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Session 5
Models and Indicators

Debating macro policy options through strategic S&T indicators linked to an Innovation System model

The Futuris Foresight operation

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Structure of the presentation

Introduction

1. Towards Learning Foresight Processes :
A proposal

2. The case of the Futuris operation in France

Conclusion

Introduction

- **Effective S&T policy has much to do with institutional learning and change.**
- **Foresight processes are about learning and change, but their strategic clout is impaired**

  by their incomplete learning processes

  due to their lack of quantification.

- **I report here of a new approach developed and implemented in the Futuris Foresight operation.**

1. Towards Learning Foresight Processes

11. Foresight for S&T policy-making and its limitations

- **Congruence between the terms of reference of the needed method and the characteristics of Foresight**

- ***Systemic, longer term, producing shared visions***
- ***participative, distributed intelligence***
- ***highlight options, strategy oriented,***
- ***multi-level governance, hybridisation of roles***

This is the exact definition of what Foresight is about

1. Towards Learning Foresight Processes

11. Foresight for S&T policy-making and it limitations

- **Foresight as a learning process**

Tacit knowledge : mental models which give meaning and interpretation

Such models structure our representations and visions of the future

Knowledge dynamics: interaction between codified and tacit knowledge

Foresight : a process of interaction and exchange of both codified (formalised) and tacit (personal, embodied) knowledge.

Scenario or 'vision' building and analysis provide an efficient basis for interaction and debate

(the tacit – codification loop of knowledge dynamics / collective learning)

1. Towards Learning Foresight Processes

11. Foresight for S&T policy-making and it limitations

- **Limits of foresight : incomplete learning processes by lack of quantitative indicators**

There is a gap to fill for Foresight processes to fulfil *in practice* the promises they hold *in principle*.

The codified (formalised) dimension of Foresight is too weak to play its role in the collective learning interaction loop with tacit knowledge

The gap : computation of strategic quantitative indicators related to the scenarios, to be discussed, criticised and thus feeding into the tacit knowledge questioning.

This is not usually done : lack of strategic efficiency of Foresight

1. Towards Learning Foresight Processes

12. A proposal : Foresight involving strategic S&T indicators based on modelling

■ The question of quantitative modelling

Task: translate description of a scenario by a few qualitative variables (the 'drivers')

into a more complete set of characteristics,

to be used for building quantitative strategic indicators needed for the assessment of the scenario.

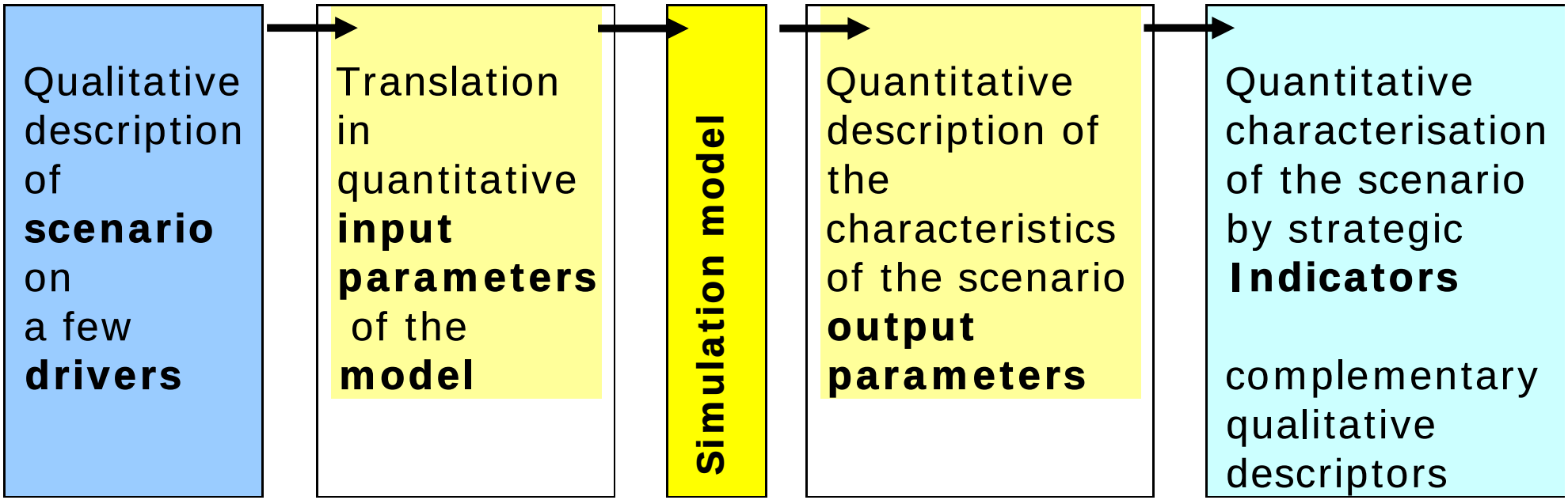
Such a translation is what quantitative modelling and indicators building is all about

1. Towards Learning Foresight Processes

12. A proposal : Foresight involving S&T strategic indicators based on modelling

The question of quantitative modelling

From scenarios to input / output parameters of model and indicators building



1. Towards Learning Foresight Processes

12. A proposal : Foresight involving S&T strategic indicators based on modelling

The proposal: Developping ad-hoc Input-Output Balance Models (I/O BM)

There exist models in certain cases, such as energy, climate, macro-economics… but usually costly to use

In many other cases, there are no models available

Foresight produces scenarios as combination of states of drivers which are qualitative, ad-hoc sketch of the system under study.

The proposal : develop simple, ad-hoc Input/Output Balance Models based on these drivers

Cases such as financial resources, human resources, energy, biomass….

1. Towards Learning Foresight Processes

12. A proposal : Foresight involving S&T strategic indicators based on modelling

- **The proposal: A process for foresight involving S&T strategic indicators**

Phase A – Conception and characterisation of the scenarios as combinations of states of drivers

Phase B – Modelling and computation of the input and output parameters associated with each scenario

I/O Balance Model

define and compute input parameters from drivers and output parameters

1. Towards Learning Foresight Processes

12. A proposal : Foresight involving S&T strategic indicators based on modelling

- **The proposal: A process for foresight involving S&T strategic indicators**

Phase C – Computation of the strategic indicators and assessment of the current evolutions and options

define and compute value of strategic indicators (‘essential questions’) built from input and output parameters

strategic assessment of each scenario using the strategic indicators as criteria

strategic assessment of current evolution and options through examination of their situation through the portfolio of scenarios.

2. The case of the Futuris operation

21. The context

- **FutuRIS is a Foresight exercise on the future of the French research and innovation system** Co-financed by the Government, Research organisations, Firms and ANRT, a non profit organisation
- Widely held view that reforms have to be done in research and innovation policies and in the organisation of public research
- Address the future of the system as a whole (public and private, its regional and European aspects, its relationships to society….), foster genuine debates on options : Foresight operation at horizon 2020
- **2003-2005 – contribution to the policy process towards Law on research (April 2006)**
- **now a strategic monitoring based on the scenarios and strategic indicators**

http://www.anrt.asso.fr/index.jsp

2. The case of the Futuris operation

PHASE A : Conception and characterisation of the scenarios as combinations of states of drivers

the macro-hypothesis on the components

components	*macro-hypothèsis A*	*macro-hypothèsis B*	*macro-hypothèsis C*
International order and global challenges	more or less challenged US leadership	Tensions, fragmentations, major role for China & India	New international régulations
Europe and France within Europe	A minima Europe	European Research & Innovation Area for civilian research	European RD & innovation system including Defence & sécurity
Science – innovation - society	Conflcts, polarisations and staemates	Market régulation of conflicts	Confidence through régulation of conflicts
Organisation, role and evolution of the State	Ad-hoc adjustements ; soft permanent crisis	Reform of the State	Reform of the State and décentralisation
Public research	Conservation of the model,better managed	Evolutions in the national context	Reconfigurations ; Strong regional poles
Industrial research and innovation	Modest level of industrial RD	Strengthening of RD and innovation in SMEs	Increase of private RD and innovation activities

2. The case of the Futuris operation

PHASE A : Conception and characterisation of the scenarios as combinations of states of drivers

Synopsis of the scenarios

Scenarios	Ia	Ib	II	III	IV	V
GDP growth	1,2	1,8	1,5	2,2	2,0	2,5
GERD / GDP	1,7	1,7	2,2	2,8	2,4	3,0
International order and global challenges	A	A	B	B	A	C
Europe and France within Europe	A	A	A	C	B	C
Science – innovation - society	A	A	B	C	B	C
Organisation, role and evolution of the State	A	A	C	B	C	C
Public research	A	A	C	B	C	C
Industrial research and innovation	A	A	B	C	C	C

Ia : Defensive regression	III : Ambition for France and Europe
Ib : Opportunistic passivity	IV : Pragmatism in a Europe of regions
II : A bet on the national and regional dynamics	V : France as an engine in a powerful Europe

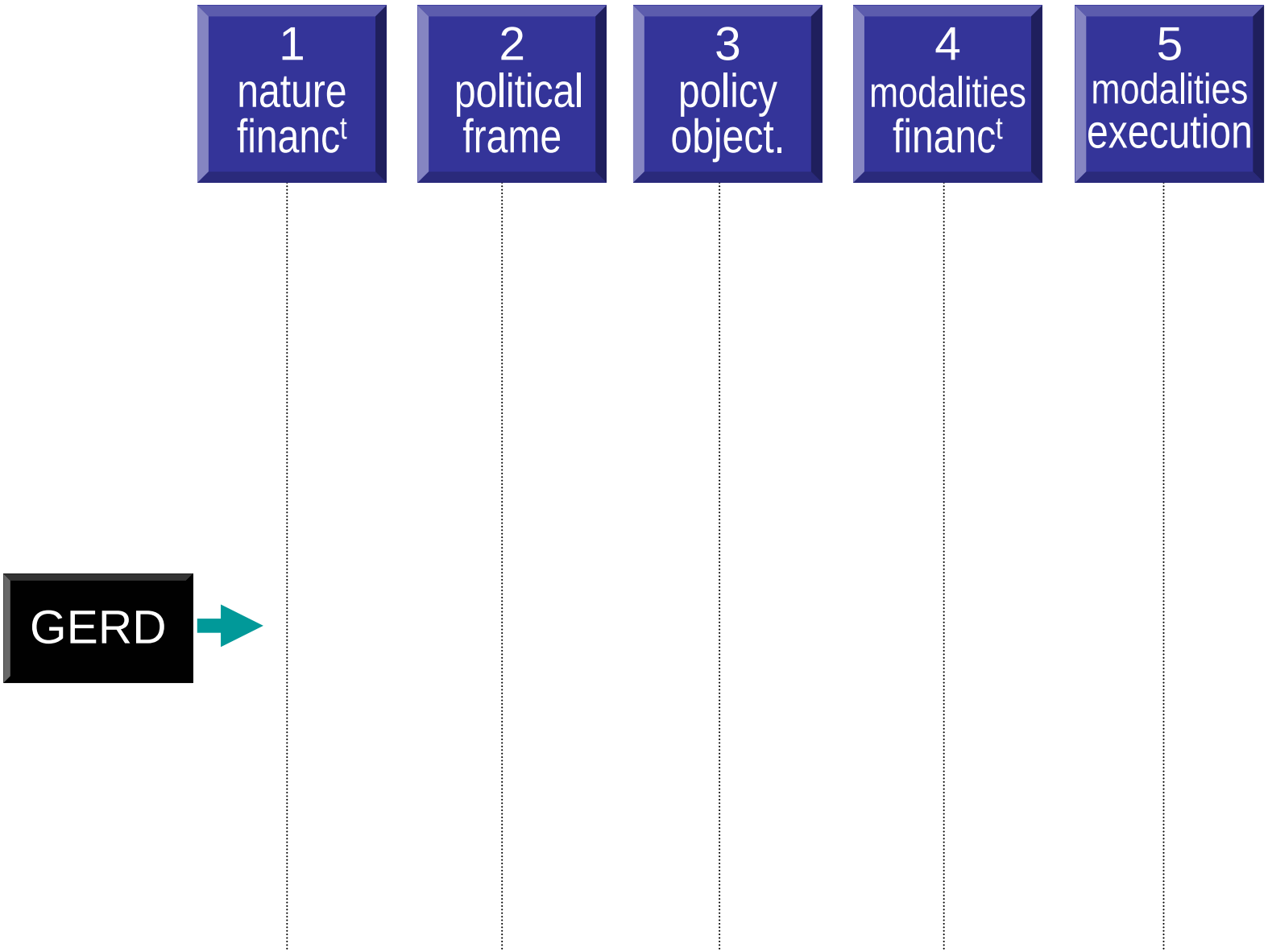
2. The case of the Futuris operation

PHASE B : Modelling and computation of the input and output parameters associated with each scenario

The Input/Output Balance Model

Financing				Execution	
1 nature	2 political frame	3 policy objectives	4 modalities	Public Labs	Industry
public	*national*	*K-production*	*budget / grants*		
		Innovation pol.	*grants*		
		LTP & defence	*budget/procur.*		
	régional	*K-production*	*grants*		
		Innovation pol.	*grants*		
	european	*K-production*	*grants*		
		+ VLE	*budget*		
		LTP & defence	*procurement*		
societal	*national*	*K-production*	*grants*		
Industrial Private	*national*	*innovation*	*budget / capital*		
	From abroad	*innovation*	*budget*		

The I/O Balance Model
The Five Input parameters



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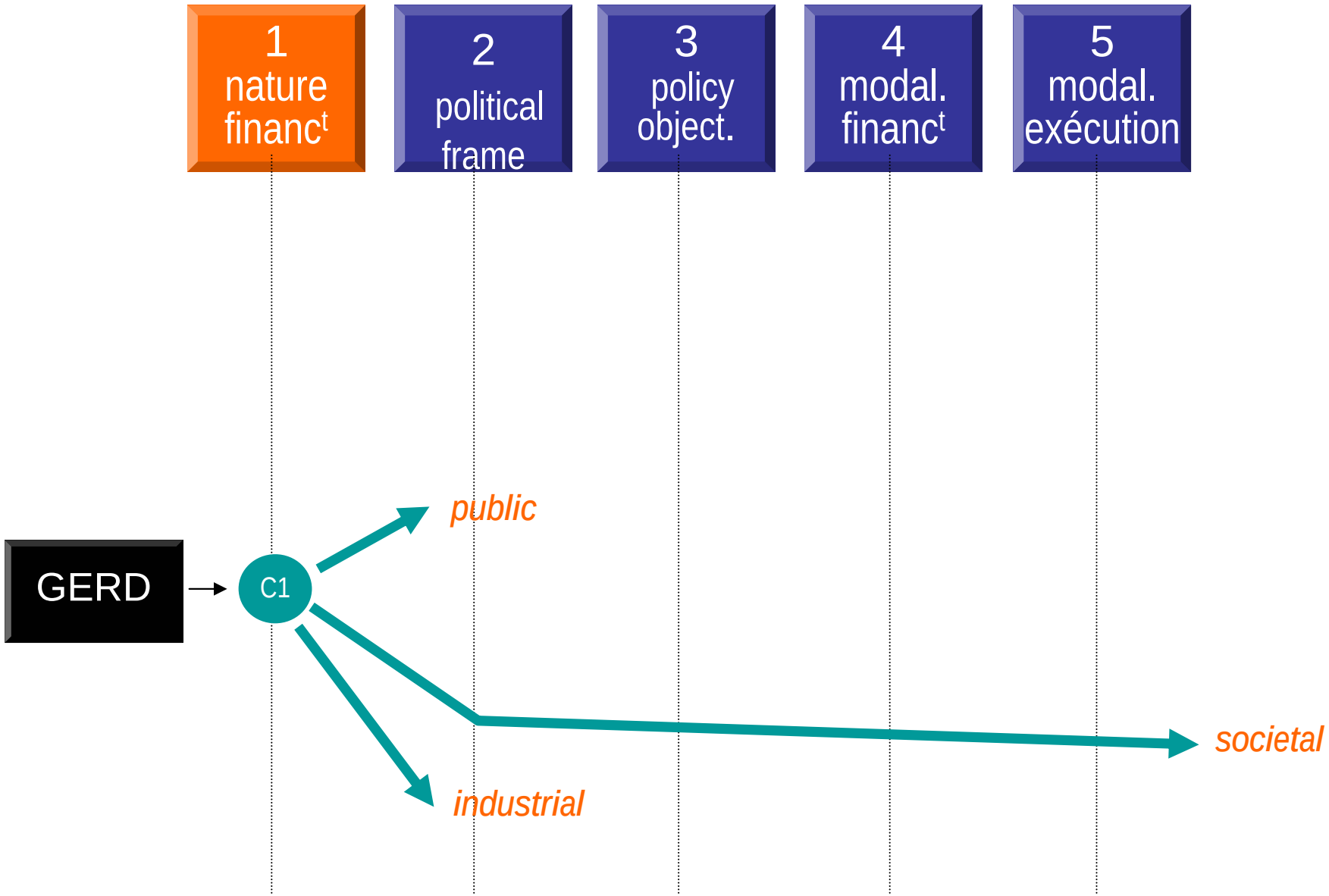

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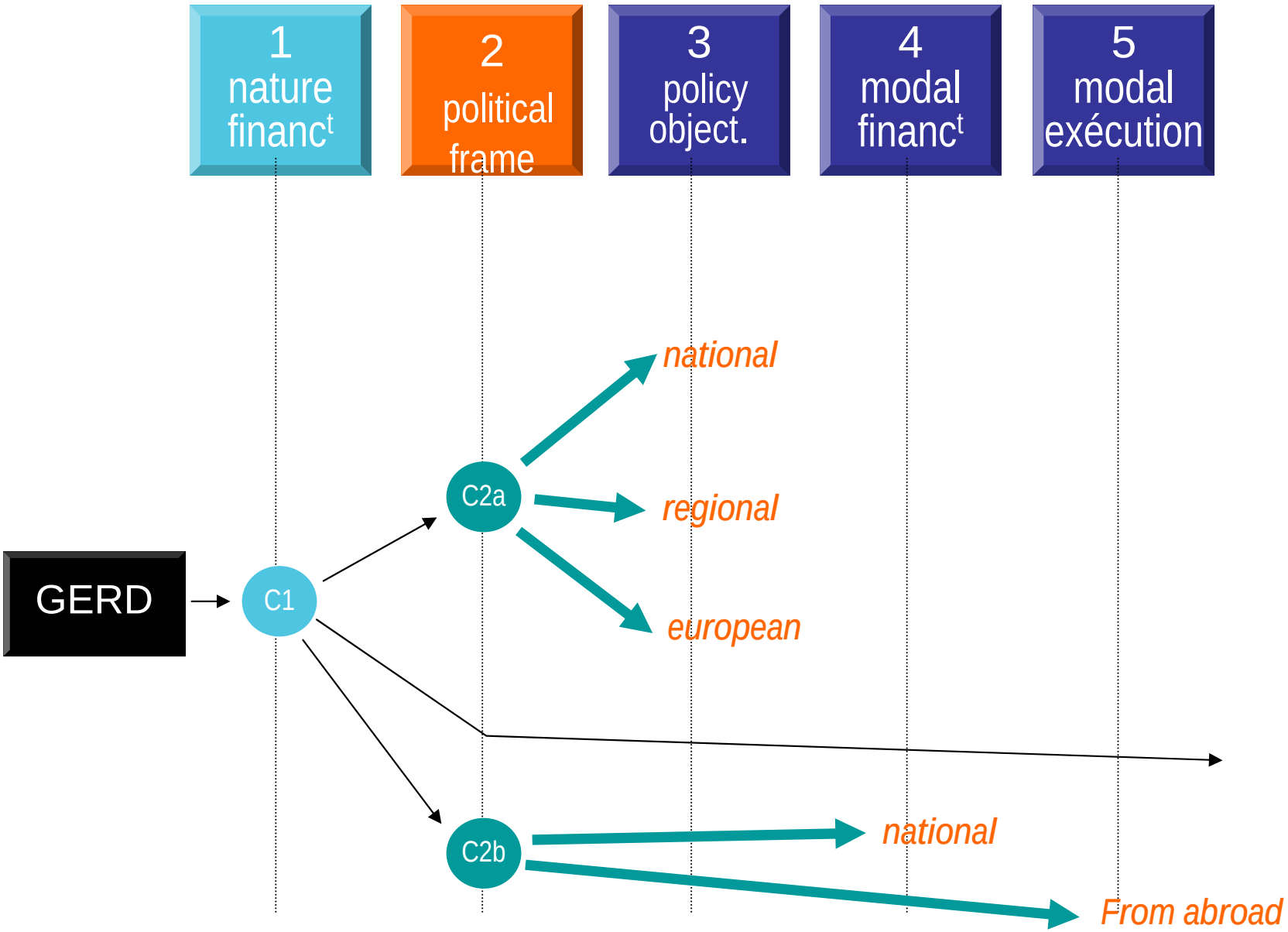

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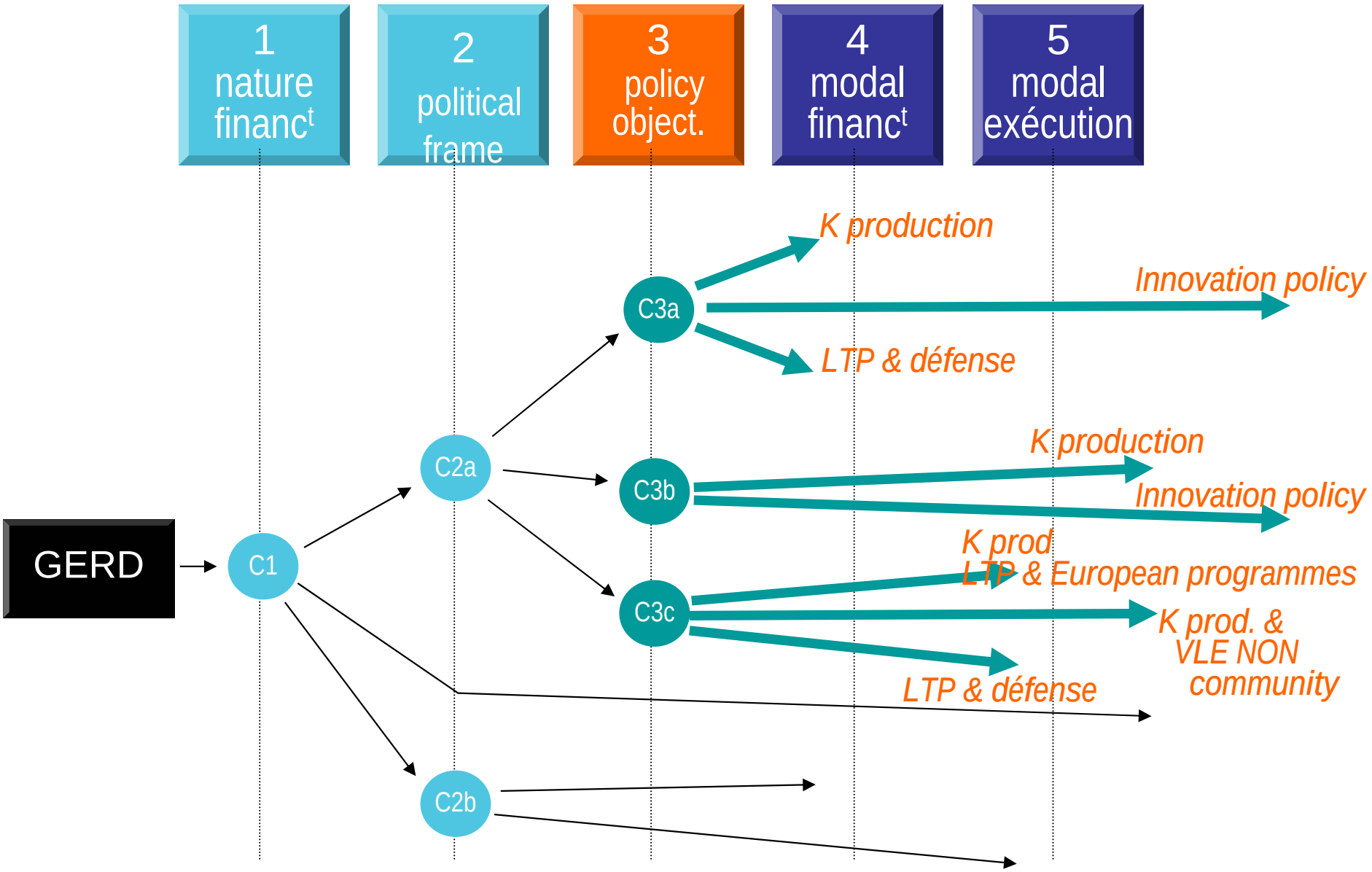

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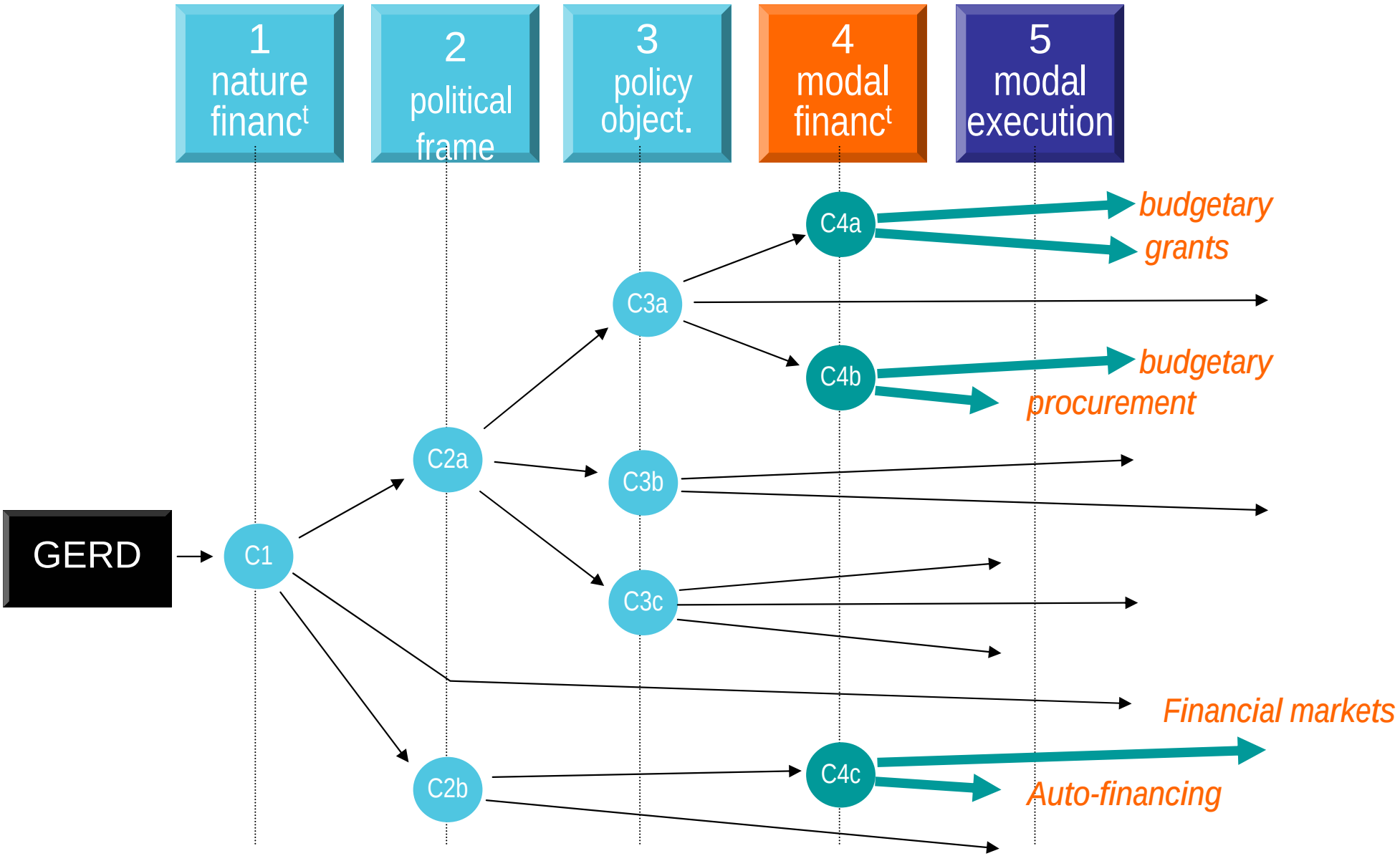

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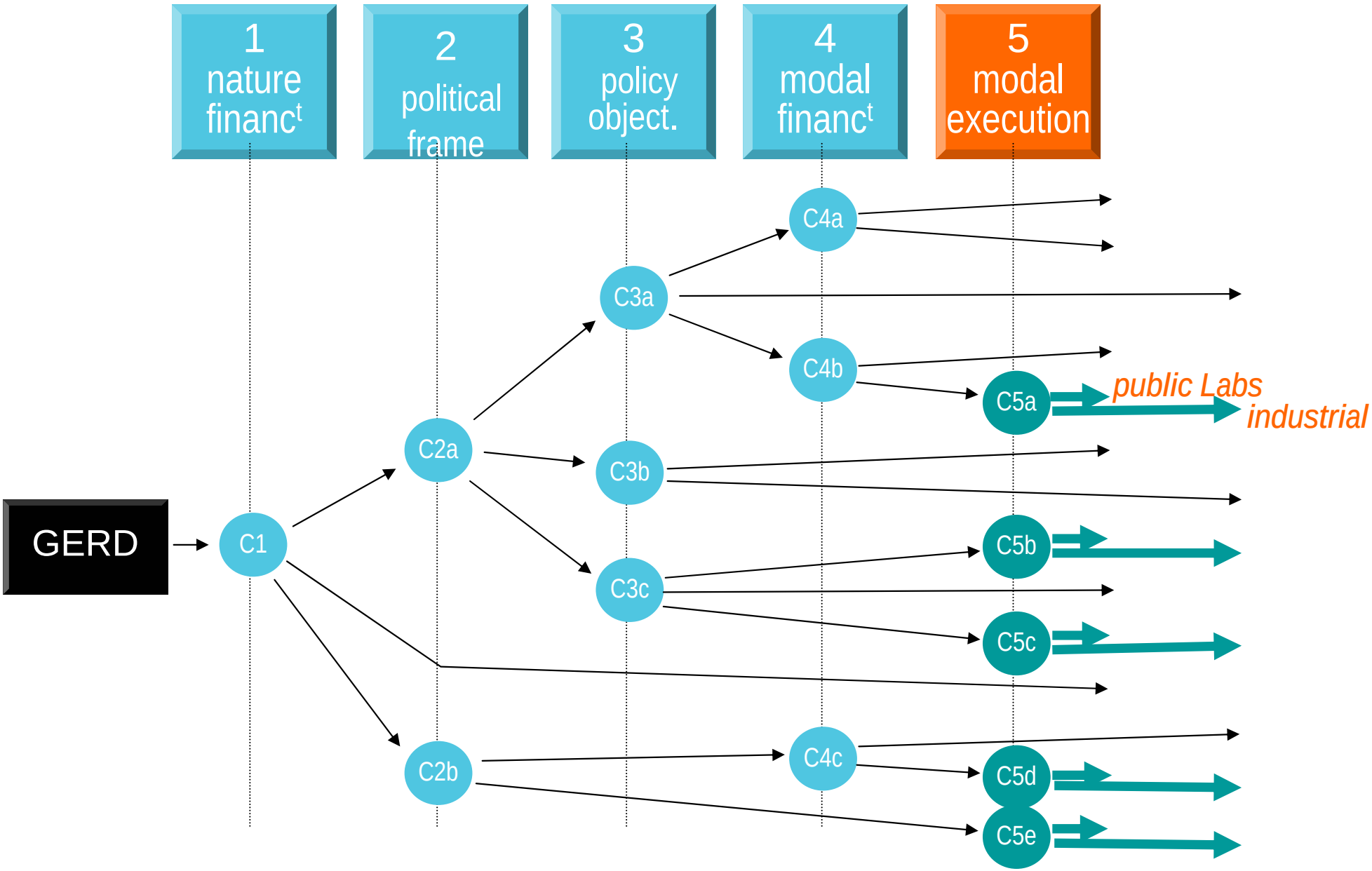

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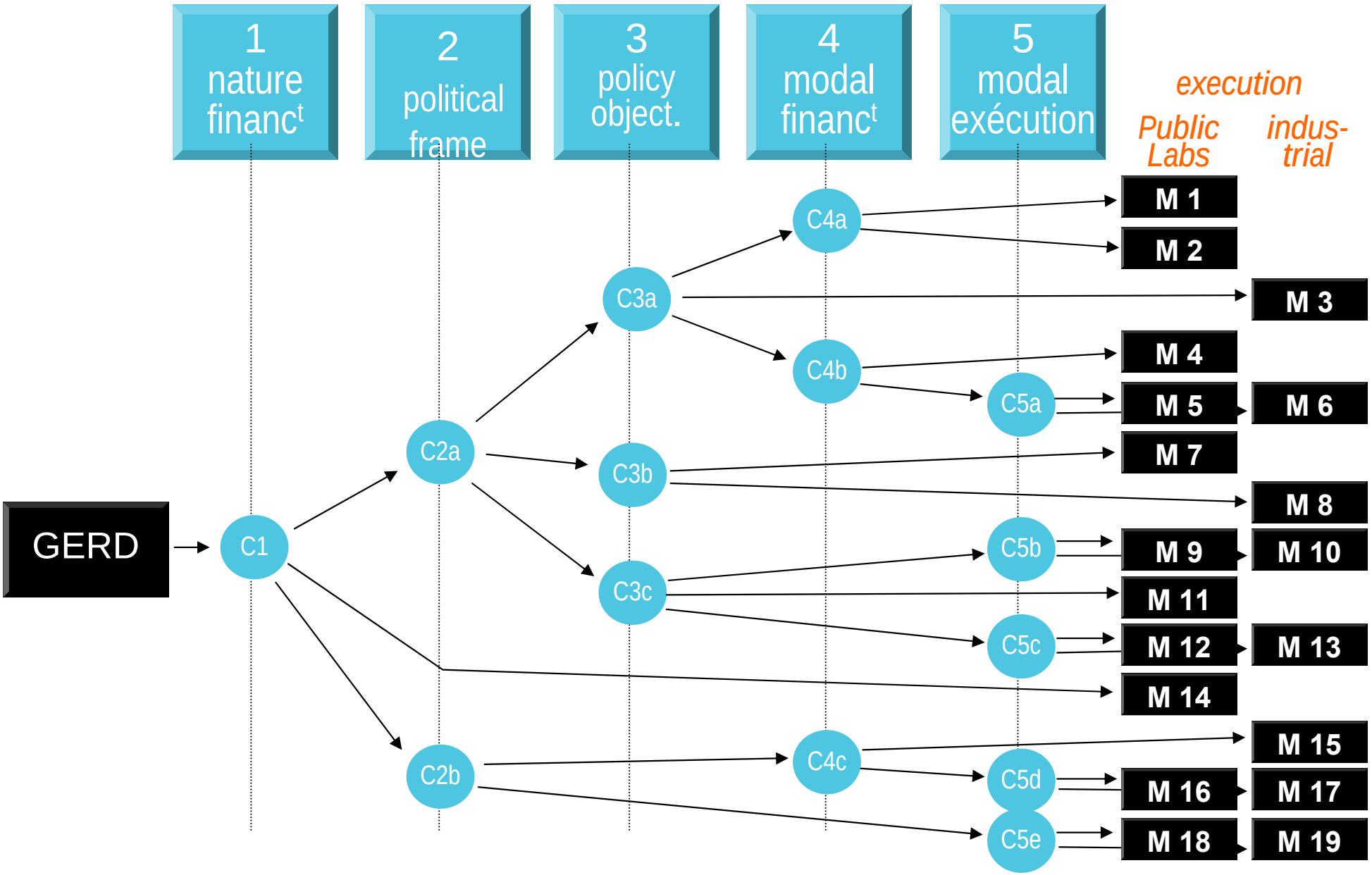

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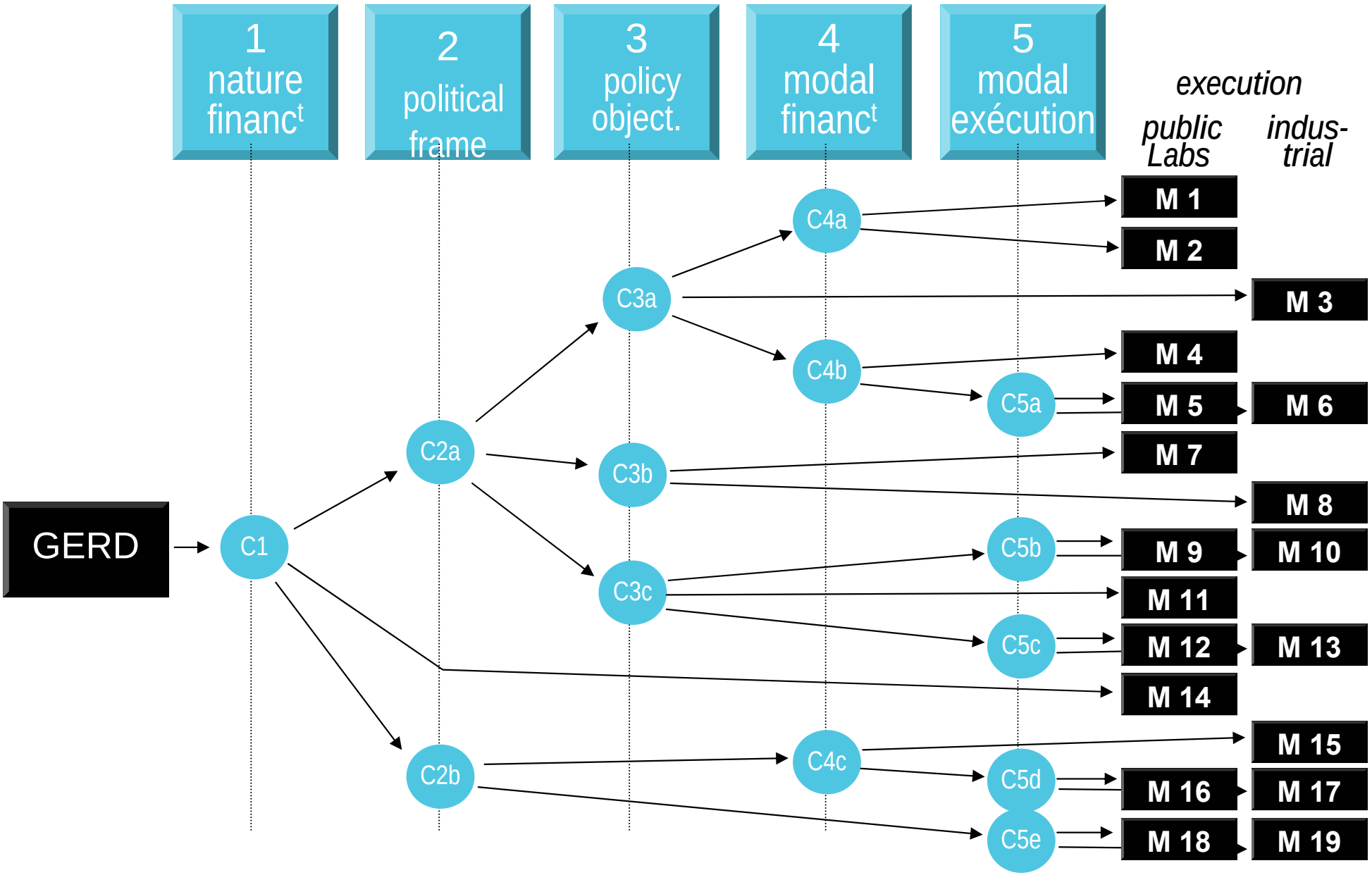
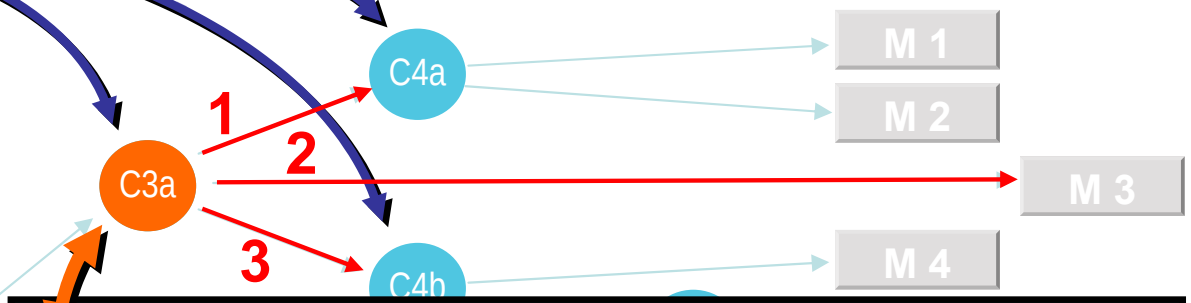


From Scenario drivers to the Input parameters of the I/O Balance Model through an impact matrix

Drivers	hypothesis fort		faible
1.1 Croissance mondiale	x	x	
1.2 Harmonie mondiale		x x	
1.3 Accessibilité connaiss.		x	x
2.1 Politique EU rech base	x x		
2.2 Gds prog. EU *T.I.M.*	x	x	



Impact matrix for parameter C3a

Driver	Hypoth HIGH Δ1 Δ2		Hypoth MEDIUM Δ1 Δ2 Δ3		Hypoth LOW Δ1 Δ2 Δ3	
1.1 Croissance mondiale	0,5	-0,3	1	-1	-1	1
1.2 Harmonie mond					0,3	-0,2 0,5
1.3 Accessibilité						

Profil d'impact

From Scenario drivers to the Input parameters of the I/O Balance Model through the Impact matrices

Matrice d'impact pour la clé **C4a**

	Etat FORT		Etat MOYEN		Etat FAIBLE	
	C4a-1	C4a-2	C4a-1	C4a-2	C4a-1	C4a-2
1.1 Croissance économique mondiale						
1.2 Harmonie mondiale (nouvel ordre multilatéral)						
1.3 Accessibilité des connaissances S&T, circulation des chercheurs						
2.1 Politique européenne recherche de base et enseignement supérieur	**-1,25**	**1,25**			**1,25**	**-1,25**
2.2 Grands programmes européens technologies-innovations-marchés	**-1,25**	**1,25**			**1,25**	**-1,25**
2.3 Europe de la RD de sécurité et défense						
2.4 Transparence et efficacité du marché Européen de l'innovation						
3.1 Compatibilité entre les différentes visions du monde au sein société						
3.2 Attitude favorable à la science et à l'innovation						
3.3 Implication réelle du citoyen dans les débats et décisions de R&I						
4.1 Rénovation du rôle de l'Etat : stratège, arbitre et régulateur	**-0,71**	**0,71**			**0,71**	**-0,71**
4.2 Décentralisation : efficacité d'une nouvelle répartition des rôles						
4.3 Ouverture et transparence dans l'élaboration des politiques de R&I	**-0,71**	**0,71**			**0,71**	**-0,71**
4.4 Politique systémique de l'innovation						
5.1 Capacité stratégique des Etablissements d'Enseignement supérieur	**-0,71**	**0,71**			**0,71**	**-0,71**
5.2 Recomposition du paysage des Organismes Publics de Recherche	**-0,71**	**0,71**			**0,71**	**-0,71**
5.3 Modernisation de la gestion des ressources financières et humaines	**-0,72**	**0,72**			**0,72**	**-0,72**
5.4 Implication des régions dans l'émergence de pôles puissants						
5.5 Articulation à l'innovation industrielle, capacité de partenariat	**-0,72**	**0,72**			**0,72**	**-0,72**
6.1 Dynamique d'innovation des PME et start-up dans le tissu local						
6.2 Politique publique d'innovation axée PME et start-up						
6.3 Attractivité du territoire pour la RDI des multinationales						
6.4 Disponibilité des ressources humaines pour l'innovation						
6.5 Politique de partenariat des entreprises avec la recherche publique	**-0,72**	**0,72**			**0,72**	**-0,72**

2. The case of the Futuris operation

PHASE B : Modelling and computation of the input and output parameters associated with each scenario

The Input/Output Balance Model

- **We define the value of the keys (input parameters) from the values of the drivers which characterise each scenario: each key can be computed from the state of the drivers through an impact matrix.**
- **Finally, each scenario can be translated into an I/O Matrix.**
- **Then, the I/O Matrix can be translated into the classical RD indicators**
- **We added a demographic model, allowing to compute the number of recruitments in public and private research per year, knowing the level of RD execution, the rate of retirement and making assumption on the evolution of the cost per researcher.**

2. The case of the Futuris operation

PHASE B : Modelling and computation of the input and output parameters associated with each scenario

The Input/Output Balance Model

- **<u>The assessment of each scenario</u> :**

Appreciation for the state of science, industry and the economy.

The kinds of research jobs, the economic activities, the regional dynamics, the role and innovation strategies of the MNFs, the international relations

The level of achievement of the national objectives regarding S&T

2. The case of the Futuris operation

PHASE C : Computation of the strategic indicators and assessment of the current evolutions and options

- **Define strategic indicators ('essential questions') built from input and output parameters**

Overall financial balances

1 Financing by the various major sources

2 The adequation between resources and objectives

Human and financial resources of public research

3. The parameters of evolution of human resources in public research

4. The sources and structure of financing of public research

Europe, Regions, Nation : pôles and 'public engines' of innovation

5. The European dimension of RD

6. The 'public engines' of innovation and the large programmes

RD and innovation in firms

7. Structure of the financing of private RD

8. The implications of attractiveness of the territory on the localisation of RD

2. The case of the Futuris operation

PHASE C : Computation of the strategic indicators and assessment of the current evolutions and options

- **strategic assessment of each scenario using the strategic indicators as criteria**

EXAMPLE STRATEGIC INDICATOR 2

The adequation between resources and objectives

objectifs	1990	2000	Ia	Ib	II	III	IV	V
K production		100	111	125	93	138	136	161
innovation policy		100	150	167	520	413	697	997
Large Civilian Progralles PTIM*		100				*(2,06)*	*(1,48)*	*(2,45)*
défense – LTP**		100	63	71	111	188	89	175
total public		100	94	106	108	177	140	201
total GERD		100	95	107	130	191	158	218

2. The case of the Futuris operation

PHASE C : Computation of the strategic indicators and assessment of the current evolutions and options

- **strategic assessment of each scenario using the strategic indicators as criteria**

EXAMPLE STRATEGIC INDICATOR 4

The relative weight of different funding sources for public Labs

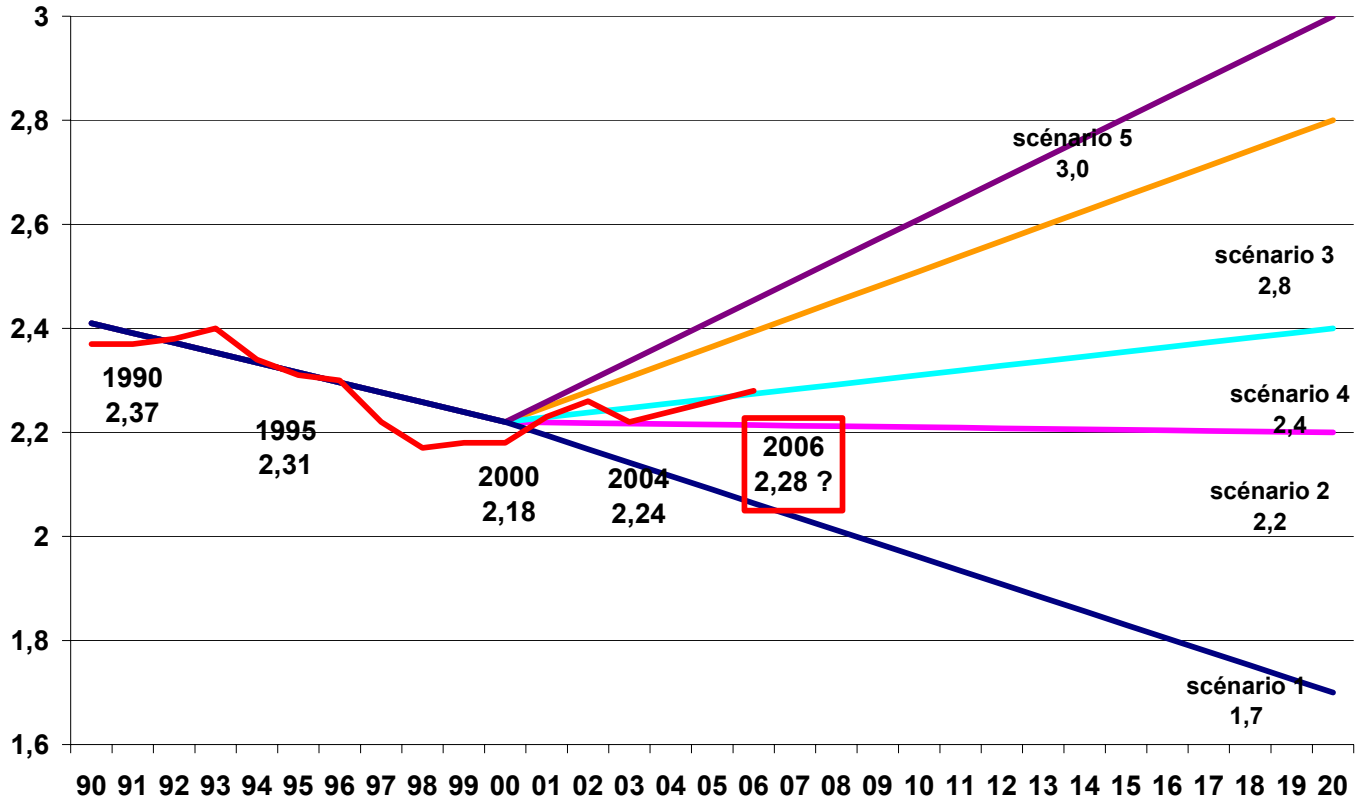
	1990	2000	Ia	Ib	II	III	IV	V
% budgetary	89,5	84,6	84,1	84,1	63,4	57,0	47,9	51,7
% grants / projects	2,4	4,9	6,6	6,7	16,1	17,3	22,1	21,7
% procurement	1,9	2,4	1,3	1,3	3,4	6,9	3,7	6,4
% fundations	1,9	2,4	2,4	2,4	4,7	5,7	4,3	5,8
% industry	4,3	5,7	5,6	5,6	12,4	13,1	14,8	14,3
total	100	100	100	100	100	100	100	100

2. The case of the Futuris operation

PHASE C : Computation of the strategic indicators and assessment of the current evolutions and options

- **strategic assessment of current evolution and options: examination of the situation through the scenarios.**

EXAMPLE STRATEGIC INDICATOR 1 : GERD and its sources



2. The case of the Futuris operation

PHASE C : Computation of the strategic indicators and assessment of the current evolutions and options

- **strategic assessment of current evolution and options: examination of the situation through the scenarios.**

EXAMPLE STRATEGIC INDICATOR 1 : GERD and its sources

Public financing of RD - % GDP

scénario type financing type	1990	1997	2000	2006	Ia	Ib	II	III	IV	V
budget State	1,26	1,00	0,98	0,99	0,72	0,72	0,71	1,02	0,75	0,97
regions + EU	0,02	0,05	0,05	0,07	0,04	0,04	0,12	0,16	0,23	0,29
TOTAL PUBLIC	1,28	1,05	1,03	1,06	0,76	0,76	0,84	1,18	0,97	1,26
enterprises	1,09	1,15	1,19	1,12	0,91	0,91	1,29	1,49	1,32	1,59
societal + fin markets	0,03	0,04	0,04	0,08	0,04	0,04	0,07	0,13	0,11	0,14
TOTAL PRIVATE	1,12	1,19	1,23	1,20	0,93	0,93	1,36	1,62	1,43	1,74
GERD	2,41	2,24	2,26	2,26	1,70	1,70	2,20	2,80	2,40	3,00

2. The case of the Futuris operation

PHASE C : Computation of the strategic indicators and assessment of the current evolutions and options

- **strategic assessment of current evolution and options: examination of the situation through the scenarios.**

EXAMPLE STRATEGIC INDICATOR 4 : The relative weight of different funding sources for public Labs

	1990	1997	2000	2006	Ia	Ib	II	III	IV	V
udgetary	89,5	85,6	84,6	79,0	84,1	84,1	63,4	57,0	47,9	51,7
grants / ojects	2,4	3,1	4,9	11,5	6,6	6,7	16,1	17,3	22,1	21,7
ocurement	1,9	3,0	2,4	3,0	1,3	1,3	3,4	6,9	3,7	6,4
ndations	1,9	1,8	2,4	1,7	2,4	2,4	4,7	5,7	4,3	5,8
ndustry	4,3	6,5	5,7	4,8	5,6	5,6	12,4	13,1	14,8	14,3
total	100	100	100	100	100	100	100	100	100	100

Conclusion

For policy options assessment and debate:

Analysis through strategic S&T indicators

linked to an Innovation System model

in the frame of scenarios elaborated in the context of a Foresight operation

A tool for dialogue among MS : Towards a coordinated European assessment

of the policies for the building of the ERA ?