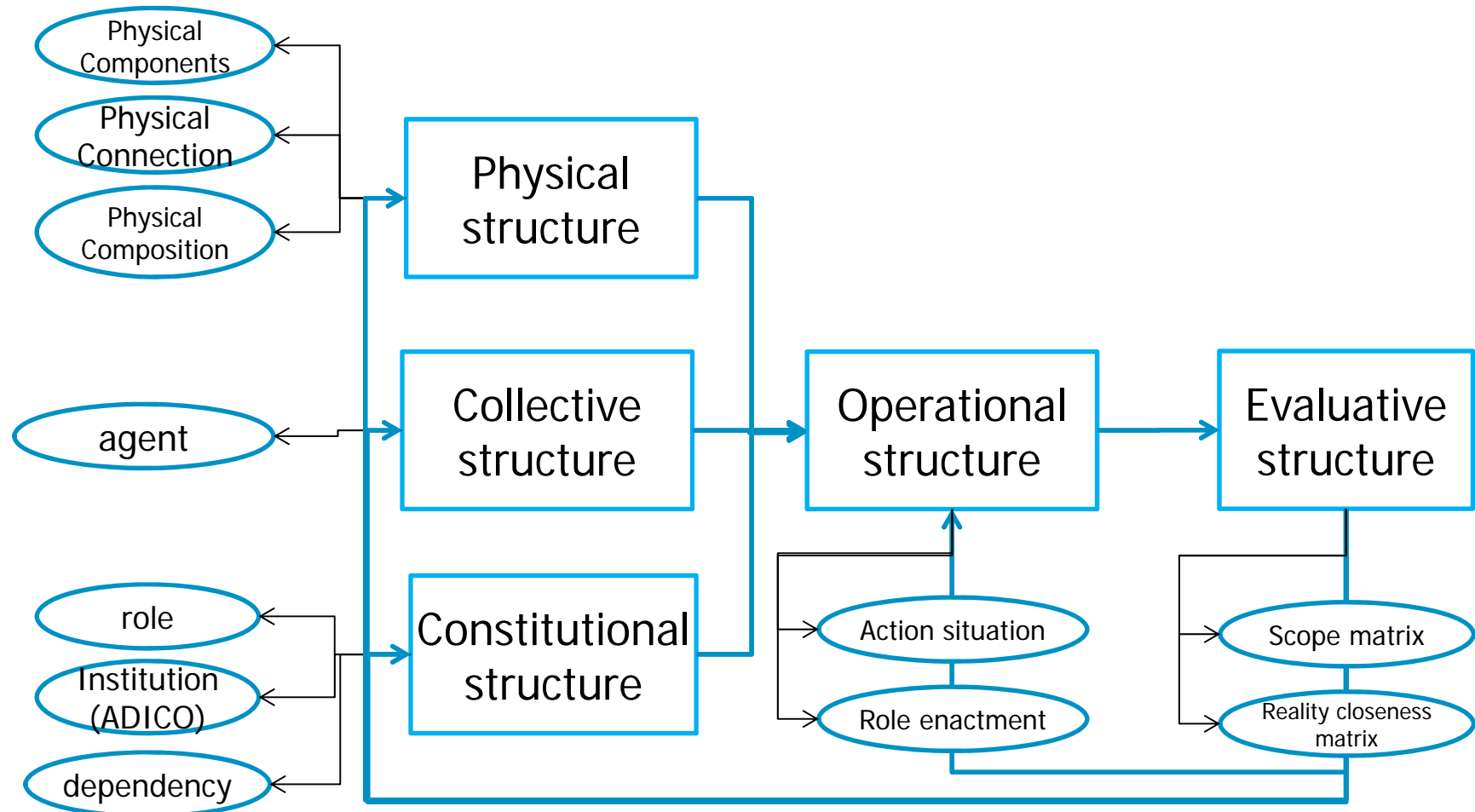


The MAIA framework

Modeling Agent Systems based on Institutional Analysis

- An ontological meta-model (modeling language) that tries to give a comprehensive view on the concepts that need to be addressed when developing an ABM.
- And the properties of those concepts...
- A methodology
 - A conceptualization phase and a detailed design phase

MAIA Meta model



MAIA applied to E-waste: Constitutional Structure

1. Roles

- Unit boss
- Segregator
- Refurbisher
- Extractor
- Government



Role Table

Role	unit boss	Segregator	Refurbisher	Extractor	Government
Objective	Profit and/or income	Profit and/or income	Profit and/or income	– Profit and/or income	- Compliance by companies to the law
Sub-objective	have workers, make connections	sell products	sell products	sell products	- Formal registration by all companies
Institutions	Distrust, Honesty, GovernmentRegistration, Corruption, ChildEmployment	SafeExtraction	SafeExtraction	SafeExtraction	Corruption
Institutional Capability	sell products, hire employees, fire employees, buy resources, pay salary	segregate computers into refurbishable parts, PWBs, connectors and waste, OR into escrap and waste	change refurbishable parts into refurbished parts	extract gold from connectors with low (25%) efficiency	<ul style="list-style-type: none"> - Fine companies that do not follow regulations - can through a Safety Inspection learn which companies are following which laws, and also if they work safe or unsafe - can calculate a fine per felony, according to the weight of the felony - can remember companies that were fined for a felony

Constitutional Structure

- Institutions
 - Attributes
 - Deontic Type
 - Aim (actions)
 - Conditions
 - Or else



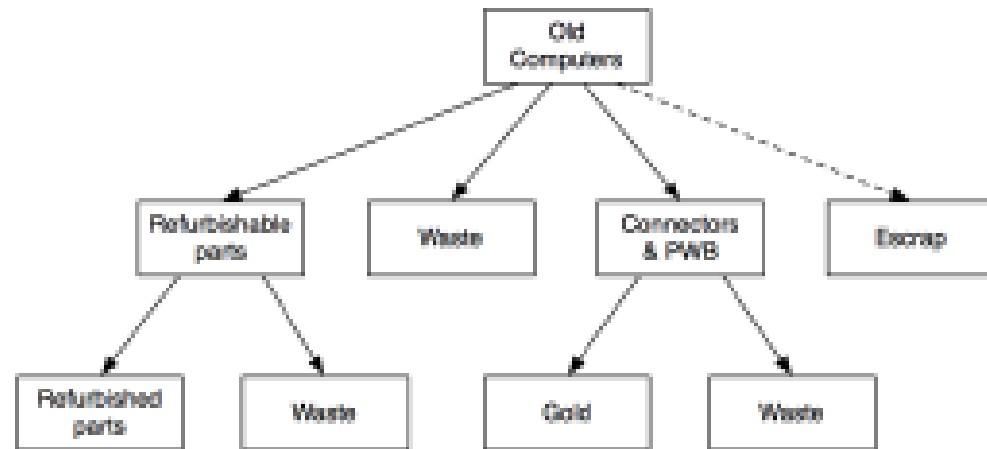
A unit boss **in prohibited** to hire children **if** he is registered with the government **or else** he will be fined


MAIA applied to E-waste: Physical Structure

1. Physical Components

- Old computers
- Refurbishable parts
- Refurbished parts
- Connectors / Connectors
- Gold
- Waste (ie computer encasing, plastic/iron/steel/aluminium)
- E-scrap (PWBs + Connectors)

2. Physical Composition





MAIA applied to E-waste: Collective Structure

- Agents
 - Worker
 - GovernmentAgent
 - ProfessionalEndRefinerAgent
 - World Market Agent

Properties, Personal Values, Type, Role, Information, Physical components, intrinsic capability

MAIA applied to E-waste: Operational Structure

- Action Situations
 - Hire Workers
 - Register
 - BuyProducts from Market
 - Crystal Project
 - treat old computers
 - treat refurbishable parts
 - treat connectors and PWBs
 - SellProducts
 - SafetyInspection

- Role Enactment

Agent	Action situation	Role
Worker	HireWorkers	Unit boss
Worker	Register	Unit boss
Worker	BuyProducts	Unit boss
Worker	CrystalProject	Unit boss
Worker	SellProducts	Unit boss
Worker	SafetyInspection	Unit boss
Worker	TreatProducts	Segregator
Worker	ProfitCalculation	Segregator
Worker	HireWorkers	Segregator
Worker	ProfitCalculation	Refurbisher
Worker	HireWorkers	Refurbisher
Worker	BuyProducts	Refurbisher
Worker	TreatProducts	Refurbisher
GovernmentAgent	Register	Government
GovernmentAgent	SafetyInspection	Government
Worker	TreatProducts	Extractor
Worker	ProfitCalculation	Extractor
Worker	CrystalProject	Extractor

MAIA applied to E-waste:

Evaluative Structure Reality Closeness Matrix

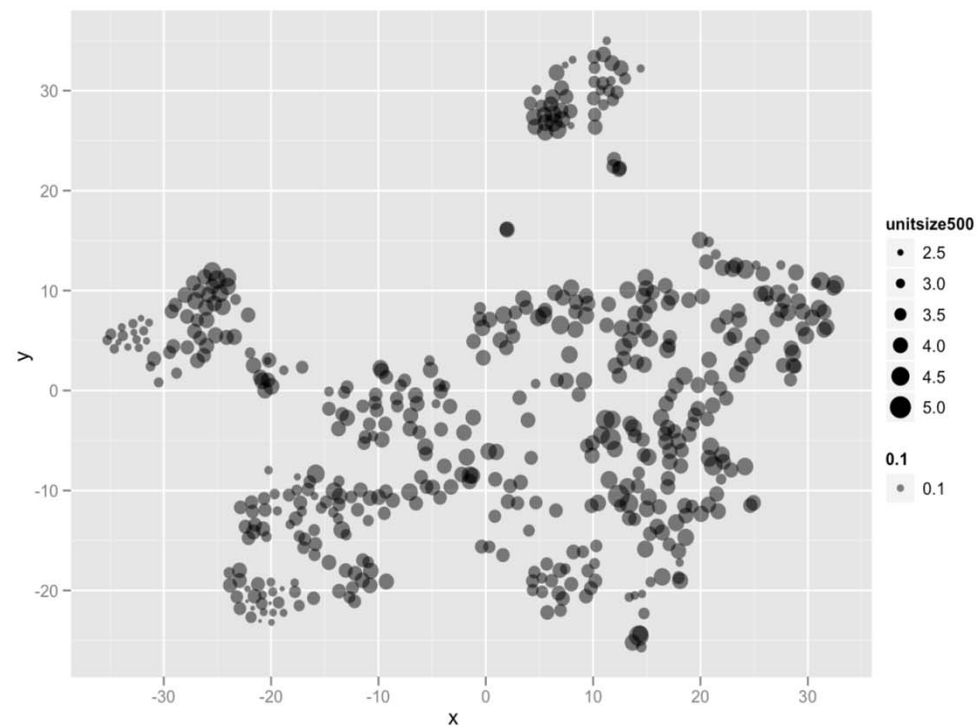
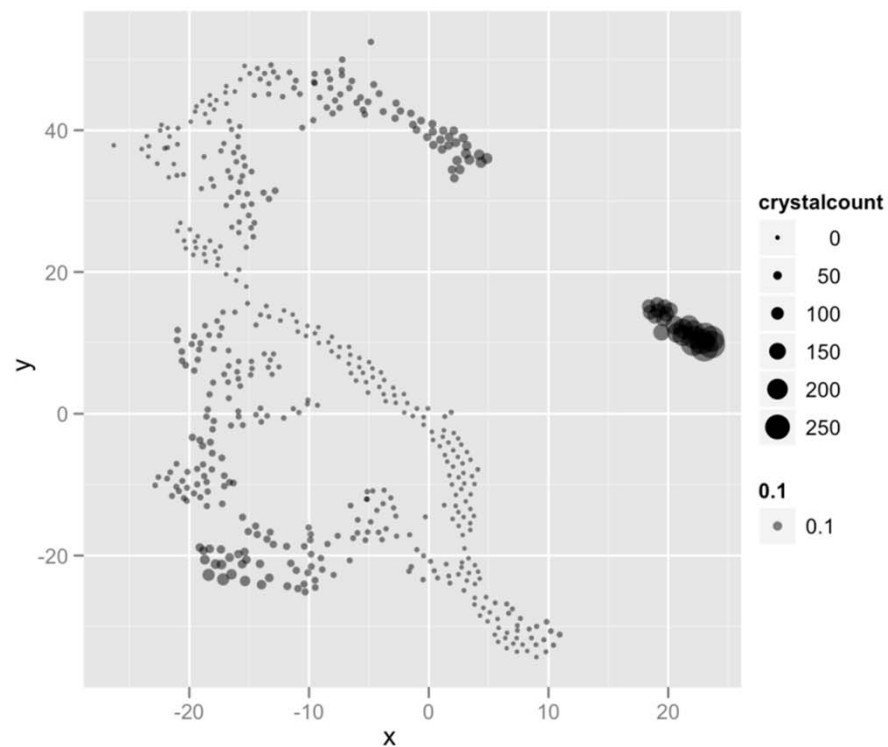
Situation:	Fluctuating Prices	Hire Workers	Register	Buy Products from Market	Buy Products from units	Crystal Project	treat old computers	treat refurbishable parts	treat connectors and PWBs	Sell Products	Safety Inspection
money	i		d	d	d		d	d	d	d	d
no. product per unit					d		d	d	d	d	
no. resources per units				d	d		d	d	d	d	
world market values										d	
average negotiated prices					d					d	
composition of units		d									
no. crystal contract						d					
unit members		d									
weight of products per unit > 0				d	d		d	d	d	d	

MAIA applied to E-waste: Evaluative Structure

Scope Matrix

Situation:	Hire Worke rs	Regist er	BuyProdu cts from Market	BuyProdu cts from units	Crysta l Projec t	treat old comput ers	treat refurbisha ble parts	treat connectors and PWBs	SellProdu cts	SafetyInspe ction
no. Refurbishers in unit	d		i	i						
no. Segregators in unit	d		i							
no. extractors in unit	d		i	i						
money (unitBoss)		d	d	d		d	d	d	d	d
money (worker)						d	d	d		
no. recycling units	d									
no. registered		d								
gold/waste/refur bished in World market									d	
escrap for refiner					i				d	
escrap per unit					i	d				

Some Simulation Results





Some Benefits of untangling ...

- A structured way of presenting concepts
 - Easy to follow
 - Documentation
 - Reuse of the model
 - Regeneration of the model
- Better communication with domain experts..
- Conceptualization of the validation process.
- Focus on social structures besides individual agents.

Conclusion

- MAIA would help the modeling process as a general guideline.
 - Not guarantee the best model.
- Only use components that one thinks are necessary to answer the questions
- Only use the level that is relevant. E.g. only conceptualization.
- What now?
 - Structure(decomposition) for decision making similar to institutions,
 - Tools
 - Web-based application
 - Eclipse plugin



Thank you for listening...

Questions?