Using System of System (SoS) based Approaches to Scenarios Design for Policy Making at Regional Level

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Agenda

The problem

Future Studies context

La Prospective methodology

System of Systems approach

First experiment: A prototype

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The problem

brief overview

during the last five years many regions received from Ecopetrol approximately **700 millions of dollars**

current situation for many regions is not leave behind **the poverty and civil instability**

2014: A project to anticipate regional behavior pattern for address the operational decision-making in critical territories

Future studies

Tools to improve public administration performance at regional level.

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The problem

Corporate Sustainability = Sustainable Territorial Development

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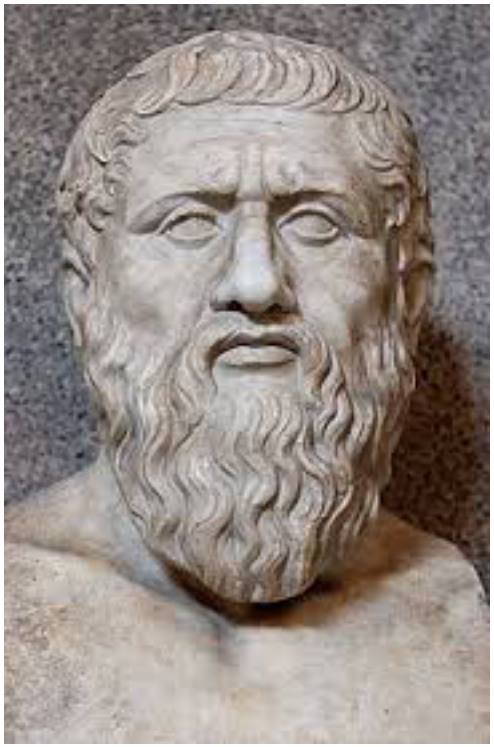
What are future studies ?



Plato (Athens, Greece 428-347 B.C.)

- - - ***The Republic***

. . . through a series of political scenarios

concept of scenarios has a long history traced back Plato to military strategy as a war game simulation

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What are future studies ?

XX century: the modern scenario techniques emerged after World War II

Herman Kahn (US)

Jerome C. Glenn (US)

Theodore Gordon (US)

US DoD
Rand Corp
GE
UN Millennium Project
"State of the Future" Magazine

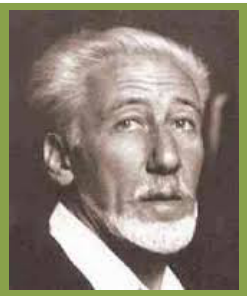
Richard Slaughter (UK)

Ben Martin (UK)

Ian Miles (UK)

The foresight principle
Manchester University

Gaston Berger (FR)



Beltrand de Jouvenel (FR)

Michel Godet (FR)

Centre d'Etudes Prospectives
Royal Dutch Shell
SEMA Metra Consulting Group
La Prospective

. . .

and more

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What are future studies ?

There are many notions around of what a scenario is or ought to be.

A scenario can be defined as a systems analysis or defined as **statement of assumption** […] **of a particular system on analysis** (Quade, et. al, 1968).

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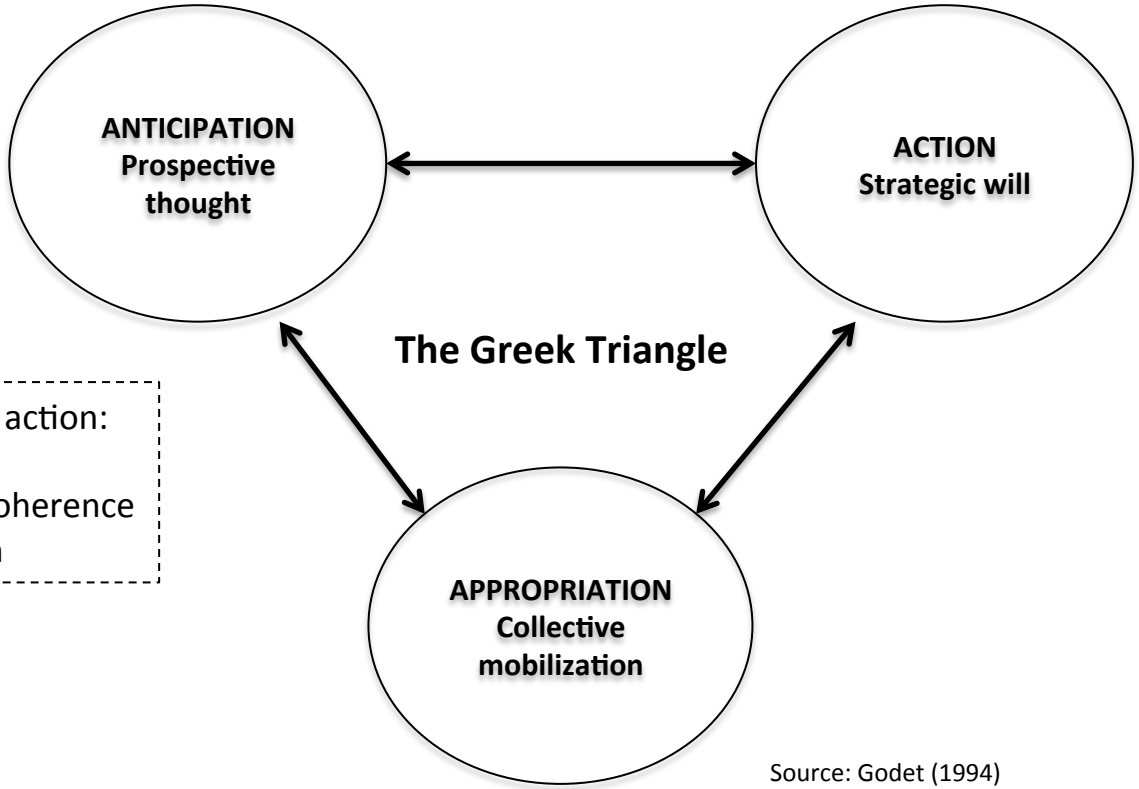
La Prospective: A French future studies approach



From anticipation to action:
- Initial reflection
- Relevance and coherence
- Efficacy of action

Source: Godet (1994)

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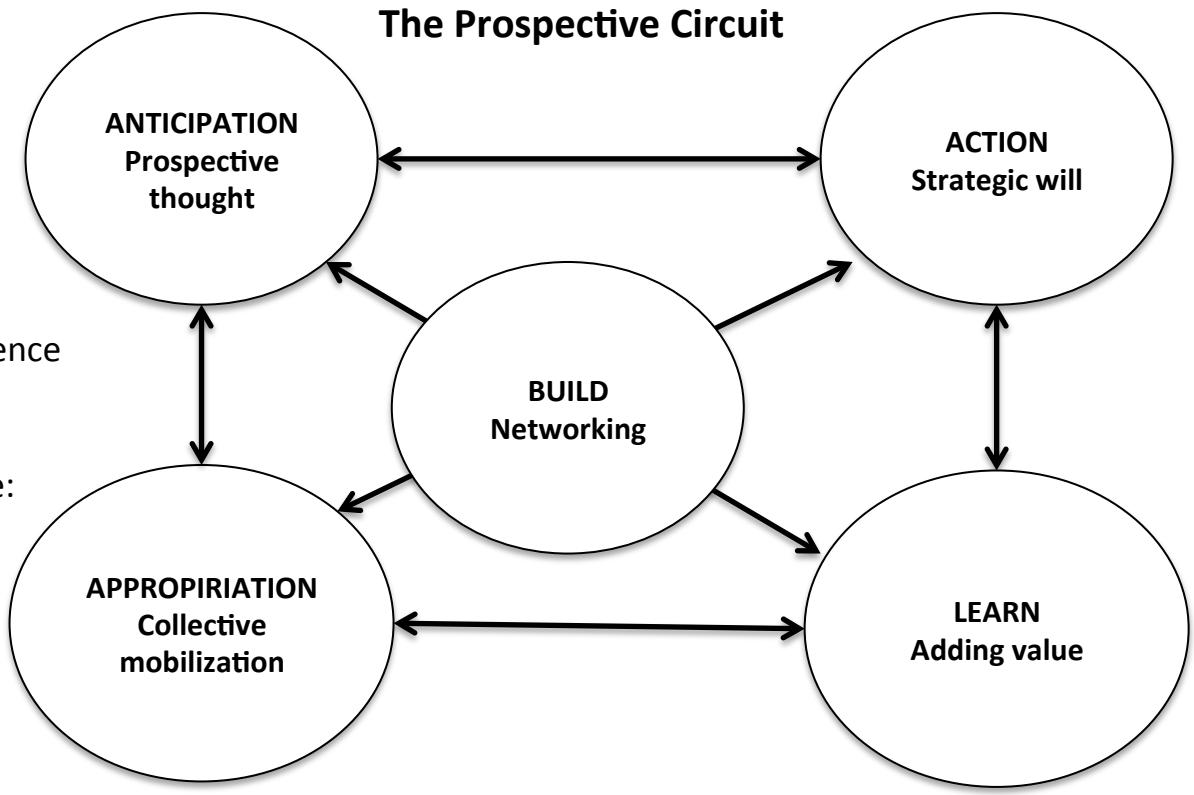
La Prospective: A French future studies approach

From a Greek Triangle
- reflection
- relevance and coherence
- efficacy of action

To the circuit Prospective:
- more networking
- more learning



Source: Trujillo (2008) adapted from Godet (1994) and Mojica (2005)

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La Prospective: A French future studies approach

Three steps

Identify strategic variables	***Futuribles*** designing	Strategic designing
State-of-the-Art SoS approach Recognize a set of strategic variables	Build futuribles = possible futures	Choice a desirable scenario Long-term planning

La Prospective + strategy = Strategic Prospective

strategic scenario building

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System of Systems approach

traditional scenario designing for regional analysis use tools as STEEP

structure the contextual macro environment

complex social system and the social behavior analysis

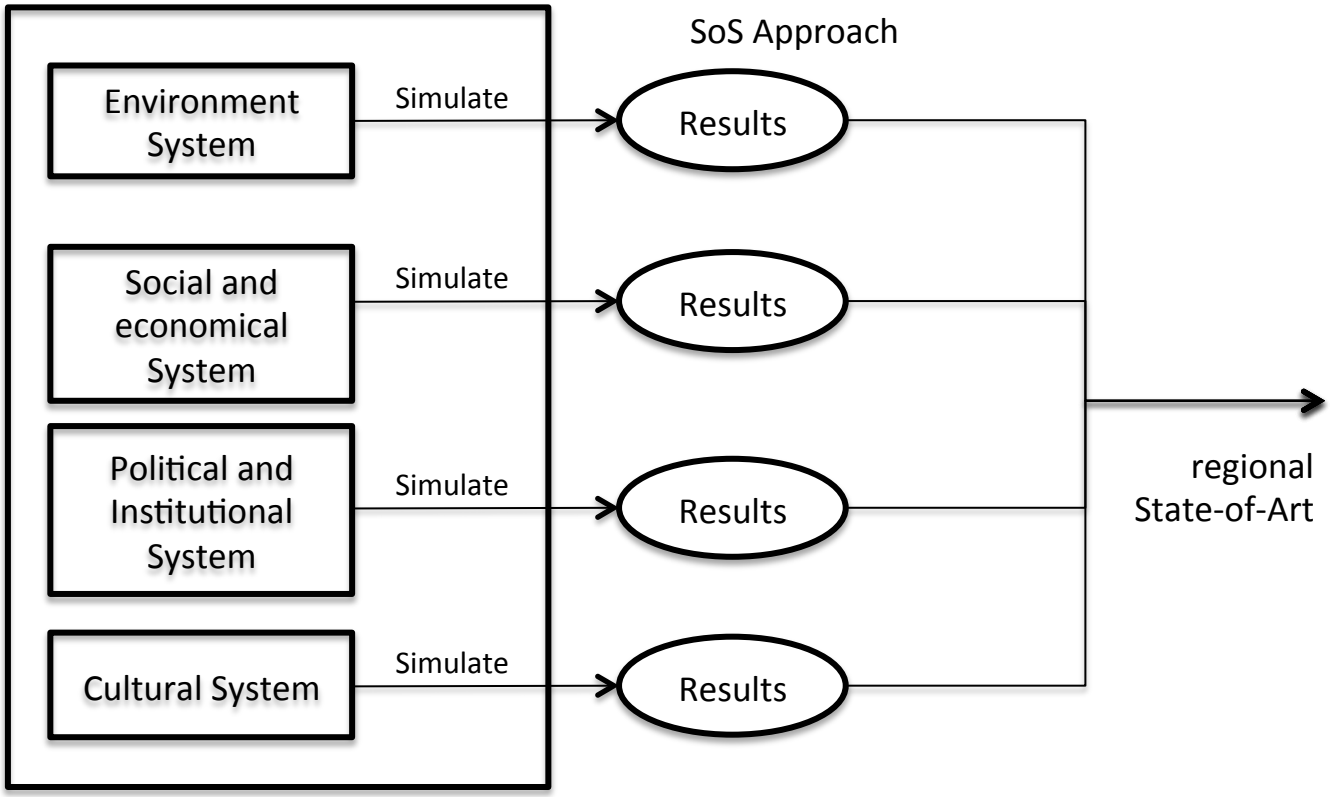
"The concept system has come to play a critical role in contemporary science. This preoccupation if scientists in general in reflected among Management Scientist in particular for whom the systems approach to problems in fundamental and for whom organizations, a special type of system, are the principal subject of study"

(Ackoff, 1971)

System of Systems approach

From a set of common domains of territorial analysis

To a federal simulation system using several M&S techniques



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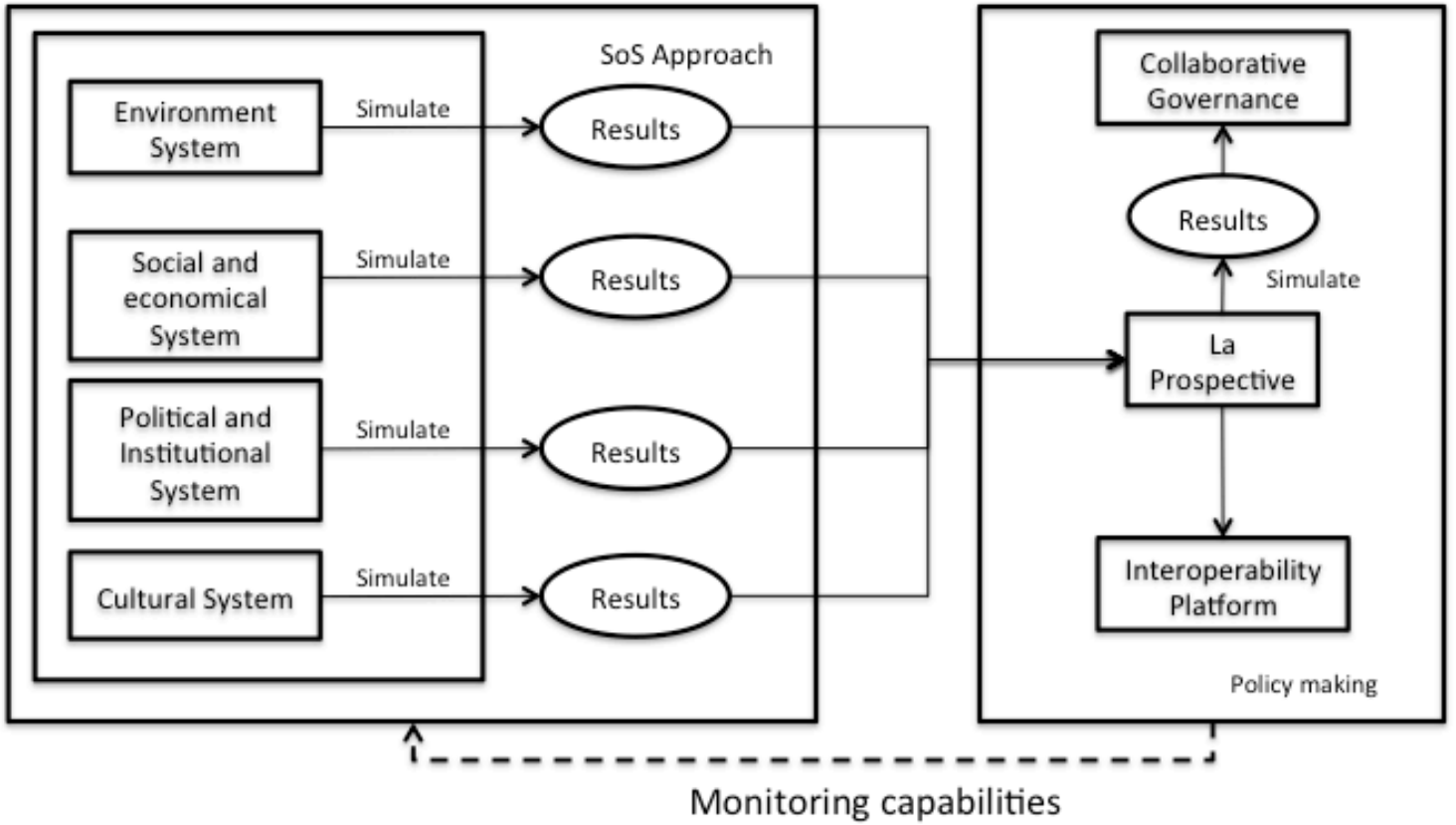
First experiment: A prototype

SoS Architecture



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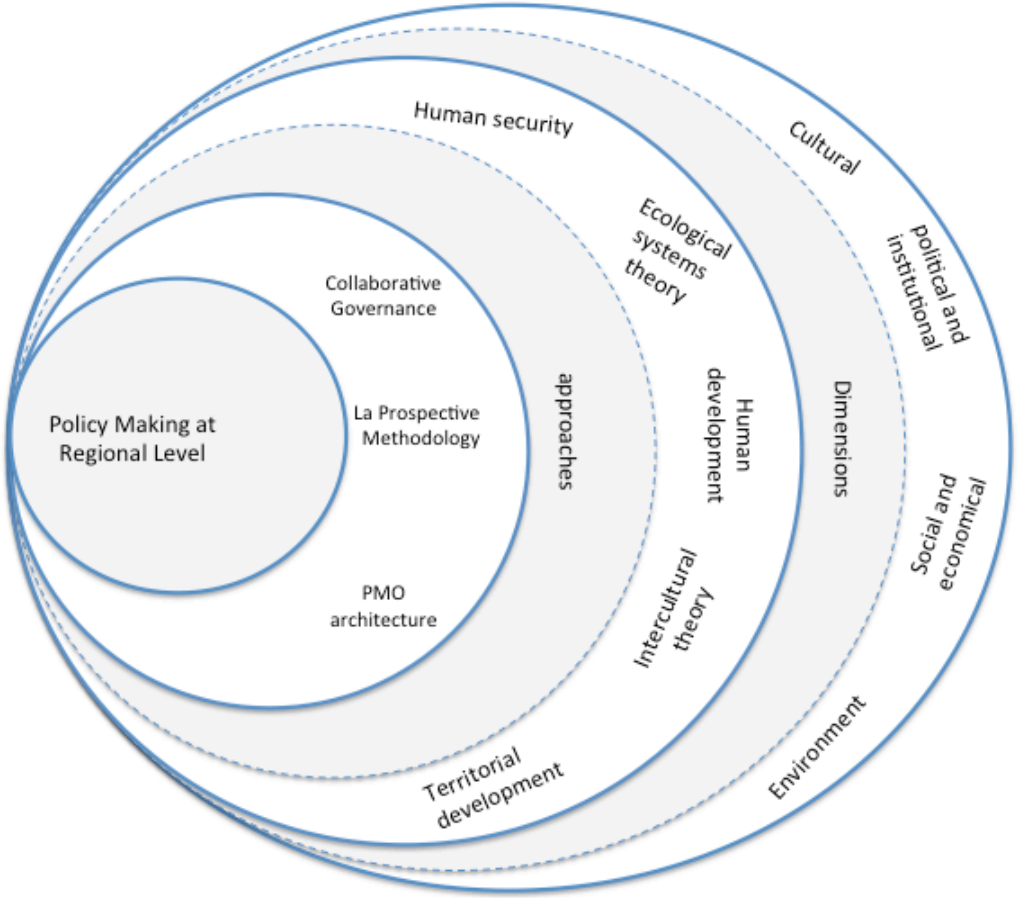
First experiment: A prototype

The SoS approach offers a federal system of analysis to recognize the strategic variables in order to create ***futuribles***



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First experiment: A prototype

M&S Solutions

Dimensions	Main Topic	Modeling Formalism
Environment	Health, Demography, Migration, Environment and Land Management	ENA technique
Social and economical	Human Capital, Income, Economic growth, Agriculture and foods	Gravity models, ENA technique
Political and institutional	Regional leadership, violence	SD and DEVS Simulation
Cultural	Trust to social and political institutions, support for democracy, tolerance to ethnic minorities, gender equality, the role of religion, and attitudes toward the environment; work, family, corruption, and moral norms	SNA, Data Clustering Techniques

First experiment: A prototype

Dimensions and its Strategic variables

Dimension	Variables
Cultural	Territorial profile
	Beliefs
Social and economical	Local sustainable development
	Local integration of mining, oil and gas and manufacturing industries
	SMEs performance
	Agricultural sector performance

First experiment: A prototype

R Scripts

Territorial profile

```
install.packages("FactoClass")
install.packages("ade4")
library(FactoClass)
library(ade4)

#
# Caracterización sobre modos de organización
#

setwd("/Users/raultrujillocabezas/Documents/Laptop Raul Trujillo/Tata/PEP/ECOPETROL")

datos = read.csv("ECP Cultural Organizaciones.csv", header = TRUE, sep=";")

# Periodo 2015
BASE2015 = datos[c(2:13)]
acp1 = dudi.pca(BASE2015)
# Ver figura
acpI = inertia.dudi(acp1,row.inertia=TRUE, col.inertia=TRUE)
s.corcircle(acp1$co,sub="2015 - Circulo de correlaciones Modos de Organización",possub= "bottomright")
# Ver figura
cat("\n Contribuciones de las filas a los ejes \n")
print(acpI$row.abs/100)
cbind(datos[c(1)], acpI$row.abs/100)
# Ver tabla
cat("\n Contribuciones de las columnas a los ejes \n")
print(acpI$col.abs/100)
# Ver tabla
par(mfrow=c(2,2)) # para 4 gráficas simultáneas
s.corcircle(acp1$co,sub="2015 - Circulo de correlaciones Modos de Organización",possub= "bottomright")
iden = datos[c(1)]
s.label(acp1$li,label=t(iden))
# Ver figura
#  Data Clustering
cluster1 = FactoClass(BASE2015, dudi.pca)
# Ver figuras y dendogramas de la técnica de Data Clustering
plotFactoClass(cluster1, col.row=c("maroon2","orchid4","darkgoldenrod2","dark red","aquamarine4"), col.col = 3, cex.row = 0.5, cex.col = 0.4)
# Ver figura de centroide de la técnica de Data Clustering
# Los resultados obtenidos ofrecen información para estimar una tendencia
```

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First experiment: A prototype

R Scripts

Beliefs

```
#
# Caracterización sobre cualidades
#

setwd("/Users/raultrujillocabezas/Documents/Laptop Raul Trujillo/Tata/PEP/ECOPETROL")

datos = read.csv("ECP Cultural Cualidades.csv", header = TRUE, sep=";")


# Periodo 2015
PARTE2015 = datos[c(2:11)]
acp1 = dudi.pca(PARTE2015)
# Ver figura
acpI = inertia.dudi(acp1,row.inertia=TRUE, col.inertia=TRUE)
s.corcircle(acp1$co,sub="2015 - Circulo de correlaciones sobre cualidades",possub= "bottomright")
# Ver figura
cat("\n Contribuciones de las filas a los ejes \n")
print(acpI$row.abs/100)
cbind(datos[c(1)], acpI$row.abs/100)
# Ver tabla
cat("\n Contribuciones de las columnas a los ejes \n")
print(acpI$col.abs/100)
# Ver tabla
par(mfrow=c(2,2)) # para 4 gráficas simultáneas
s.corcircle(acp1$co,sub="2015 - Circulo de correlaciones sobre cualidades",possub= "bottomright")
iden = datos[c(1)]
s.label(acp1$li,label=t(iden))
# Ver figura
#  Data Clustering
cluster1 = FactoClass(PARTE2015, dudi.pca)
# Ver figuras y dendogramas de la técnica de Data Clustering
plotFactoClass(cluster1, col.row=c("maroon2","orchid4","darkgoldenrod2","dark red","aquamarine4"), col.col = 3, cex.row = 0.5, cex.col = 0.4)
# Ver figura de centroide de la técnica de Data Clustering
# Los resultados obtenidos ofrecen información para estimar una tendencia
```

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First experiment: A prototype

R Scripts

```
install.packages("enaR")
install.packages("devtools")
library(devtools)
library(enaR)
setwd("/Users/raultrujillocabezas/Documents/Laptop Raul Trujillo/Tata/PEP/ECOPETROL")
datos2 <- matrix(scan("datos"),nrow=7)
flow.matriz = datos2
rownames(flow.matriz) <- colnames(flow.matriz) <- paste("node",(1:nrow(flow.matriz)),sep="")
inputs <-runif(nrow(flow.matriz),0,7) # Este valor variaría cada vez que se ejecute.
exports <- inputs
storages= inputs + exports
fake.model <- pack(flow=flow.matriz, input=inputs, export=exports,storage=storages, living=TRUE)
fake.model%v%"output"
fake.model%v%"input"
fake.model%v%"living"
as.matrix(fake.model,attrname="flow")
unpack(fake.model)
m <- fake.model
ssCheck(m)
m <- balance(m,method="AVG2")
ssCheck(m)
St <- enaStructure(m)
attributes(St)
St$ns

F <- enaFlow(m)
attributes(F)
F$ns
F$G
F$NP
enaAscendency(m)
S <- enaStorage(m)
attributes(S)
S$ns

UF <- enaUtility(m, eigen.check=TRUE,type="flow")
US <- enaUtility(m, eigen.check=TRUE,type="storage")
attributes(UF)
UF$U # La matriz aquí obtenida es el insumo para avanzar con el proceso en MS-Excel
```

Social & economical dimension

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First experiment: A prototype

MS-Excel

integral utility matrices (U) y la correspondiente matriz de signos sgn (U)

Social & economical dimension

U

	node1	node2	node3	node4	node5	node6	node7
node1	0.952171943	-0.068197295	-0.0600887599	0.368440565	0.427975952	0.13678322	-0.2781727141
node2	0.015183465	0.961358269	-0.0030678356	-0.011227298	-0.363368967	0.03080123	0.0000866172
node3	0.120504516	-0.032551923	0.9314515211	-0.273033424	-0.002594372	-0.35853648	0.7033667929
node4	-0.072206636	0.050145379	0.1368084822	0.860062968	-0.040311961	0.26100978	-0.5402141255
node5	-0.007878821	0.095192792	0.0002494547	0.006115572	0.947749891	-0.08513894	0.0370578675
node6	0.001952568	0.008558926	0.0038605467	-0.032190800	0.106084275	0.97803206	0.0296815560
node7	-0.007961209	-0.004115553	-0.0074358437	0.076090628	-0.058135549	0.03366353	0.9391235417

Souces: (Zhang, Liu, Yang, Li & Yang, 2012; Battistella, Colucci, De Toni & Nonino, 2013; Borrett & Lau, 2014)

sgn(U)	1 InternalEnvironment	2 AgricultureSector	3 ExplotationSector	4 ManufacturingSector	5 DomesticSector	6 RecyclingSetor	7 ExternalEnvironment
1 InternalEnvironment	+	-	-	+	+	+	-
2 AgricultureSector	+	+	-	-	-	+	+
3 ExplotationSector	+	-	+	-	-	-	+
4 ManufacturingSector	-	+	+	+	-	+	-
5 DomesticSector	-	+	+	+	+	-	+
6 RecyclingSetor	+	+	+	-	+	+	+
7 ExternalEnvironment	-	-	-	+	-	+	+

Tabla de relaciones

1	(su12,su21)=	(+,-)	1 explota a 2	entorno interno explota a sector agrícola
2	(su13,su31)=	(+,-)	1 explota a 3	entorno interno explota a sector externo
3	(su14,su41)=	(+,-)	1 explota a 4	entorno interno explota a sector manufactura
4	(su15,su51)=	(-,+)	5 explota a 1	sector doméstico explota a entorno interno
5	(su16,su61)=	(+,+)	relación simbiótica o mutualismo	sector simbiótica entre entorno interno y sector reciclaje
6	(su17,su71)=	(-,+)	7 explota a 1	entorno externo explota a entorno interno
7	(su23,su32)=	(-,-)	2 compite con 3	sector agrícola compite a sector explotación
8	(su24,su42)=	(+,-)	2 explota a 4	sector agrícola explota a sector manufactura
9	(su25,su52)=	(+,-)	2 explorta a 5	sector agrícola explota a sector doméstico
10	(su26,su62)=	(+,+)	relación simbiótica o mutualismo	relación simbiótica entre sector agrícola y sector reciclaje
11	(su27,su72)=	(-,+)	7 explota a 2	entorno externo explota a sector agrícola
12	(su34,su43)=	(+,-)	3 explota a 4	sector explotación explota a sector manufactura
13	(su35,su53)=	(+,-)	3 explota a 5	sector explotación explota a sector doméstico
14	(su36,su63)=	(+,-)	3 explota a 6	sector explotación explota a sector reciclaje
15	(su37,su73)=	(-,+)	7 explota a 3	entorno externo explota a sector explotación
16	(su45,su54)=	(+,-)	4 explota a 5	sector manufactura explota a sector doméstico
17	(su46,su64)=	(-,+)	6 explota a 4	sector reciclaje explota a sector manufactura
18	(su47,su74)=	(+,-)	4 explota a 7	sector manufactura explota a entorno externo
19	(su56,su65)=	(+,-)	5 explota a 6	sector doméstico explota a sector reciclaje
20	(su57,su75)=	(-,+)	7 explota a 5	entorno externo explota a sector doméstico
21	(su67,su76)=	(+,+)	relación simbiótica o mutualismo	relación simbiótica entre sector reciclaje y entorno externo

Relaciones de explotación	18	85,71%
Relación de mutualismo	2	9,52%
Relación de competición	1	4,76%
	21	

Reconocimiento de relaciones

Entorno externo explota a sector doméstico y explotación del sector agrícola
Entorno interno explota a sector agrícola, externo y manufactura

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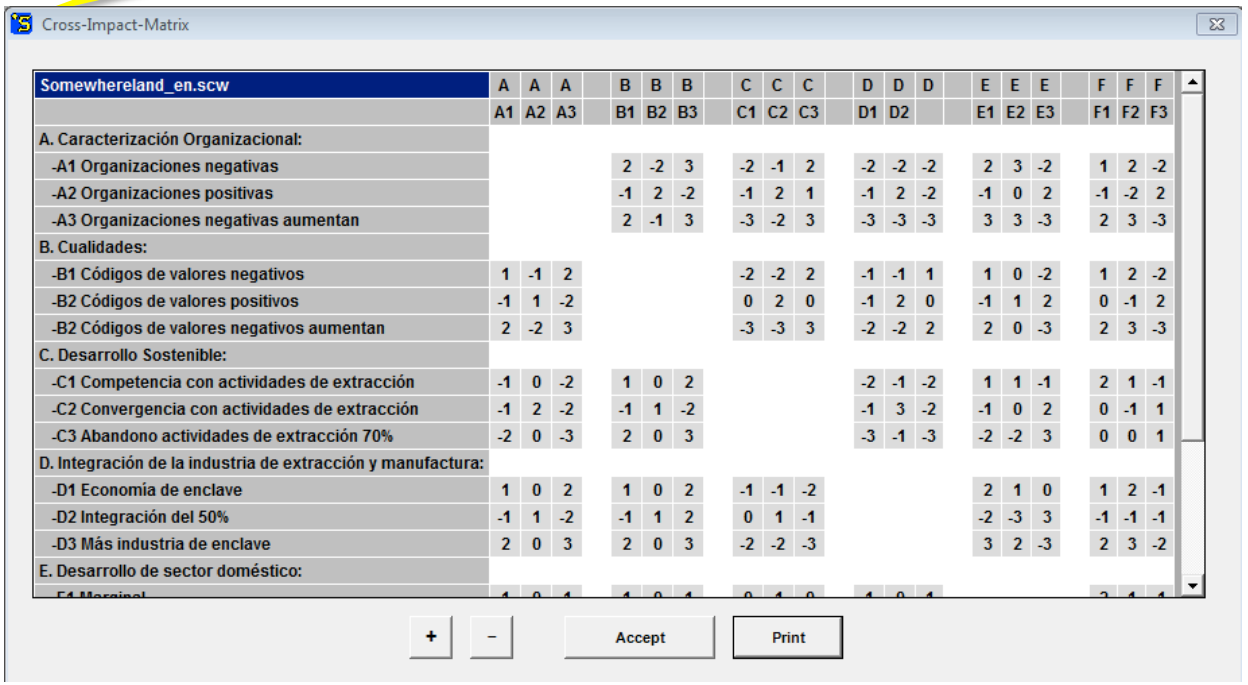
First experiment: A prototype

cross-impact matrix and morphological analysis techniques

ScenarioWizard 4.2



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First experiment: A prototype

Two (plausible) Futuribles

"Paradise" scenario

"more civil instability" scenario

Strategic Variables	Scenarios	
	#1	#2
Territorial organizational profile	Legal civil organizations and governmental agencies share collective governance	Illegal organizations share collective governance
Beliefs	Can see a close relationship between ethics and being a person	Can´t see a close relationship between ethics and being a person
Local sustainable development	Convergence between extraction industry, and local "green" industry	70% Mining and Oil and Gas industry leave behind their operation fields.
Integration of mining, oil and gas and manufacturing industries to local economy	Integration grows around 50% and improve 80% the demand on local workforce	More enclave economy and decrease 30% the demand on local workforce
Develop of the small-and medium-sized manufacturers and local services companies	Multiple by 5 the profit and quantity of SMEs local	Marginal grows
Agricultural sector performance	2 times more agriculture activity since 2014	40% less agricultural activity since 2014

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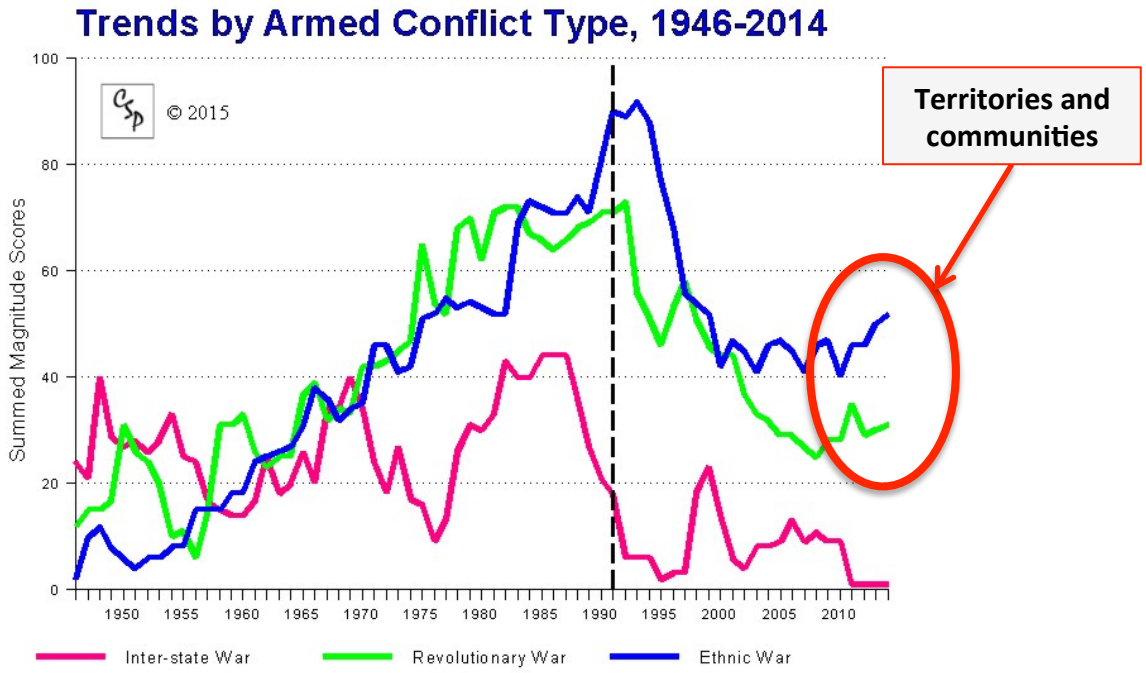
First experiment: A prototype

Collaborative Governance dimensions

Dimension	Definition
Architecture	Interaction in network between communities of social actors, using an organization model based on a PMO array.
Addressing sources	Distributed control. A multiagency coordination system.
Borders and boundaries	Open. Adaptive co-management model.
Organizational context	The authority is divided. Action through cooperation.
Leadership approach	Facilitate the generation of ideas for solving problems and developing new initiatives. Apply effective methods for decision-making.
Administrative approach	Management processes aimed at providing mediation between the members of the collaborative network.
Features of administrative processes	Selection of stakeholders. Public Deliberation + Decision-making + Implementation of Public Policies.
Achievement goals	Produce results reliably and generate innovative proposals continuously.
Success Criteria	Cooperative negotiation. SIMS: Strategic Intelligent Monitoring System.
Nature of planning	Nonlinear. Focus on understanding the evolution in time of the territorial system.
Objectives of public participation (inclusion)	Aimed at creating conditions for social learning and capacity development for troubleshooting.
Democratic legitimacy	Democratic deliberation. Constitute a meta-governance "management complexity and plurality".
Expected behavior	Determined by the interaction levels among participants. Resilience.

Souce: O'Leary, R., & Bingham, L. B. (Eds.). (2009). *The collaborative public manager: New ideas for the twenty-first century*. Georgetown University Press.

Conclusions



Source: Center for systemic Peace

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Conclusions

The SoS approach configures a new kind of ***future scenarios designing*** thanks to **recognize** regional patterns of behavior.

The proposal offers:

1) New forms of futures studies
2) Co-creation between the local stakeholders and corporate experts
3) Build collective vision of the future
4) Identify interrelations using imagination, creativity and, modeling and simulations tools
5) Improves the interactions and reduces the lack consensus in post-civil war territories

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Thank you

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