What do we need to consider when configuring Large Industrial Commodity Supply Chains?

Lessons from the Sugar Industry

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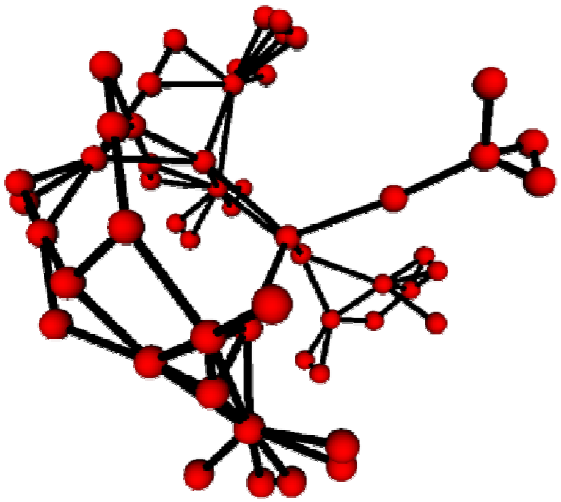

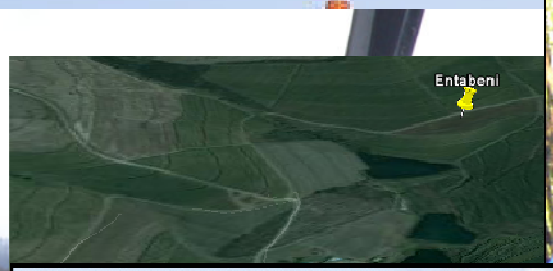
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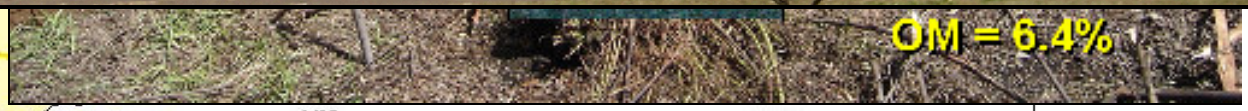

OM = 6.4%

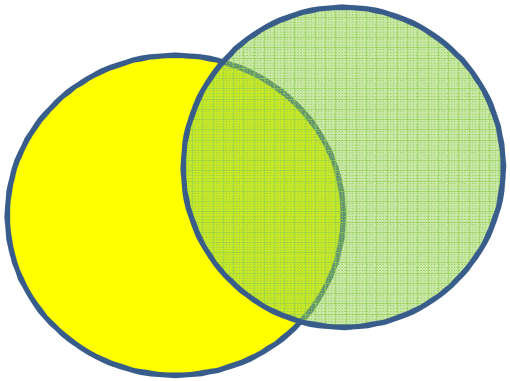
18°E
24°E
30°E

Exercise:

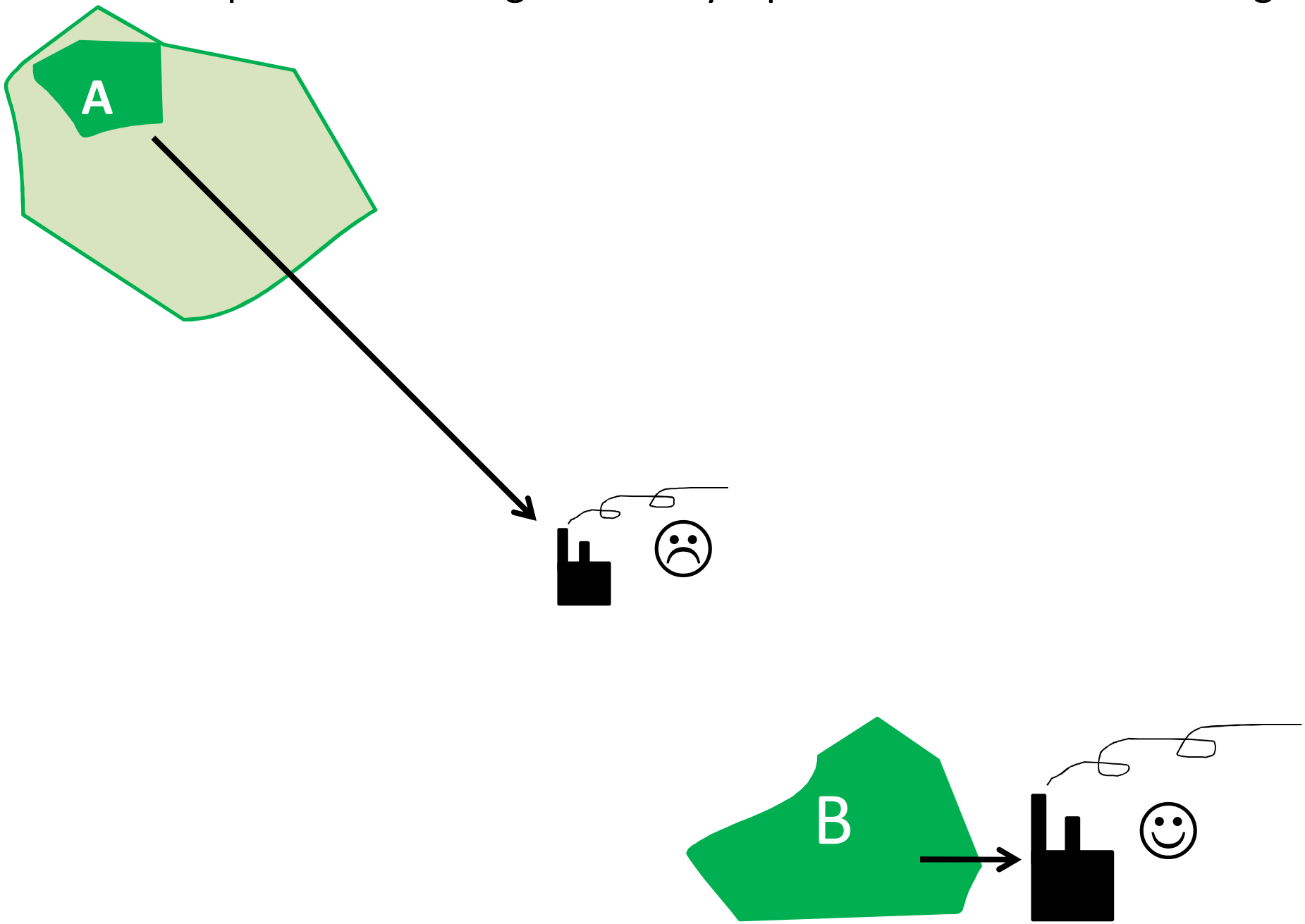
Pick any two people in the audience

Now position yourself exactly halfway between those two persons

Bounded rationality is a concept based on the fact that rationality of individuals is limited by the information they have or by the model of what really matters to them.



An example from the sugar industry – please tell me who is wrong



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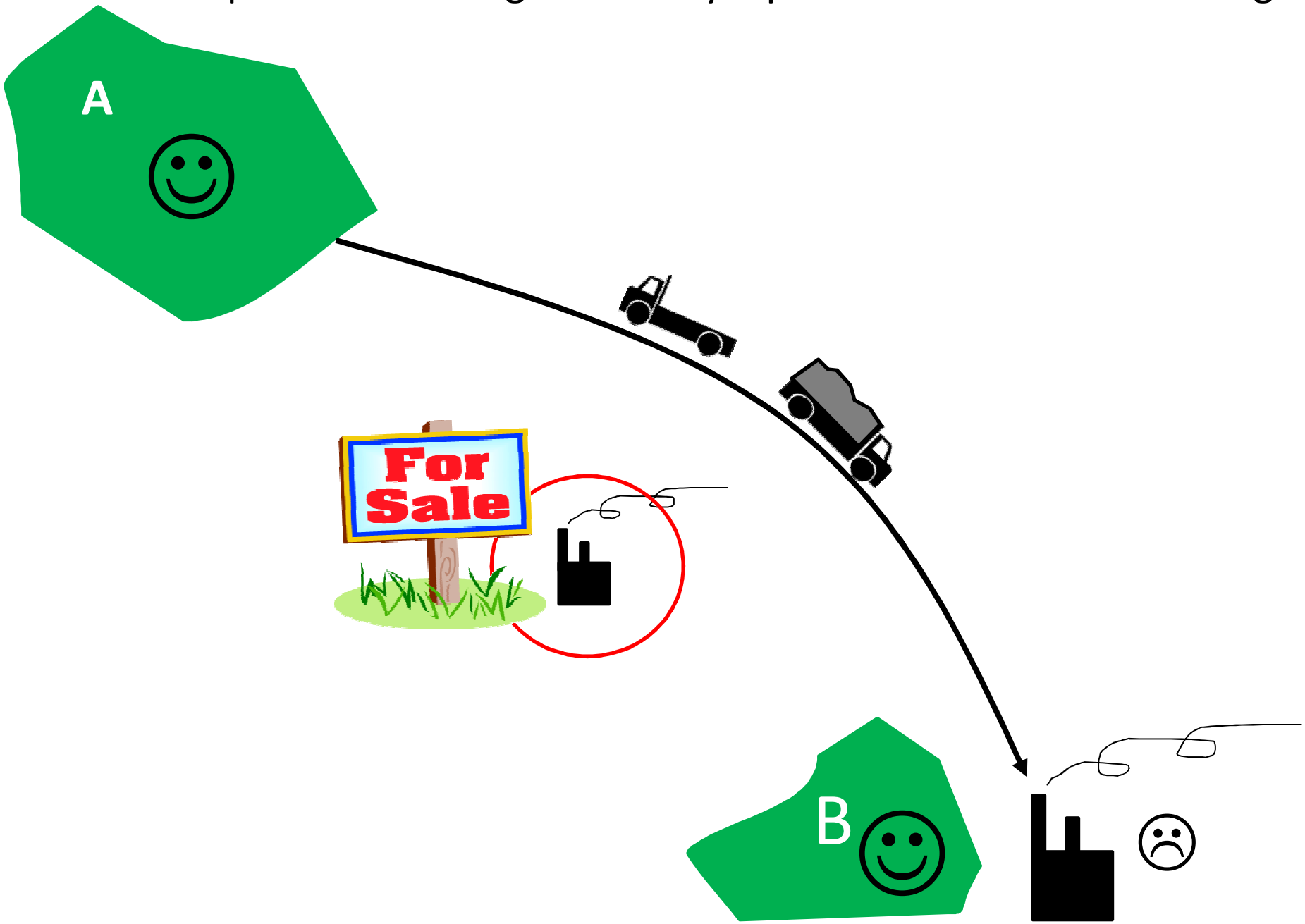

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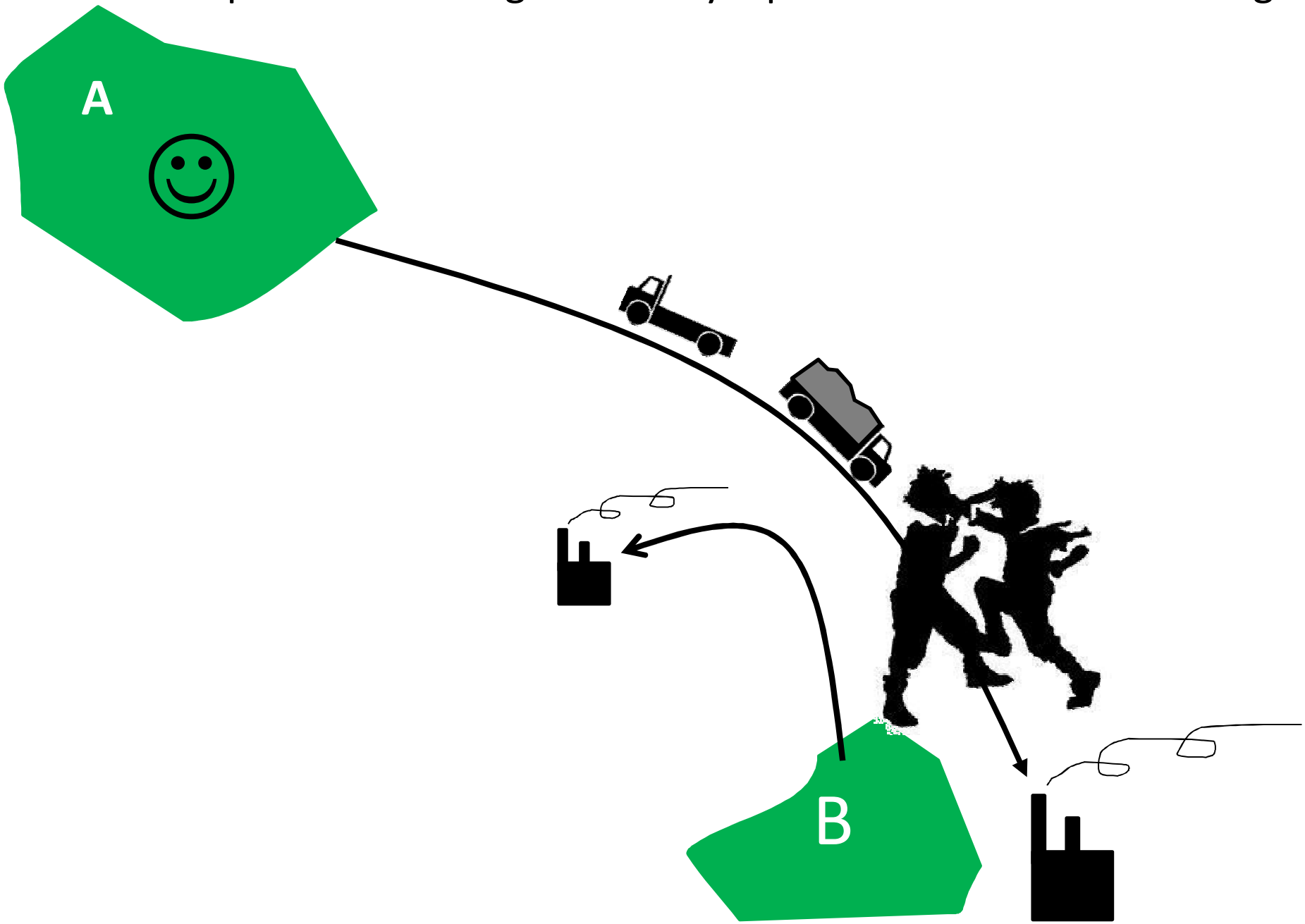

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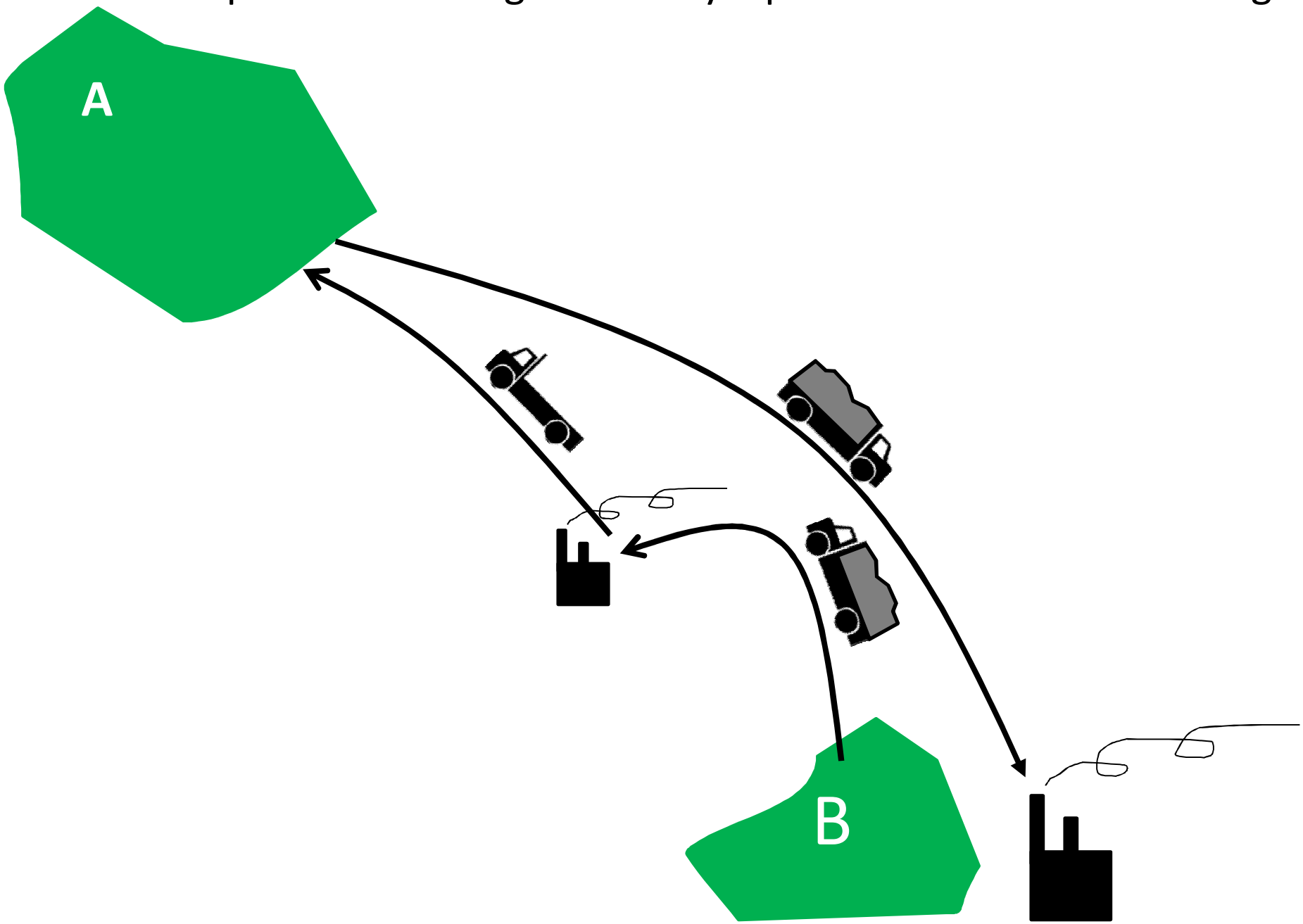
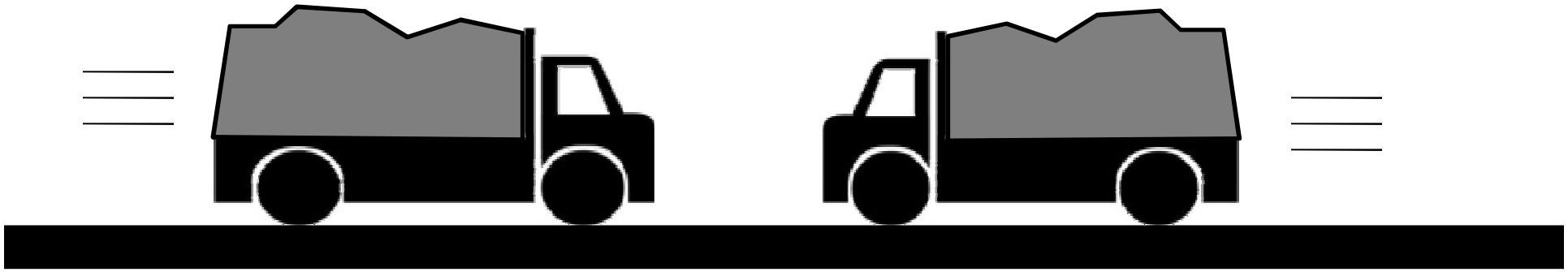


Although everybody is acting rationally

Full sugarcane trucks owned by the same person carrying the same product pass each other in an opposite directions on the freeway



How does this happen?

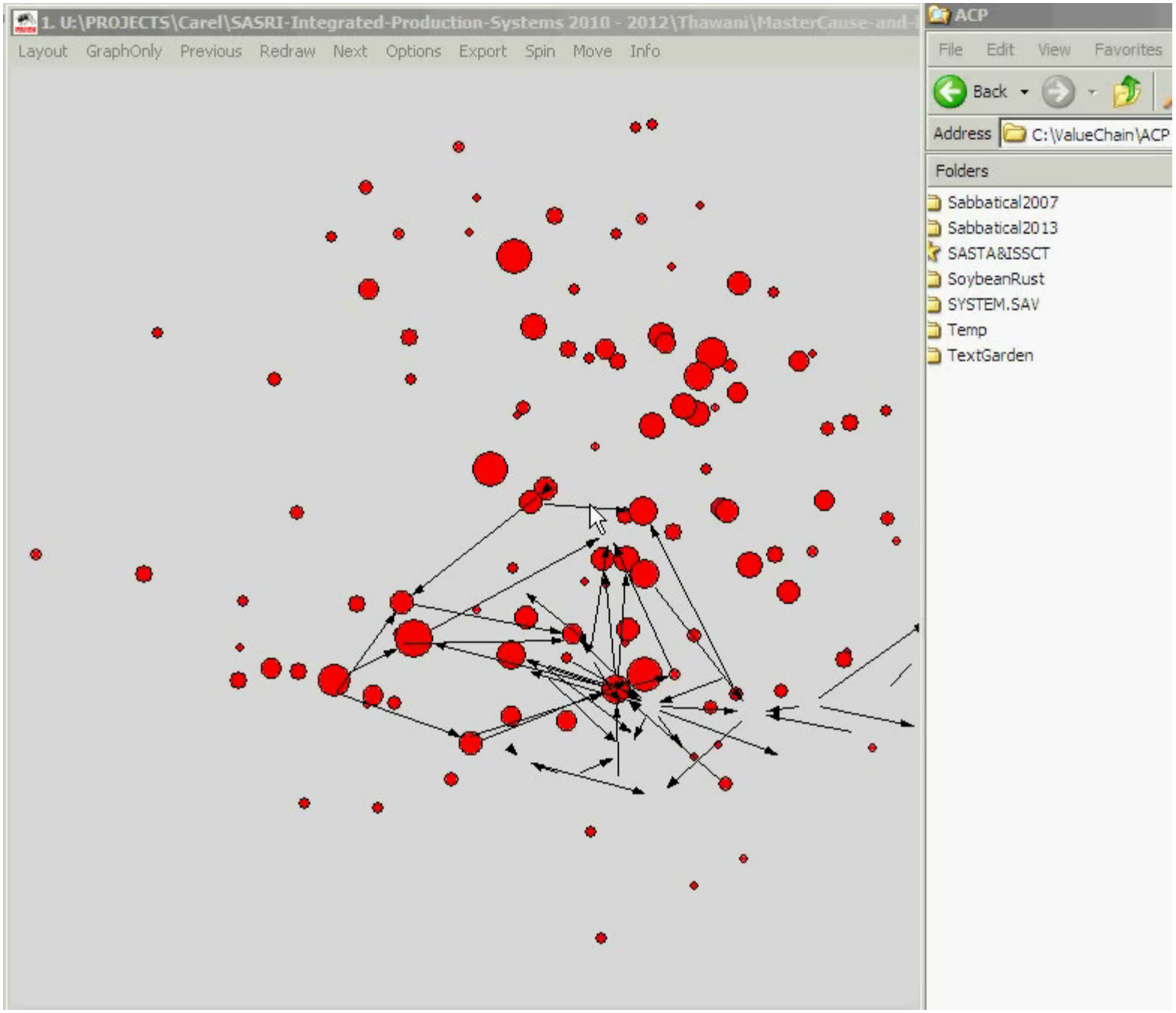
Bounded Rationality & Complexity

Complexity

A **large number** of system parts with a large amount of **connectivity** between parts

1. A Complex System is unpredictable but not irrational

2. A non-repetitive nature (we cannot run experiments)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ACP
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Folders
Sabbatical2007
Sabbatical2013
SASTA&ISSCT
SoybeanRust
SYSTEM.SAV
Temp
TextGarden

Vertex Name	Centrality (%)	KPI	Leverage
Lower cane supply reliability	90.7	47	13
Lower cutter productivity	91.0	37	2
Lower cane quality	84.8	37	3
Rainfall events	91.6	1	30
Cane lodging	88.2	15	29
Yield reduction	85.7	30	20
Transport efficiency	89.4	27	11
Extended milling season	96.8	6	25
Mill breakdowns	89.4	9	23
No-cane stops	88.2	20	13
High cane moisture content	83.0	18	21
Cane deterioration	91.2	18	9
Soil in cane	91.0	18	18
Cane variety	80.3	20	2
Low cane [illegible] capacities	93.3	17	8
High operating costs	85.9	18	1
Trashing (mulching)	89.7	9	16
Aged equipment	88.5	0	16
Low sugar recovery	79.3	17	1

Leverage Points

Performance Metrics

Analyse Structural Feedback Loops

Prioritize Problems

Make sense out of the messyness

Is it fair to presume biofuel supply chains will be messy?

Capacity Building In South Africa, Namibia and Ghana to Create Sustainable Non-Food Bio-oil Supply Chai

Large scale production
High degree of community involvement
Countries where political forces can dominate economical forces

To stim[illegible] **supply chains** using [illegible] food oil-bearing model crop; to transfer know-how f[illegible] experienced teams to others.

To provide capacity-building for ACP universities so that they are able to offer technical expertise and training to regional initiatives in renewable CHP, carry out research on the production and exploitation of 2nd generation biofuels exemplified by jatropha and microalgae, monitor the implementation of sustainability criteria and trading, and monitor the impacts of biofuels on **food, land use and the environment.**

To **increase renewable CHP user demand**.

Is it fair to presume biofuel supply chains will be messy?

Capacity Building In South Africa, Namibia and Ghana to Create **Sustainable** Non-Food Bio-oil Supply Chains

Long-term non-exploiting focus
Community involvement
A system with adaptive capacity

To stimulate **investment** in th… ng and distribution infra-structure of 2nd … new **businesses**.
To foster partner… **g supply chains** using jatropha as a 2nd … model crop; to transfer know-how from experienced … to others.
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To stimulate **investment** in the research, production, processing and distribution infra-structure of 2nd generation biofuels destined for CHP, and in new **businesses**.
To foster partnerships between energy businesses and **farming supply chains** using jatropha as a 2nd generation non-food oil-bearing ma… …nsfer know-how from experienced team…
To provide capac… …e to offer technical expertise and tra… …out research on the production a… …biofuels exemplified by jatropha and microalgae, … …the implementation of sustainability criteria and trading, and monitor the impacts of biofuels on **food, land use and the environment.**
To **increase renewable CHP user demand**.

Corporate structure
Regulations, policies & standards
A world full of accountants & lawyers

Is it fair to presume biofuel supply chains will l

Seasonal & climatic variability
Limited skills
Ownership *vs.* Employment (Autonomy)
Payment agreements
Conservative / Traditionalism
Competition: Land, water, products, etc…

Ca d Ghana to Create y Chains

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Multi-criteria – fertile ground for bounded rationality

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Variable supply chain demand & markets

Large scale production .....

Community involvement.....

Political forces.....

Corporate structure.....

Regulations, policies & standards.....

Accountants & lawyers.....

Seasonal & climatic variability.....

Limited skills.....

Autonomy .....

Payment agreements .....

Traditionalism .....

Competition: Land, water, products, etc... ...

Bounded rationality .....

Long-term non-exploiting focus .....

A system with adaptive capacity .....

Variable supply chain demand / market.....

*The **BIG** Challenge:*

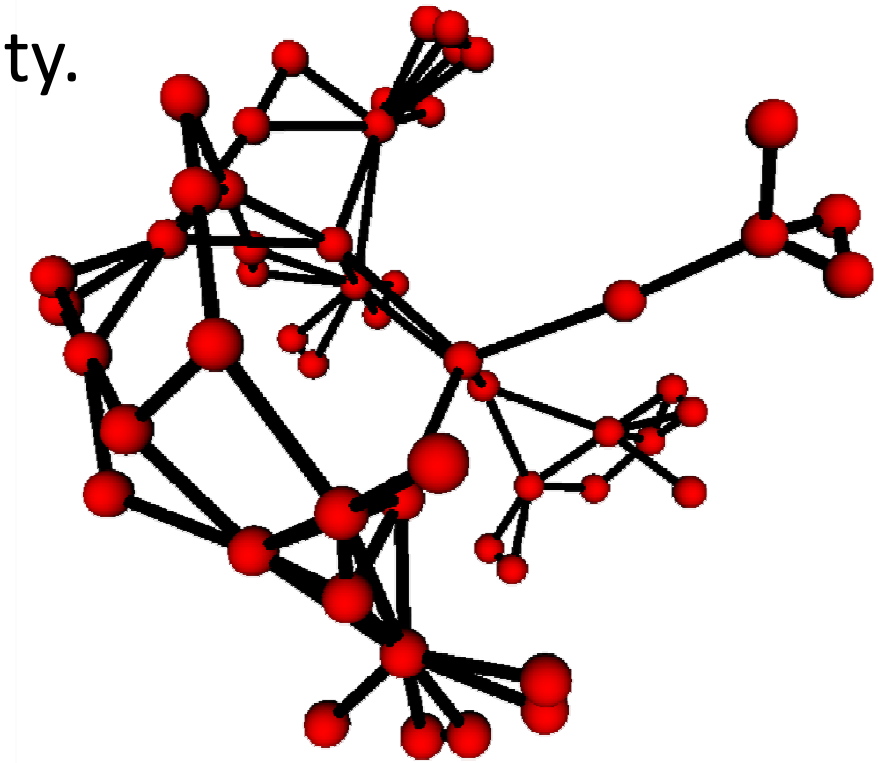
Considering the complexities in the system, configure the supply chain is such a way that it would:

(a) Exploit the positive features in the system,

(b) Mitigate the negative features, and

(c) Promote an adaptive capacity.

Design with complexity in mind



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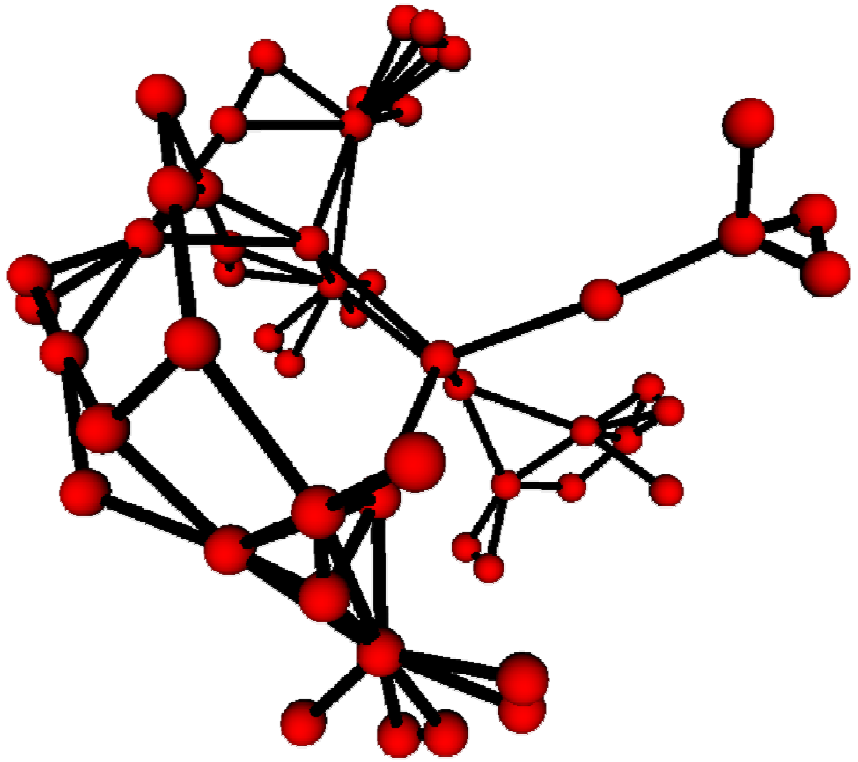


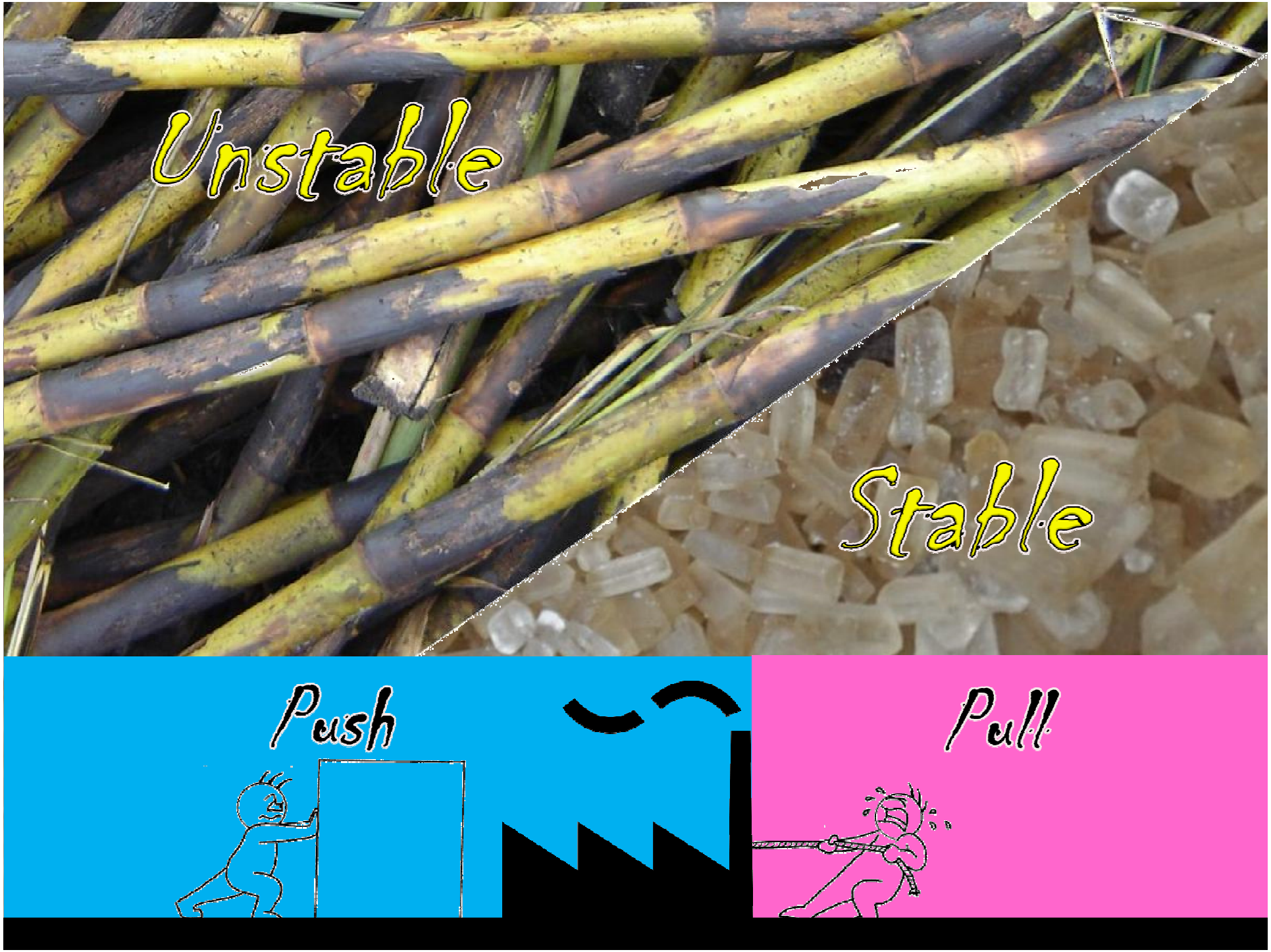
TRIZ

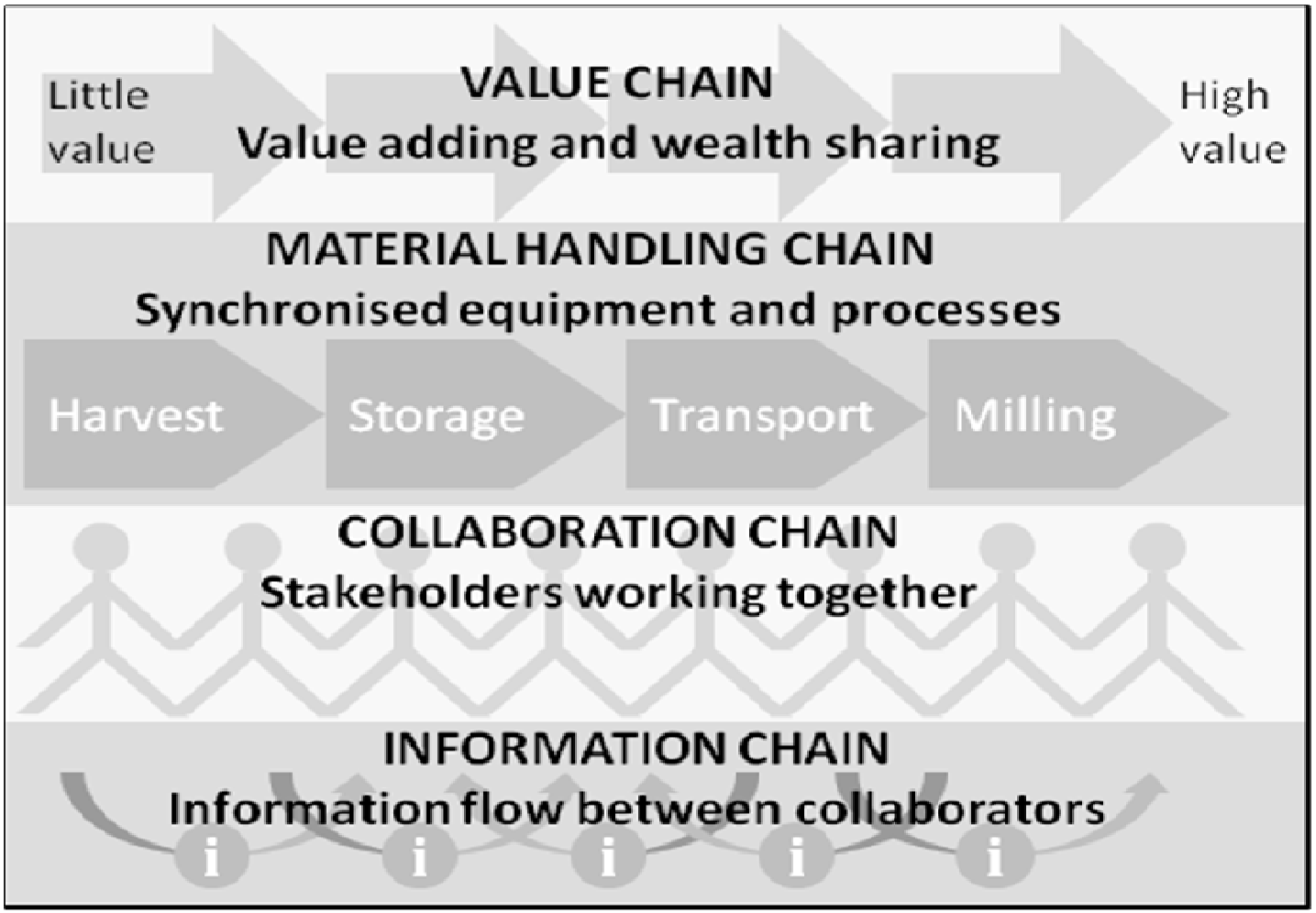
SSM

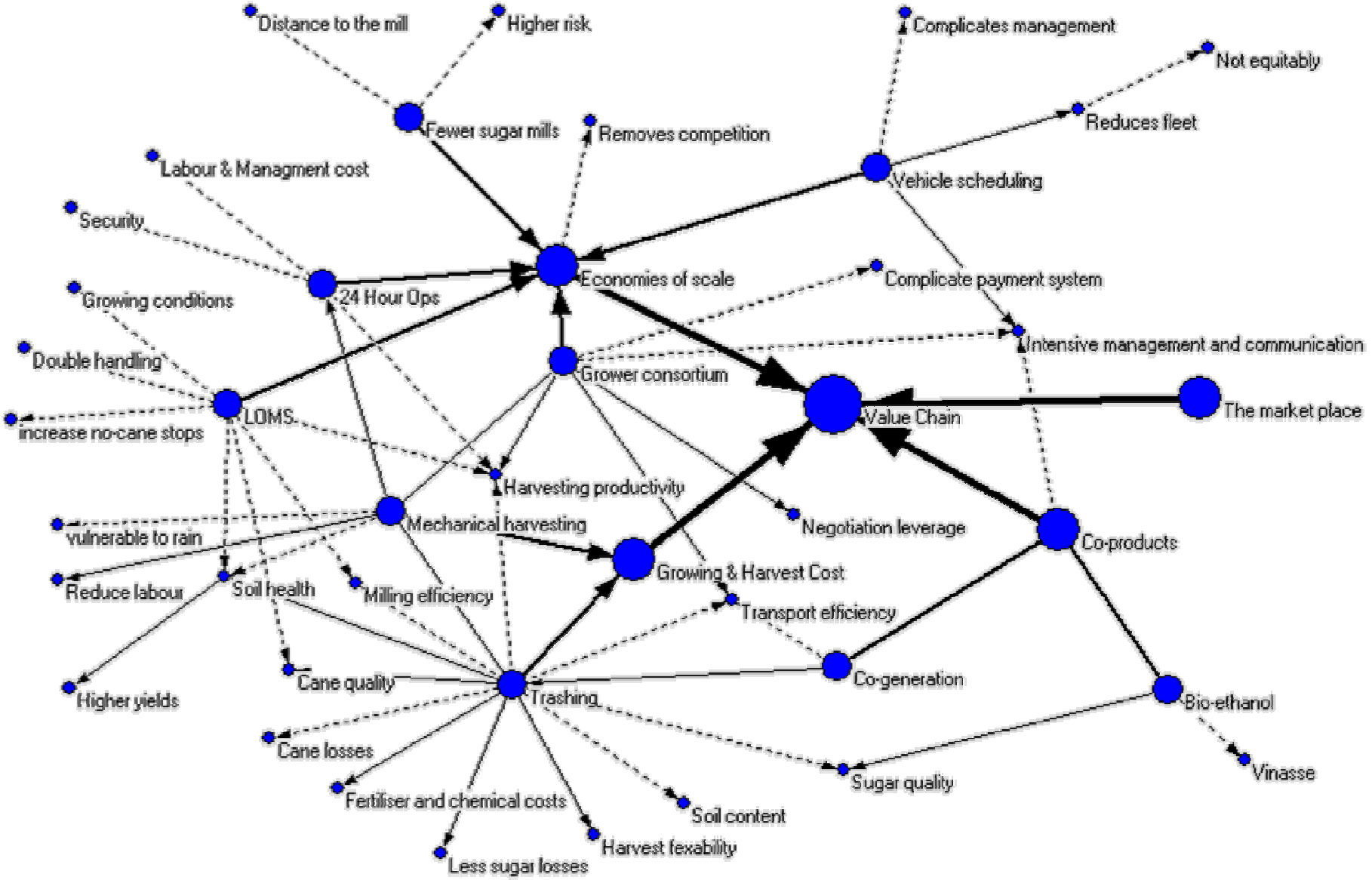
Game Theory

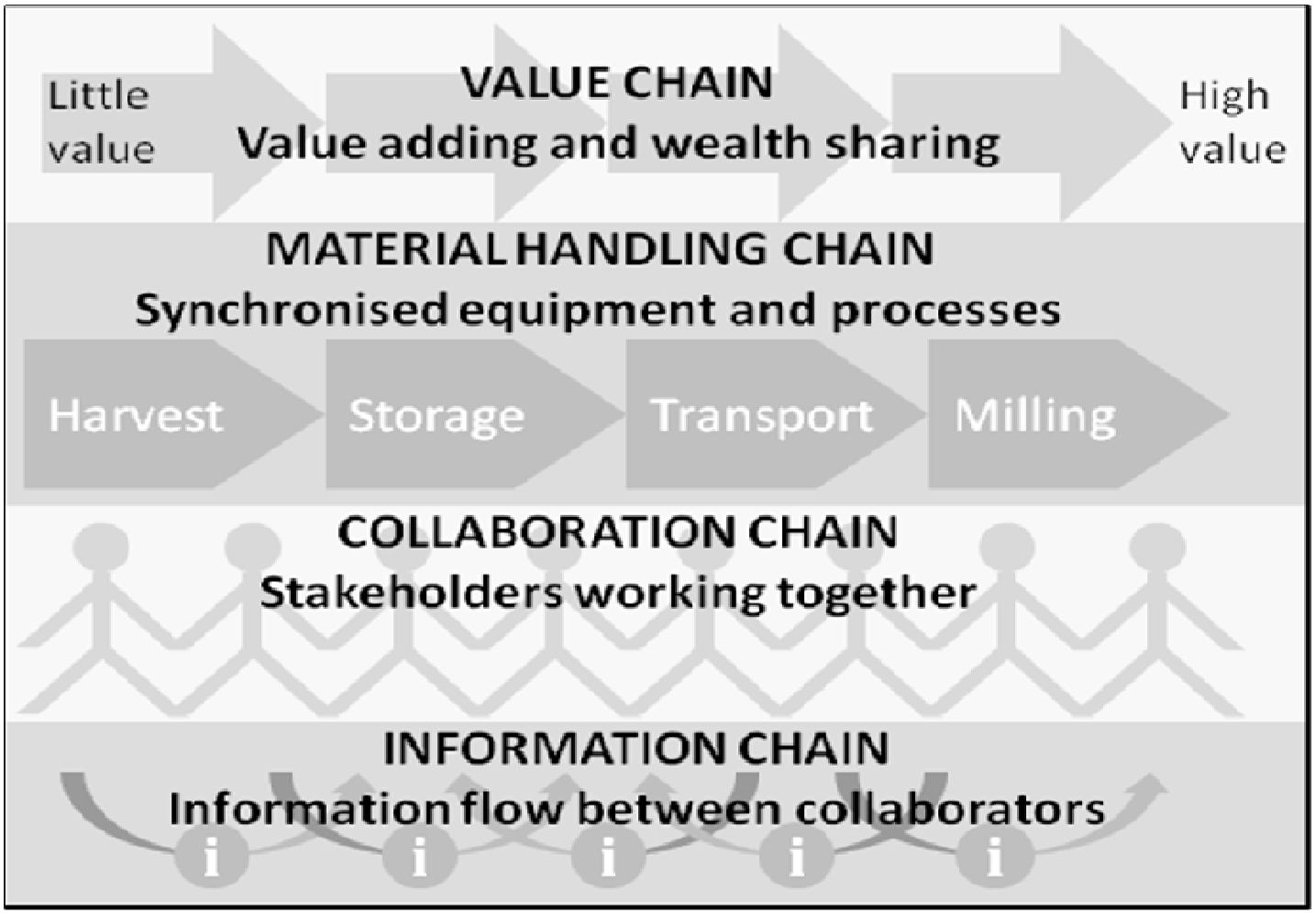
Metamodelling & Ontologies

Theory of constraints


Unstable
Stable
Push
Pull


Little value
VALUE CHAIN
Value adding and wealth sharing
High value
MATERIAL HANDLING CHAIN
Synchronised equipment and processes
Harvest
Storage
Transport
Milling
COLLABORATION CHAIN
Stakeholders working together
INFORMATION CHAIN
Information flow between collaborators


Distance to the mill
Higher risk
Fewer sugar mills
Removes competition
Labour & Managment cost
Security
Growing conditions
Double handling
increase no-cane stops
LOMS
24 Hour Ops
Economies of scale
Grower consortium
Harvesting productivity
Mechanical harvesting
vulnerable to rain
Reduce labour
Soil health
Milling efficiency
Higher yields
Cane quality
Trashing
Cane losses
Fertiliser and chemical costs
Less sugar losses
Harvest flexability
Soil content
Sugar quality
Growing & Harvest Cost
Transport efficiency
Co-generation
Bio-ethanol
Vinasse
Negotiation leverage
Value Chain
The market place
Co-products
Complicates management
Not equitably
Reduces fleet
Vehicle scheduling
Complicate payment system
Intensive management and communication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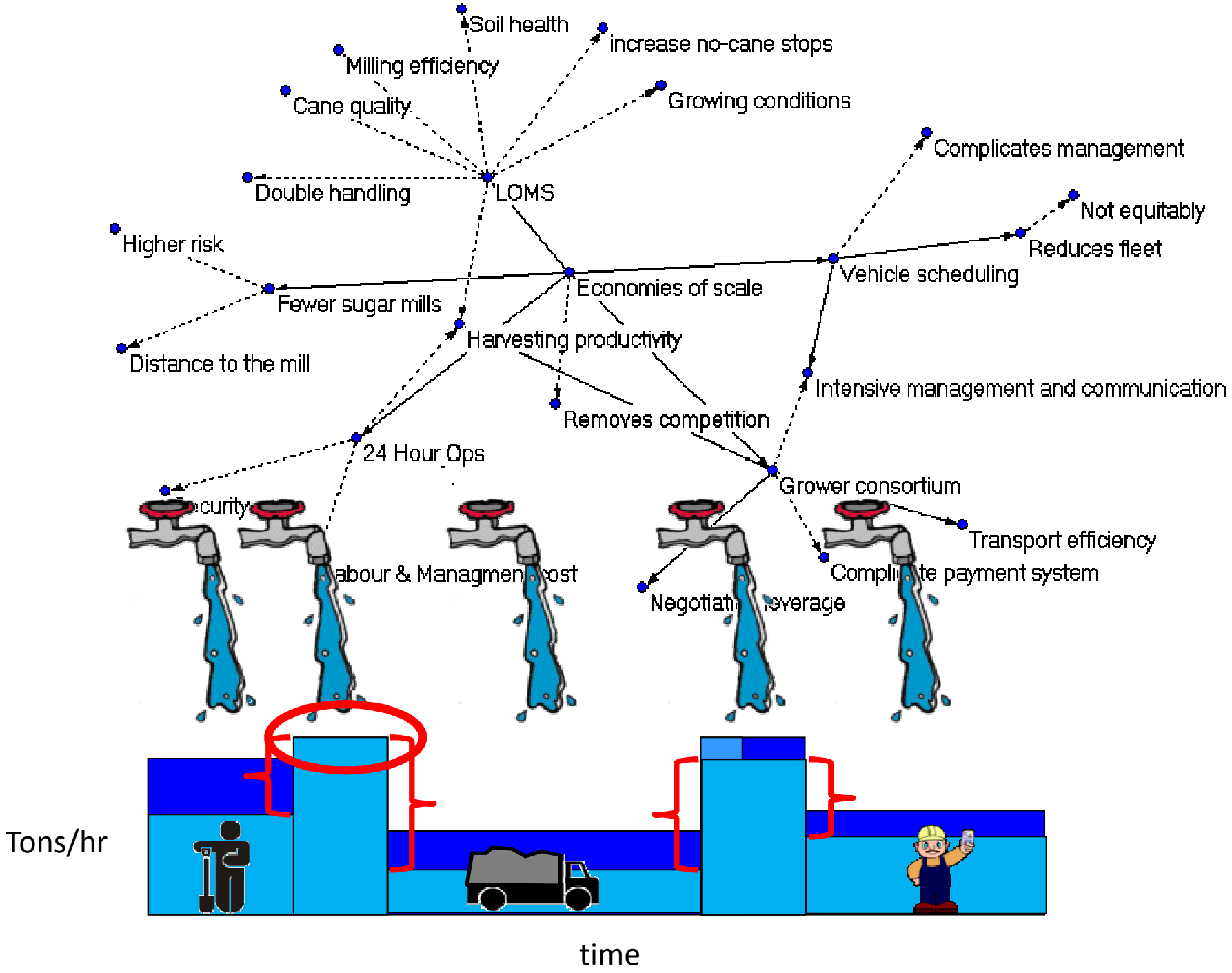
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Higher risk
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Economies of scale
Fewer sugar mills
Harvesting productivity
Distance to the mill
Intensive management and communication
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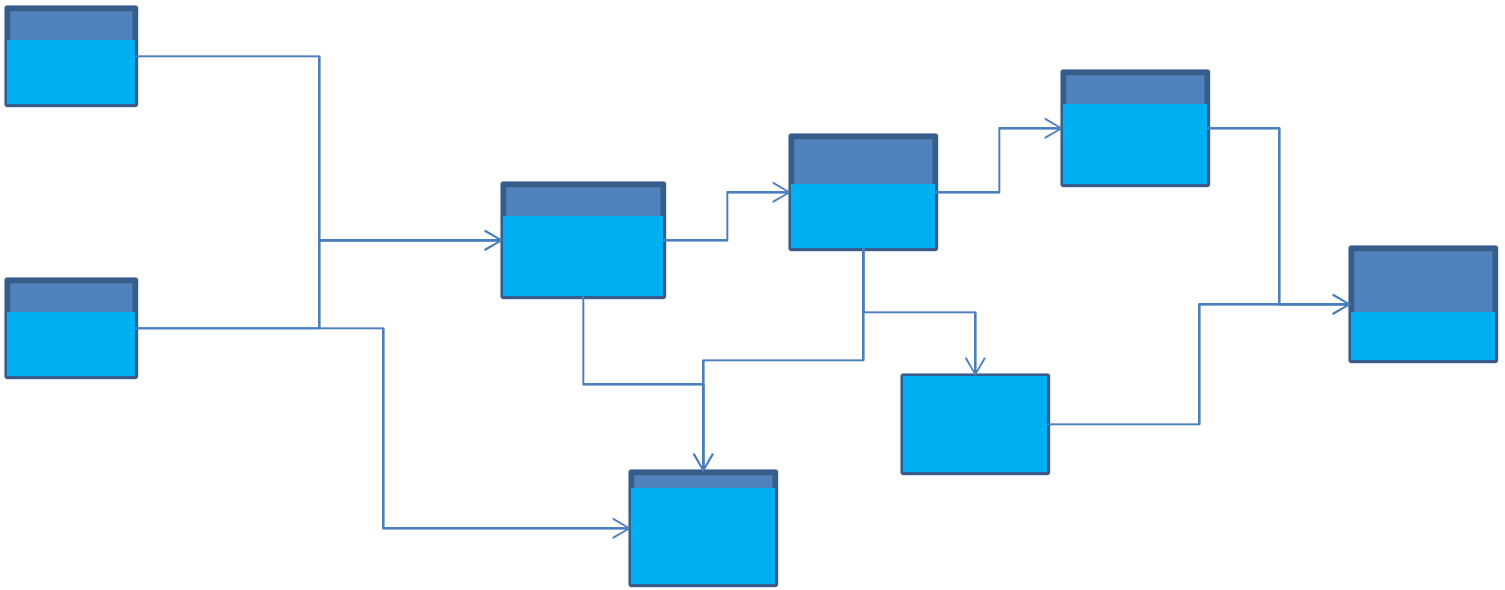
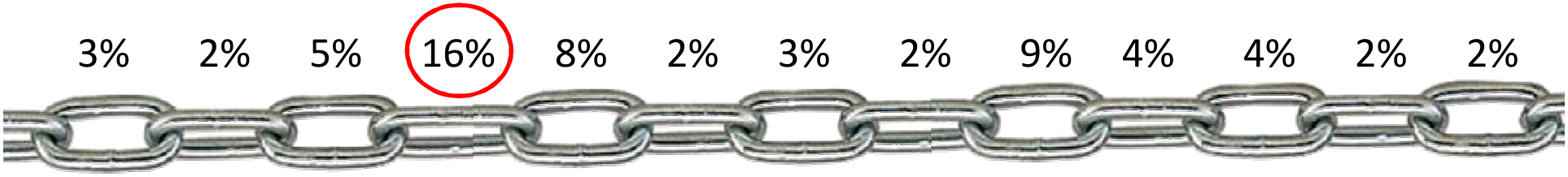
Grower consortium
curity
Transport efficiency
abour & Managmen ost
Compli te payment system
Negotiati everage
Tons/hr
time


Risk?

Risk of Failure

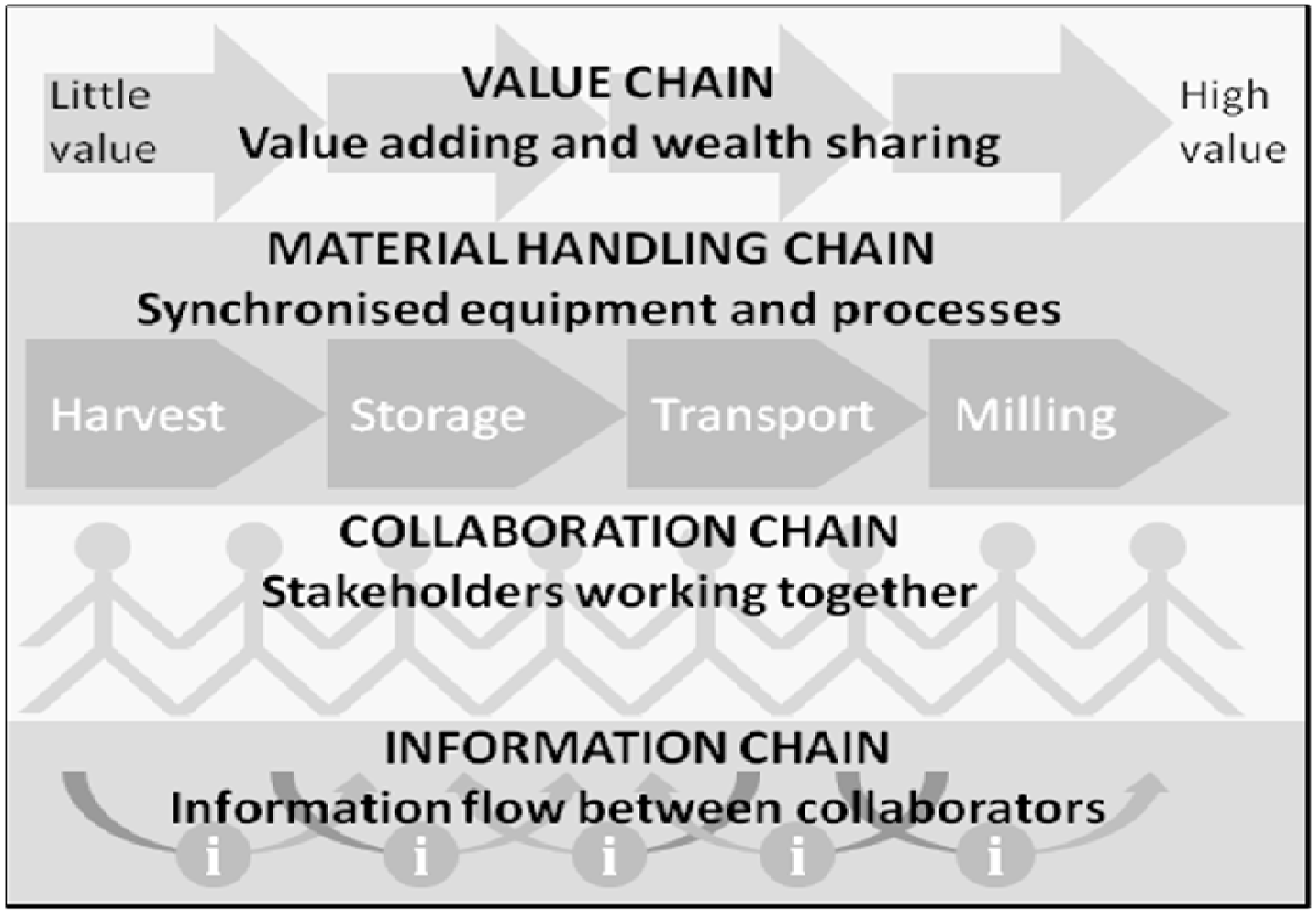


Total Supply Chain Risk = ***62%***

CONSISTENCY !!!!

The Perfect Order:

The right product, with ✓
The right quality, from ✗
The right source, to ✓
The right destination, in ✓
The right condition, at ✗
The right time, with ✗
The right documentation, for ✓
The right cost. ✗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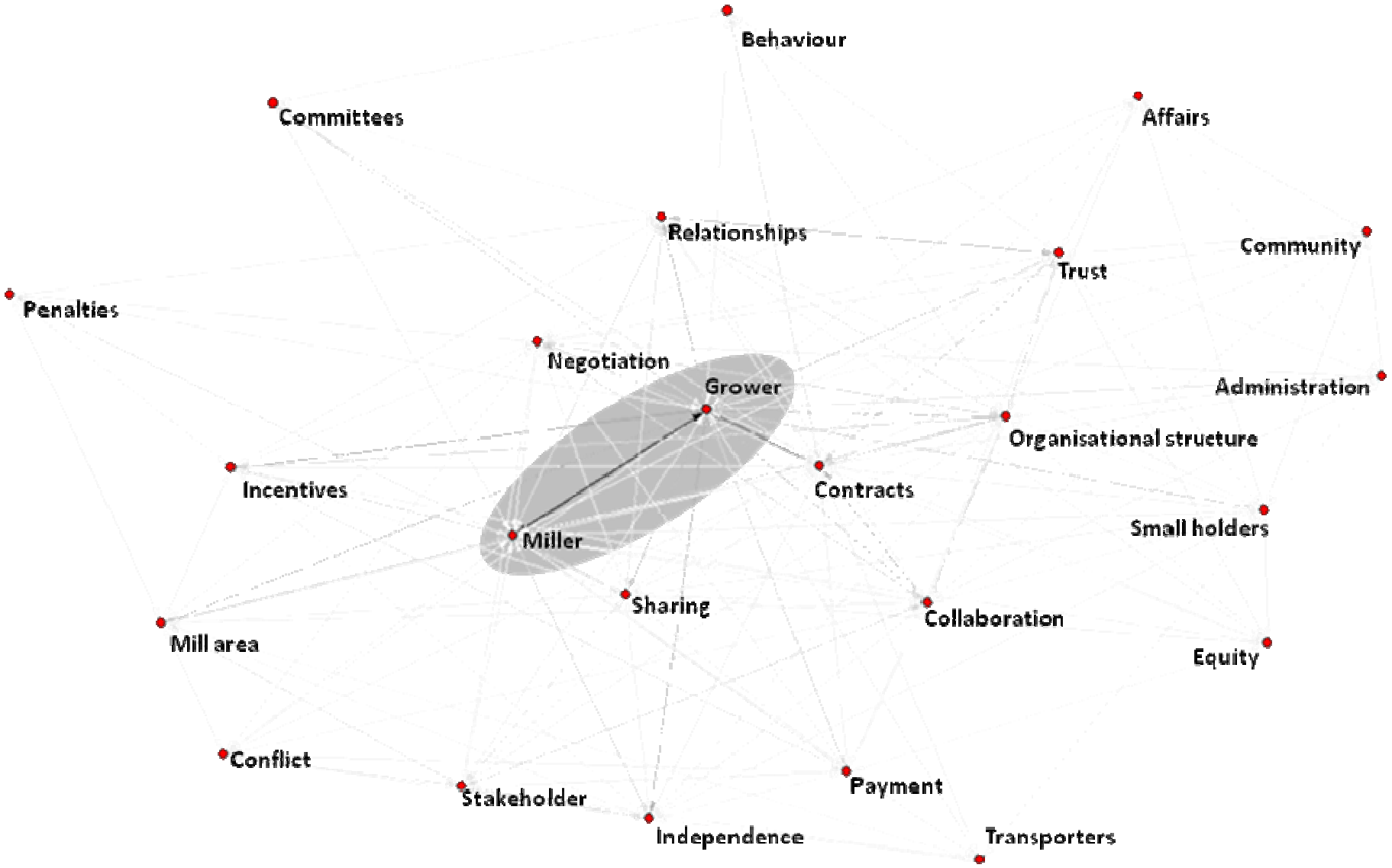
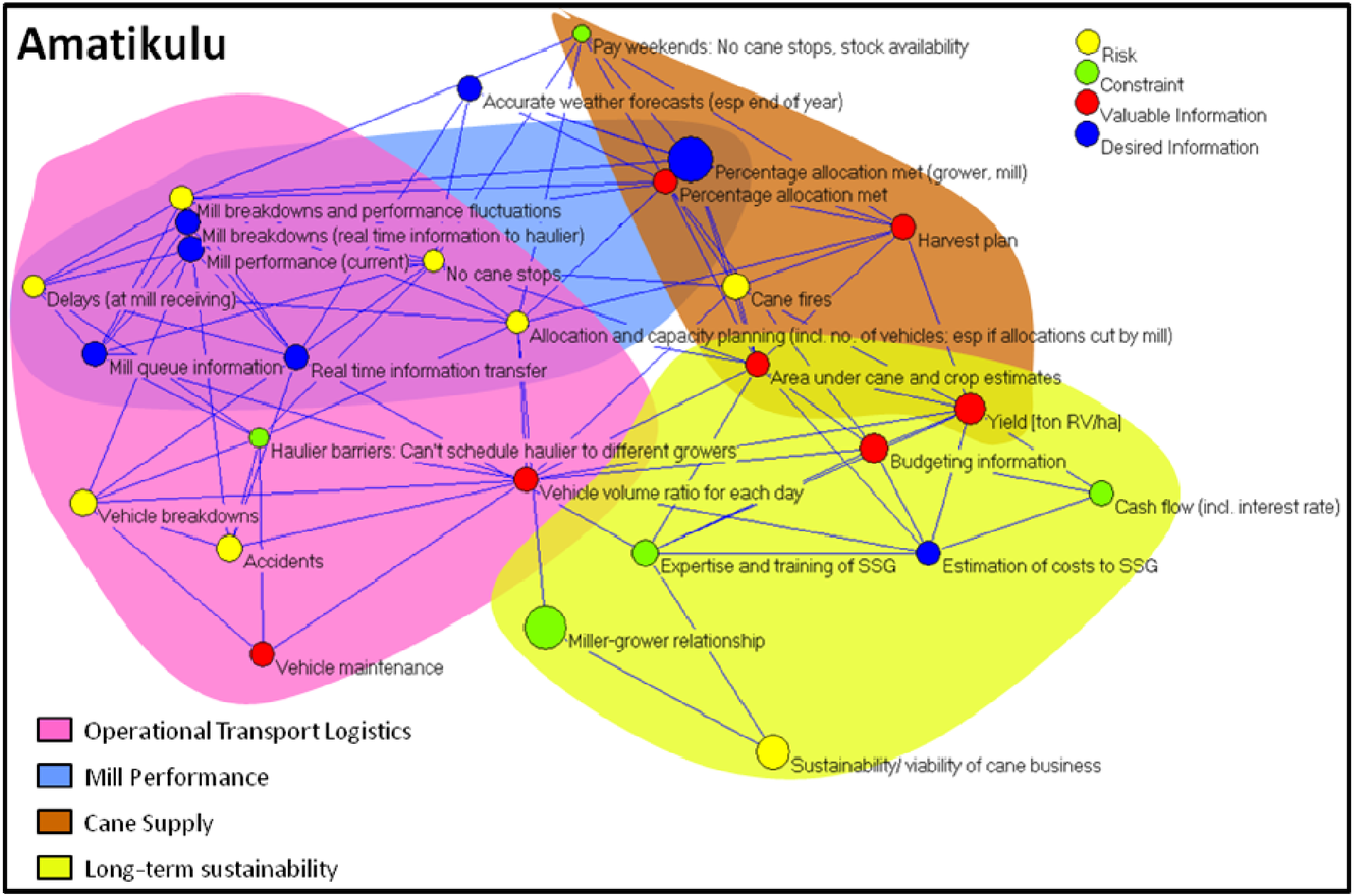
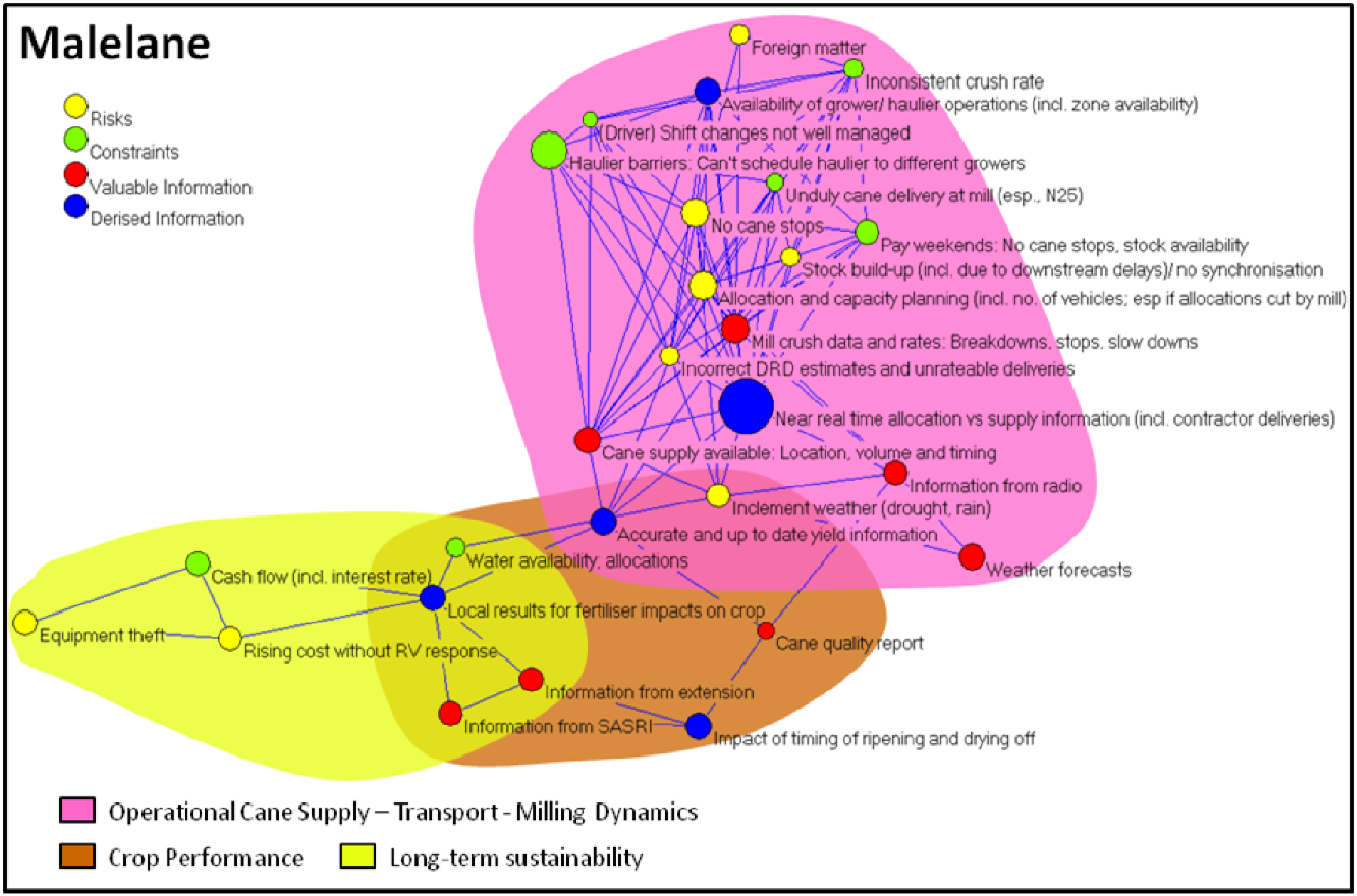
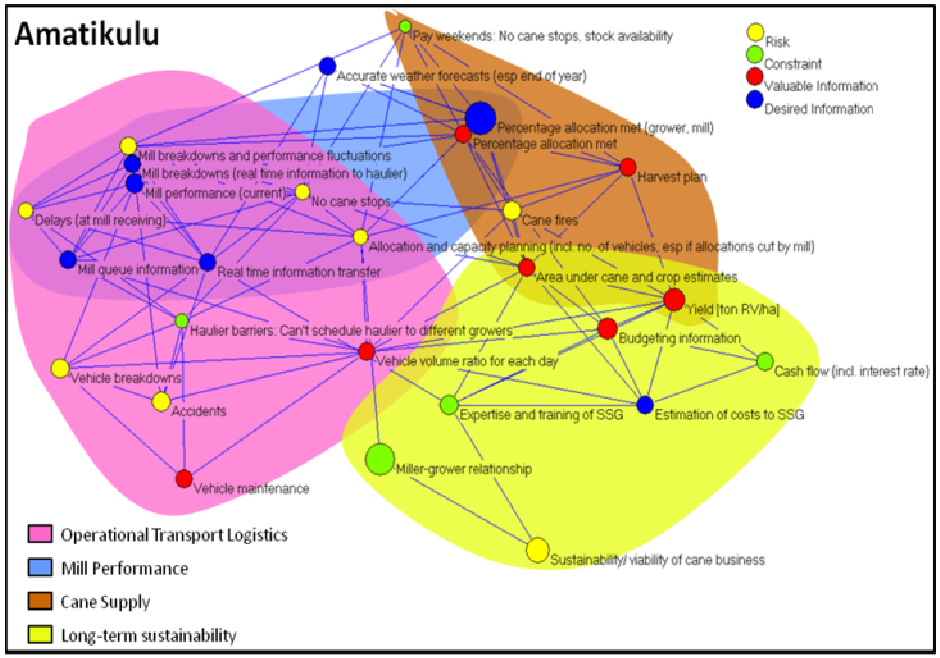
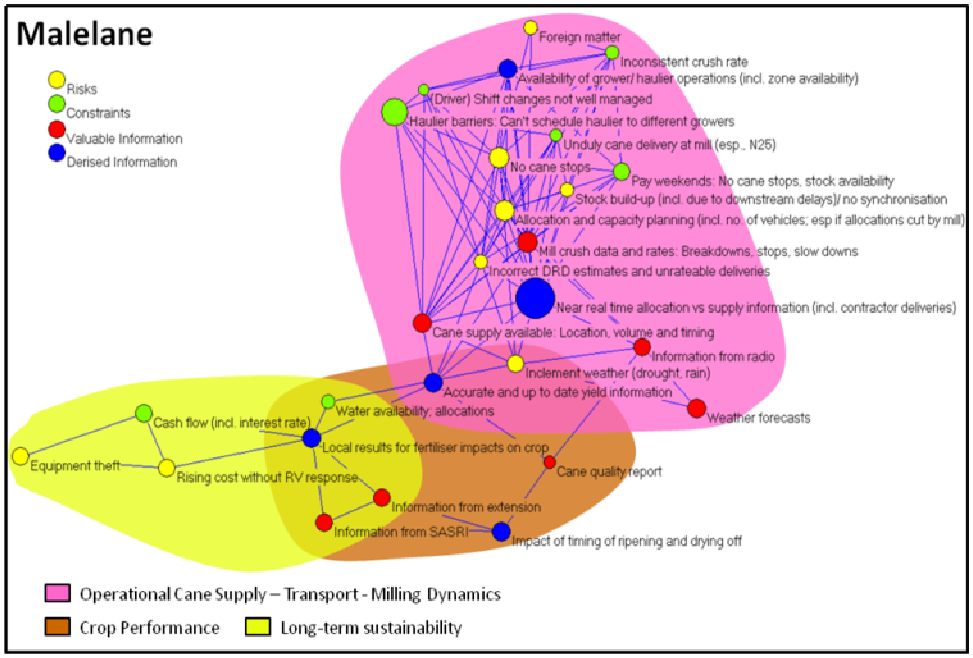

Behaviour
Committees
Affairs
Relationships
Community
Trust
Penalties
Negotiation
Grower
Administration
Organisational structure
Incentives
Contracts
Small holders
Miller
Sharing
Collaboration
Mill area
Equity
Conflict
Payment
Stakeholder
Independence
Transporters


Amatikulu
Pay weekends: No cane stops, stock availability
Accurate weather forecasts (esp end of year)
Percentage allocation met (grower, mill)
Percentage allocation met
Mill breakdowns and performance fluctuations
Mill breakdowns (real time information to haulier)
Mill performance (current)
No cane stops
Harvest plan
Delays (at mill receiving)
Cane fires
Allocation and capacity planning (incl. no. of vehicles; esp if allocations cut by mill)
Mill queue information
Real time information transfer
Area under cane and crop estimates
Yield [ton RV/ha]
Haulier barriers: Can't schedule haulier to different growers
Budgeting information
Vehicle volume ratio for each day
Cash flow (incl. interest rate)
Vehicle breakdowns
Accidents
Expertise and training of SSG
Estimation of costs to SSG
Miller-grower relationship
Vehicle maintenance
Sustainability/ viability of cane business
Risk
Constraint
Valuable Information
Desired Information
Operational Transport Logistics
Mill Performance
Cane Supply
Long-term sustainability


Malelane
Risks
Constraints
Valuable Information
Derised Information
Foreign matter
Inconsistent crush rate
Availability of grower/ haulier operations (incl. zone availability)
(Driver) Shift changes not well managed
Haulier barriers: Can't schedule haulier to different growers
Unduly cane delivery at mill (esp., N25)
No cane stops
Pay weekends: No cane stops, stock availability
Stock build-up (incl. due to downstream delays)/ no synchronisation
Allocation and capacity planning (incl. no. of vehicles; esp if allocations cut by mill)
Mill crush data and rates: Breakdowns, stops, slow downs
Incorrect DRD estimates and unrateable deliveries
Near real time allocation vs supply information (incl. contractor deliveries)
Cane supply available: Location, volume and timing
Information from radio
Inclement weather (drought, rain)
Accurate and up to date yield information
Weather forecasts
Water availability; allocations
Cash flow (incl. interest rate)
Local results for fertiliser impacts on crop
Equipment theft
Rising cost without RV response
Cane quality report
Information from extension
Information from SASRI
Impact of timing of ripening and drying off
Operational Cane Supply – Transport - Milling Dynamics
Crop Performance
Long-term sustainability

Mill area	Number of vertexes	Total number of triangles	Maximum number of triangles per vertex
Amatikulu	27	306	23
Malelane	27	447	55
Sezela	29	360	37



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