World Institutes for
Disaster - Risk - Management
D R M

STRATEGY - TACTICS - EXAMPLE

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Executive Summary

Setting priorities in the worldwide disaster risk management is one of the main goals of the strategy, to be put into concrete terms by the study in hand.

The ***sucessfull translation into action*** supposes satisfaction of all three requirements, the economical, ecological and social. Disregarding only one of them, may jeopardize a whole project. Such perception is the guideline for the recommended strategy.

Challenge as well as difficulty of a consistent ***DRM project portfolio*** are a rigorously aim-focussed networking of all the many aspects from most sophisticated risk assessment technics cross up to financial risk management in both, industrialized and developing countries, as shown by the proposed methodology.

Due to the complex (highly non-linear) systems there is no alternative to the recommended ***top down approach*** for representative statements, as the only sound bases for an optimized decision making. The reductionistic bottom up approach leads into crucial contradictions, often hampering the succes of a project.

Segmented and discipline-oriented, hence, reductionistic research and know how is vastly developed. In contrary, for holistic (e.g. inter-, trans-disciplinary) risk management, only little literature and know how is available, especially for quantified statements, which are indispensable to set priorities in order to realize projects. The development of such instruments could become a ***fundamental merit of DRM***.

The study in hand sketches a ***methodology***
- starting with a ***networked view*** of the world
- subdividing the world so far only, in order to apply available experiences and rules for ***quantification***,
- thereby providing representative results, assumed for a ***reliable risk management***
- putting ***computerized tools***, as flow charts, checklists and simulation models at disposal, practical minded for a most efficient, case-specific realization
- optimizing the powerful options, offered by computer technology, to handle the enermous amount of data and most complicated networking sucessfully and ***traceable for laymen*** too
- generating a ***decision tool***, showing the return on investment for the mitigation of disasters
- coming up with a ***rating of the scenarios*** in discussion, providing their ranking as basis for ***setting priorities.***

The next step must put the outlined ideas into concrete forms, as part of a ***three year plan***.
A first draft of proposals, as to be proceeded from the year 2000 to 2002, has been shown and started to be discussed already.

STRATEGY of DRM

The objective of DRM is to enable people to anticipate disasters in order to take action to protect life and property. The goal is to ensure a sustainable development, which implies the impacts to become triple-supportable, namely economically, ecologically and socially. The following guidelines are the consequence.

Economic compliance assumes efficiency. It supposes a procedure which is both, necessary and sufficient. Therefore, the top down (holistic) approach with minimum discretization is required, whereas any bottom up (reductionistic) approach is excluded, as explained in chap. 3.4. Most decisive for the cost is primarily the presumed accuracy, besides the accepted residual risk. Continuous focussing on the accuracywise weakest aspects is a consequence for the optimization of cost.

Ecologically, main-indicators are the degree of i) self-organization (autopoiesis), ii) dynamics and iii) diversity of the system, impacted by the disaster. If one of these indicators is substantially hampered by the impact, caused by the disaster, such impact is not supportable by the natural environment.

Social acceptance assumes adequate safety, rule of law, fairness, welfare and understanding, as expressed by the social balance

Consequently, the **strategy of DRM** focusses primarily on

- **sustainability**, i.e. triple supportability of the impacts, caused by disasters : **i) economically, ii) ecologically, iii) socially**
- **efficiency**, requiring indispensably a **top down approach** with minimum discretization;
- **optimization** **of cost and values** for a required accuracy of the proof of sustainability;
- **conservation** **of the natural capacities** concerning self-organization, dynamics, diversity;
- **achievement** **of social acceptance**, reached by a reasonable social balance.

TACTICS for DRM - Methodology and tools

The methodology to achieve all strategic goals consists in the relevant optimization of the cybernetic flow, which is the flow of matter, energy and information. Information related risks are financial risks and risks concerning liability, rules of profession, due diligence, know how, besides many others. Hazard is understood as a state outside of the tolerated range, which provides sustainability, i.e. economical, ecological and social supportability. Management means the optimization of the measure in order to bring the state of the system within such tolerated range.

The proposed management tool ECO KIT is a control circle (Regelkreis) for an iterative optimization of the measure, as described before. Checklists are provided for the minimum discretization of i) the cause of a disaster, ii) the impacted natural environment and iii) the impacted interests. The three case-specified checklists form the axis of the cube of matrices, comprising the case-specific hazards, risks, measures and costs.

The presented ROI/RIO-compass shows the future development of the return on investment (ROI) for the scenarios under consideration, depending on their sustainability (RIO), due to the agenda 21 of the conference at Rio 1992.

The priorities of measures, as required by DRM, renders the rating of the discounted scenarios, if ranked according to the best performance of risk diminution compared to the investment.

EXAMPLE - Management of risk by a hurricane

The above mentioned methodology and tools are explained in priciple by the example of the management of risk by the caribbean hurricane ANDREW, which occurred on August 1992.

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EXAMPLE - Management of risk by a hurricane

1 DISASTER

1.1 Natural and man-made disasters (A)

A disaster can be of either natural or man-made (artificial, technical) origin.

DISASTER	space (spheres)	content // emission of		
		matter & energy		**information**
Natural	Atmosphere	Air	- Radiation - Ozone - Climate (CO_2) - Hurricane - Lightningstroke	
	Hydrosphere	Water	- Hail - Snow - Rain - Avalanches - Floods - Waves - Droughts	
	Lithosphere	Soil	- Vulcanism - Earthquakes - Debrisflow - Landslides - Settlement - Sinking	
	Biosphere	Organisms	ANIMALS - Vectors - Locust PLANTS - Fire - Forestdying	
Man-made (technical, artificial)	Anthroposphere	Artificial Systems	MATTER - Gas - Liquid - Solid ENERGY - Heat - Vibrations - Electromagn. waves -	ECONOMICS - financial - liability NATURAL SCIENCES - Software - Gen-Technology - Nuklear HUMANITIES - dispute - health - social

Generalized, "disaster" means a disastrous cybernetic flow (F), which is the flow of matter (m), energy (e) and/or information (i), thus $F = F_{m,e,i}$.

$F_{m,e,i}$ is considered as disastrous, if it
- exceeds its tolerated maximum value ($F_{TOL\ max}$) or
- falls short of its tolerated minimum value ($F_{TOL\ min}$).

The tolerated range of the impacted, cybernetic flow is determined by the vulnerabilities of the impacted interests against the impacted flow.

1.2 The cybernetic flows (F_A, F_{DUE} , F_{TOL})

As mentioned, the cybernetic flow (F) is the flow of matter (m), energy (e) and information (i), thus $F = F_{m,e,i}$.

F_A is a **momentary** cybernetic flow ($F_{A\ m,e,i}$), as the re-action, caused by the disaster (A). A is the cause of the disaster. Generally speaking, it represents the disturbing term, which is the action, impacting the non-impacted flow ($F_{without\ A}$).
F_A depends on space ($\underline{x}$) and time(t), hence : $F_A = F_{m,e,i\ (x,t)}$. F_A is forecasted by experience or modelling, as numerical simulation. The locus, where $F_{A\ (x)} = 0$, becomes the envelopment of the space of impact and determines the case specific environment (U_A), within which the momentary cybernetic flow (F_A), as the content of U_A, must be determined and will be compared with its tolerated value (F_{TOL}).

$F_{DUE\ /\ I}$ is the **optimal** cybernetic flow for the interest (I). For various impacted interests, F_{DUE} usually differs and may even diverge.

$F_{TOL\ max\ /\ I}$
$F_{TOL\ min\ /\ I}$ The same holds for the extremal **tolerated** cybernetic flows ($F_{TOL\ max\ /\ I}$, $F_{TOL\ min\ /\ I}$). They are determined by the vulnerability of the impacted interest (I) against F_A.

1.3 The quantification of a hazard (G_A)

The hazard (G_A) is the danger, caused by the disaster (A) and can be quantified as

$$G_A = (F_A - F_{DUE}) / (F_{TOL} - F_{DUE}) \qquad (1)$$

G_A = hazard by A
A = cause of disaster — if $G_A < 0$ ==> $G_A = 0$
F_A = cybernetic flow by A — if $F_{TOL} = F_{DUE}$ ==> $G_A >> 1$
F_{DUE} = optimal cybernetic flow
F_{TOL} = extremal tolerated flow

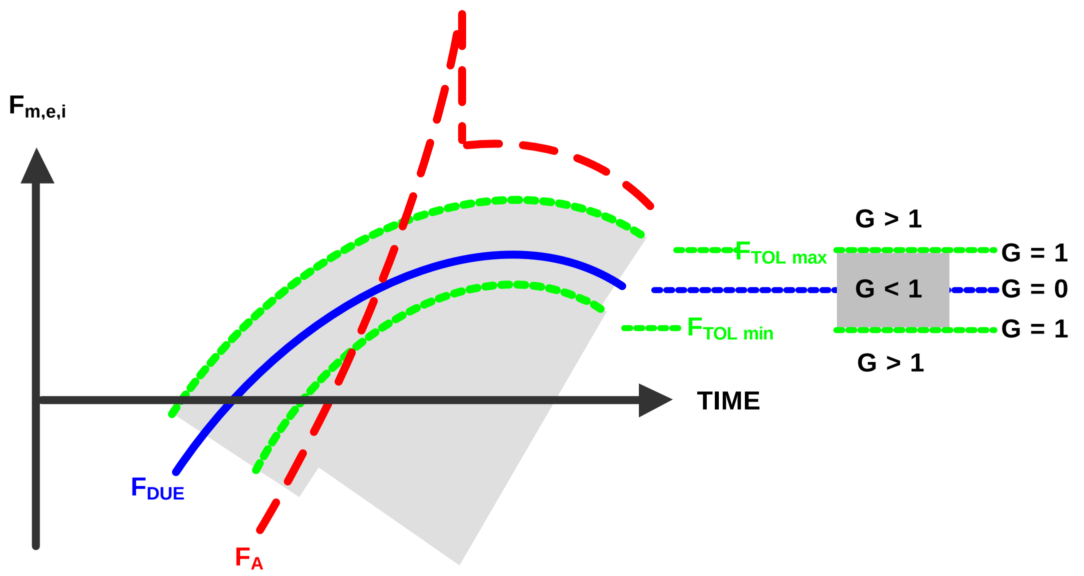
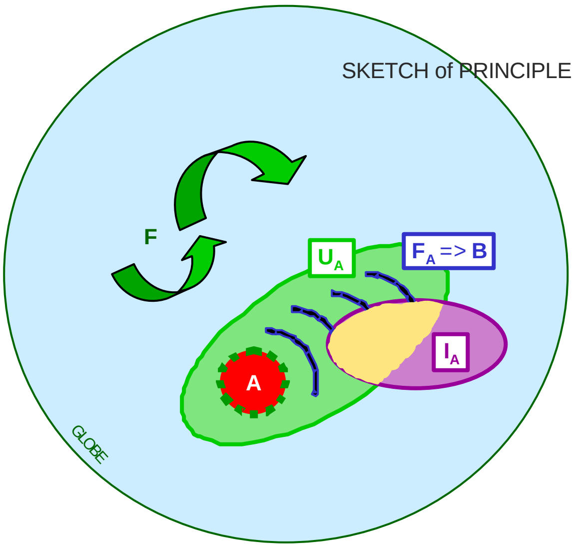


Fig. 1 *The cybernetic flows (F) with the range of tolerance in function of time*

		EXAMPLES				
Disaster (A)	**Cybernetic Flow (F)**	**F_A**	**F_{DUE}**	**$F_{TOL\ max}$**	**$F_{TOL\ min}$**	**G_A**
drought	level of groundwater	- 10	+ 2	-	- 4	2
accident	number of deaths	217	0	100	-	2.17
loss of work	number of lost work-places	100	0	10	-	10

1.4 The endangered system



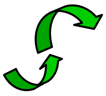
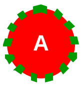
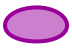
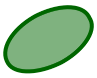
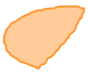
	F =	**FLOW** =	**cybernetic flow** ($F_{m,e,i}$) = flow of matter (m), energy (e), information (i)	= **CONTENT** of the world, thus of the ENVIRONMENT (U_A)
	A =	**ACTION, CAUSE** =	**disruptive factor** of the world, of its content $F_{m,e,i}$, A is characterized by i) its envelopment and ii) the flow (F_n), normal to the envelopment	= **INFLUENCING**
	F_A =	**RE-ACTION** due to A =	**impact** due to A (° $F_{WITH\ A}$) , whereas the change of the world $B_A = F_{WITH\ A} - F_{WITHOUT\ A}$	= **INFLUENCE**
	I_A =	**INTEREST** of => neighbour of A	**vulnerability ($E_{I/A}$)** of interest (I) versus A, i.e. versus F_A, determining F_{DUE} and F_{TOL}	= **INFLUENCED**
	U_A =	**ENVIRON-MENT** of A =	**part of the world** within conservatively assumed space of influence by A	= **SPACE** of ENVIRONMENT of A
	=	**OVER-LAPPING** =	**area of potential conflict ;** conflict results, if $F_{TOL\,max} < F_A < F_{TOL\,min}$	= **SPACE** of **CONFLICT** of I with F_A and A resp.

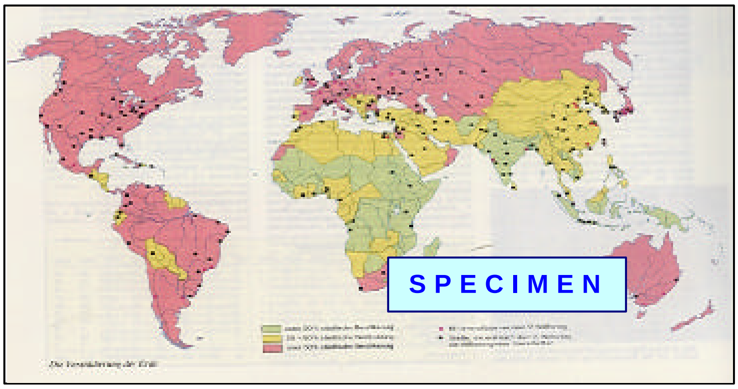
Fig. 2 *The endangered sytem*

As the cybernetic flow is the content of the world, it must be the content of the system too.

The flow of matter, energy and information ($F_{m,e,i}$) without the disaster (A) is the original flow of the system. Influenced by the source of the disaster as the action (A), F becomes the content (F_A) of the endangered system, equal to the re-action (B_A). U_A is the space of the endangered system, as the environment relevant for A.

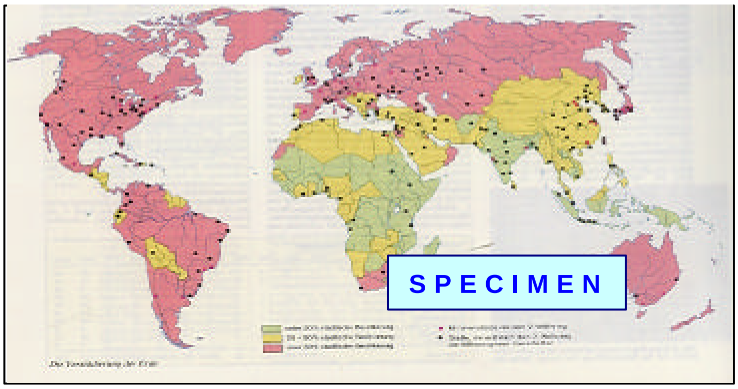
Since F, A and I are dependent on time, also B and U_A , thus, the endangered system is a function of time. Any change of any part of the system leads to a new scenario of the system.

1.5 Worldmap of DISASTERS

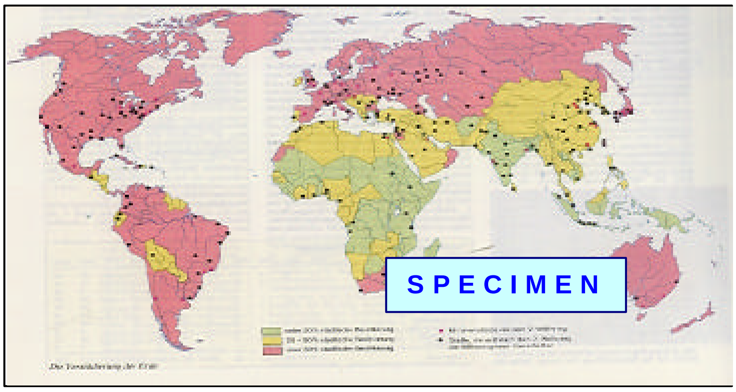


1.6 Worldmap of LOSSES

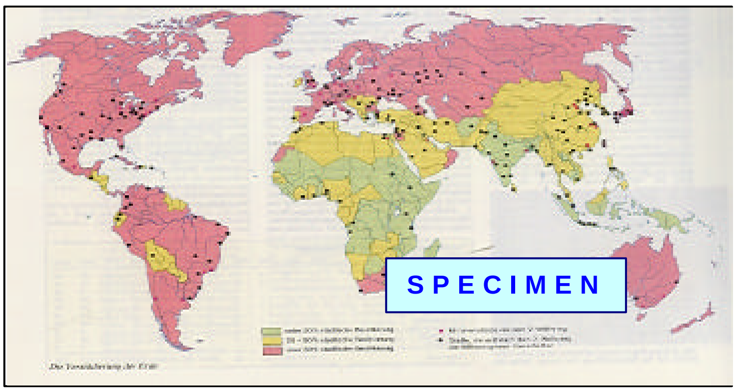
1.6.1 Worldmap of CYBERNETIC LOSSES



1.6.2 Worldmap of MONETARIZED LOSSES



1.7 Worldmap of PRIORITIES for hazard relieves



2 RISK

2.1 The concept of risk

The concept of risk applies to the comparison of a certain hazard with an other hazard of the same intensity and potential of loss respectively. According to this concept, a hazard is considered the less disastrous, the less probable of it occurring, because of time-specificly lower loss.

2.2 The quantification of risk (R_A)

Commonly, the risk (R_A) is defined as the product of the hazard (G_A, due to the disaster A) and the probability of the hazzard's occurrence (X_G). For the risk (R_A), created by the disaster (A), holds

$$0 \leq \mathbf{R_A = G_A * X_G} = ((F_A - F_{DUE}) / (F_{TOL} - F_{DUE})) * (X_A * X_I * X_O) \leq G_A \qquad (2)$$

The cybernetic flows (F) are quantified according to Sect. 1.2.
X_A is the probability of occurrence of the disaster (A), determined from experience or statistically.
X_I is the probabilty of existence of the interest (I), see fig. 2, also determined from experience or statistically.
X_O is the probability of the space- and timewise overlapping of the neighbouring interest with the impact by the disaster. X_O must be determined case-specifically.
X_G is the product of the three probabilities above.

Because $0 \leq X_G \leq 1$, the risk is reduced against the hazard, according to its probability. Due to the multiplication, this reduction is linear. With the dimensionless hazard (G), see eq.1, the dimension of the risk (R) corresponds to the dimension of X_G.

2.3 The tolerated risk (R_{TOL})

The tolerated risk (R_{TOL})

- is equal to the accepted residual risk,
- is the gauge, on which the management must be focussed on,
- is deciding the measure and the cost,
- is the parameter, which triggers everything.

Nevertheless, the society and the individuals are rather interested in the hazard, than in its probability of occurrence and in the resulting risk. Probability and risk are of interest from e.g. economical point of view, whereas an individual, hit by a disaster, does not concern himself about its probability. Therefore and in general, the society or individuals prefer to decide about the tolerated hazard and the tolerated flow (F_{TOL}) respectively, than about the tolerated risk (R_{TOL}).

Inspite of such preference by the society, the concept of risk is promoted from economical points of view, although or because a tolerated risk is a weaker condition than a tolerated flow. It is weaker, because a non-tolerated flow can, still complying with the tolerated risk, be compensated by a low probability, see eq.2. However, due to these different attitudes, a project may be economically favourable - because of a low risk, i.e. with a timespecifically low loss, due to a low probability, inspite of a high hazard - yet, can be jeopardized or hampered by the public opinion, arguing exclusively with the high hazard. Consequently, the project is socially un-favourable.

The determination of whatever tolerance is finally a political decision, to be taken by the individuals and society of concern. Already the decision about a tolerated hazard and even more the decision about a tolerated risk may differ and even diverge considerably between various individuals, depending on their awareness of hazard or willingness to take risk.

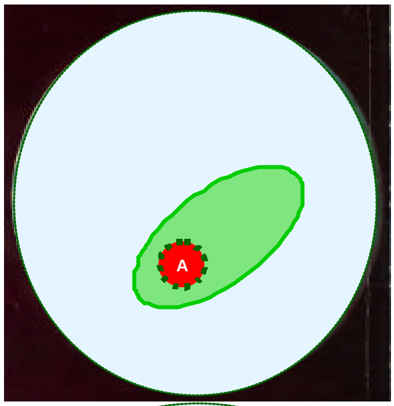
In case, no tolerated risk is given, but a tolerated flow (F_{TOL}) and, as a consequence, a tolerated hazard (G_{TOL}) with $F_A = F_{TOL}$ in eq.2, the tolerated risk (R_{TOL}) becomes trivial, because of the standardization of the hazard G on the tolerated flow, see eq. 1, which leads to $G_{TOL} = 1$:

$$0 \leq R_{TOL} = G_{TOL} * X_G = (((F_A = F_{TOL}) - F_{DUE}) / (F_{TOL} - F_{DUE})) * (X_A * X_I * X_O) \leq G_{TOL} ,$$

$$0 \leq \mathbf{R_{TOL} = X_G} = (X_A * X_I * X_O) \leq 1 \qquad (3)$$

3 MANAGEMENT

The goal of DRM (Disaster Risk Management) is to reduce the risk in order to reach a sustainable development, which implies economical, ecological and social acceptance of the impacted flow of matter, energy and information (F_A).



3.1 Necessity to act

Necessity to act is given, from point of view of
- hazard,
  if the present state of cybernetic flow (F_A) lies
  - outside of the tolerated range, see fig. 1, i.e.
  - above or below of F_{TOL}, formally expressed as
    $F_{TOL\,max} < F_A < F_{TOL\,min}$, which means equally
  if $G_A > 1$ (since G is standardized on the tolerated flow),
  and ,thus, $0 \leq G_A \leq 1$ indicates a tolerated hazard.
- risk, if $R_A > X_G$, according to eq. 3.

3.2 "ECO KIT " - the management tool

ECO-KIT is the general proceedure in order to optimize the measure (ΔA) for mastering the risk (R_A), caused by the disaster (A).

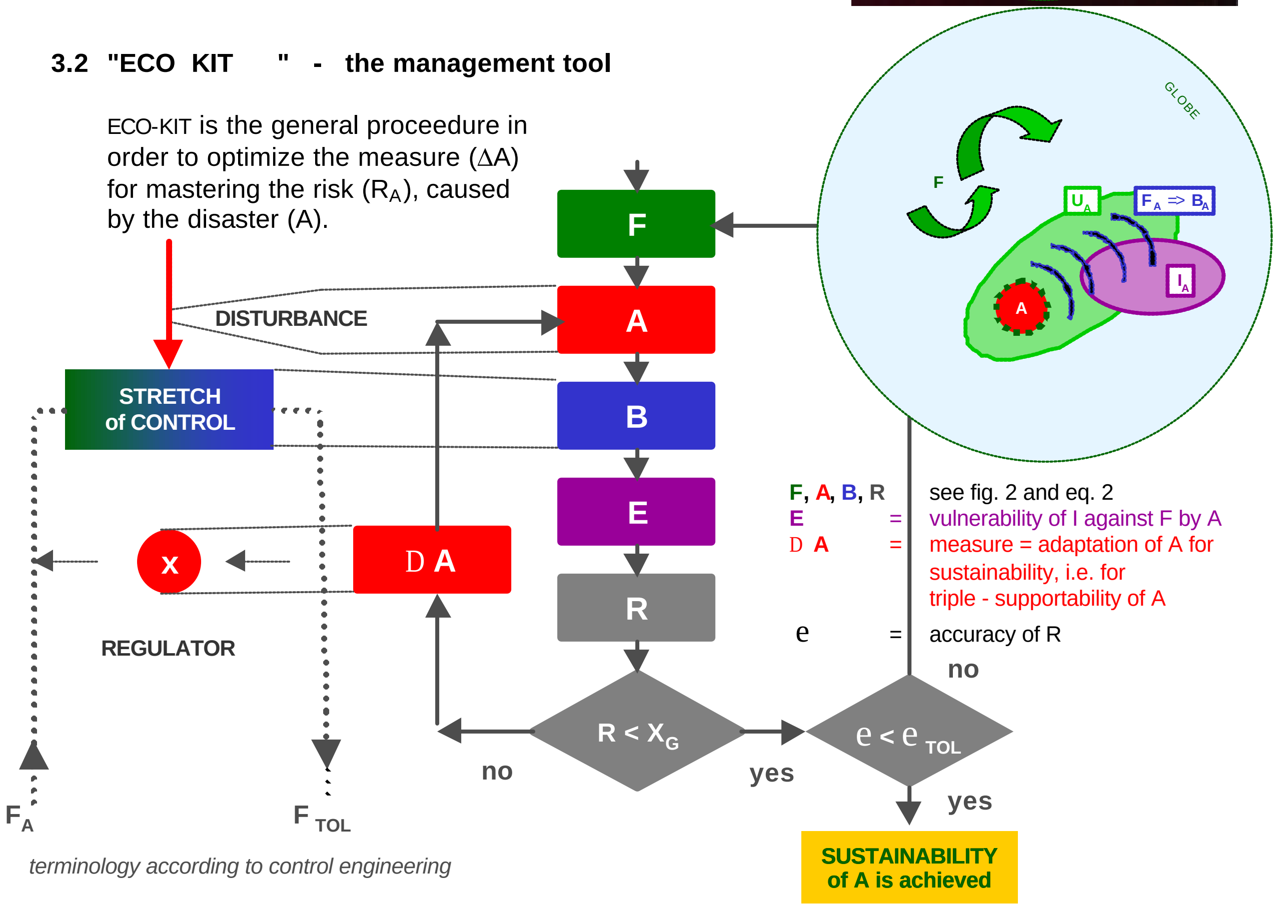


Fig. 3 *ECO KIT - the management tool*

The measure (ΔA), optimized by disaster risk management, must be determined iteratively, because there is no analytical formulation available for the highly non-linear system. The regulation circle ECO-KIT is the management tool for Disaster Risk Management (DRM), with
- the risk (R) triggered regulation criteria, $R_A < X_G$, according to eq. 3.
- the accuracy (ε) triggered regulation criteria, $\varepsilon < \varepsilon_{TOL}$.

The accuracy (ε) is often disregarded, although it is the most important aspect, because the required accuracy decides about time and cost. No other issue is of comparable importance.

3.3 The measure (DA) - the management's result

As measures (ΔA), there are technical and non-technical measures conceivable.

There exists a vast variety of technical measures. Yet principally, they converge on the following three types:

I	reduction	of the action, of the source,	of the emission
II	reduction	of the re-action, of the influence	of the transmission
III	reduction	of the impact,	of the immission

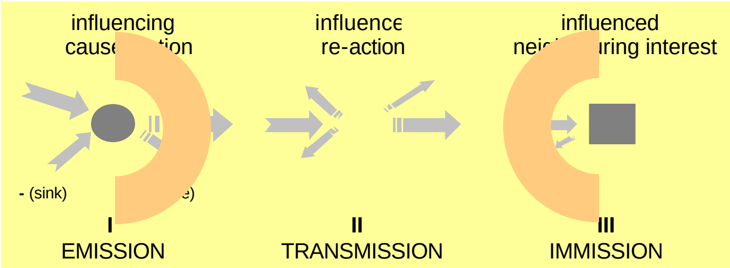


Fig. 4 *The three types of technical measures*

Non-technical measures are :
- reduction of sensitivity
- adjustment of regulation
- financial compensation

3.4 The "top down" - approach

For representative results and statements, there is no alternative to the "top down"-approach. By a "bottom up" - approach i) the interactions, which are characterizing the system, are not considered and ii) the usually practised superposition of partial solutions is mathematically wrong for a non-linear system, thus, leads to non-representative results. Only the "top down"-approach, with its holistic (systemic, correlated, hence, non-reductionistic) view, takes the interactions into consideration, which is a presupposition for representative statements.

The difficulty, rising with the top down approach, is the fact, that for the holistic behavior of the system no analytical relationships can be formulated. Consequently, the system must be discretizised until the reactions of all parts, resulting from the discretization of the system, can be described mathematically. The thereby lost interactions must be recovered by iteration over the boundary conditions of all parts. Otherwise the simulated behavior of the system is not representative and the base for the management, for the case specific decision making, is not sound.

Besides representative results, a further decisive advantage of the top down approach against the bottom up approach is the conclusivity of whatever (check-)list, as shown in annex 1, 2 and 4, resulting from the discretization.

3.5 Discretization of the system

3.5.1 Discretization of time : momentary states

Subsequent to the specification of the system, see fig. 2, the discretization of the development of the system is the next step to be done. The case-specific momentary states are the result. Each alternative of boundary conditions or system characteristics renders a scenario. For every momentary state of every scenario, the following discretization of space and its content is due.

3.5.2 Discretization of space and of its content : checklists

The discretization of the system, see fig.2, with regard to its space and its content respectively, as required by sect. 3.4, means the discretization of each element of the regulation circle ECO-KIT, as described in sect. 3.2., and is shown below :

3.5.2.1 F_{UA}	**cybernetic flow within U_A**	==>	**Checklist F** *(see annex 1)*	= y-axis, abscisse of = y-axis of	matrix of re-action F_A cube of matrices
3.5.2.2 **A**	**cause of disaster,** = **action**	==>	**Checklist A** *(see annex 2)*	= x-axis, ordinate of = x-axis of	matrix of re-action F_A cube of matrices
3.5.2.3 F_A	**flow F by A ,** = **re-action (F_A)**	==>	**Matrix of re-action (F_A)** *(see annex 3)*	= basement of	cube of matrices
3.5.2.4 I_A	**interests of** neighbours of A	==>	**Checklist I** *(see annex 4)*	= z-axis of	cube of matrices *(see annex 5)*

The set up of the cube of matrices, as a result of the discretization, with
- **Checklist F as the x-axis** and
- **Checklist A as the y-axis**, together generating the
- **Matrix of re-action (F_A)**, which is the basement of the cube of matrices, which - with
- **Checklist I as its z-axis** - is shown on principle in the following sketch.

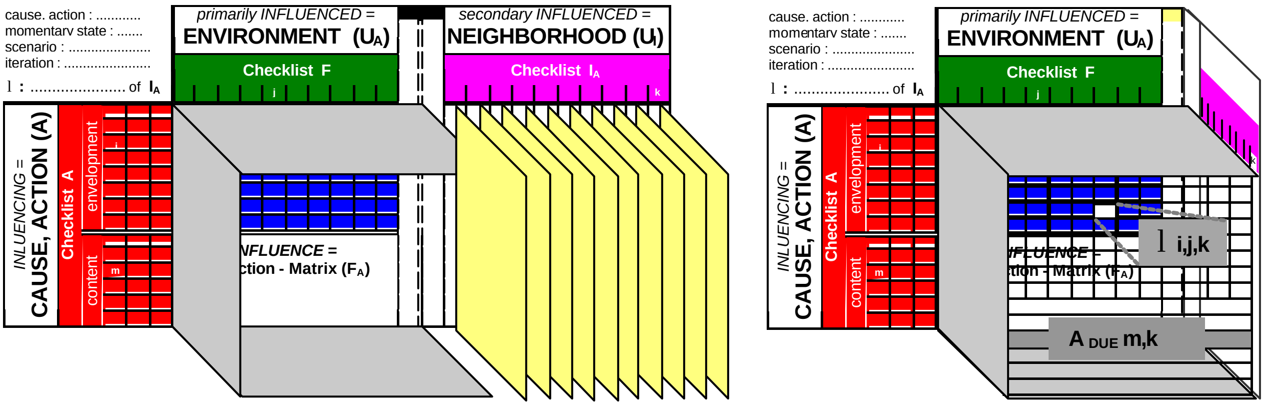


Fig. 5 *Cube of matrices opened up* *Cube of matrices for parameter l*

In order to achieve results, which are easy comprehensible in any respect, for each one of the following parameters λ (3.5.2.5 - 3.5.2.14) a cube of matrices must be built up for each scenario of each momentary state, efficiently feasible, if correspondingly organised computerwise.

	Parameter l	Meaning				l-Cube	= cube of matrices λ
3.5.2.5	F_{DUE}	vulnerability of interest (I) against momentary flow (F_A)	==>	due flow - cube	==>	**F_{DUE} - cube**	= cube of matrices F_{DUE}
3.5.2.6 $E_{I/A}$ =>	$F_{TOL\ max}$		==>	max. flow - cube	==>	**$F_{TOL\ max}$ - cube**	= cube of matrices $F_{TOL\ max}$
3.5.2.7	$F_{TOL\ min}$			min. flow - cube	==>	**$F_{TOL\ min}$ - cube**	= cube of matrices $F_{TOL\ min}$
3.5.2.8	G_A	hazard by A	==>	hazard - cube	==>	**G_A - cube**	= cube of matrices G_A
3.5.2.9	X_G	probability of G_A	==>	probability - cube	==>	**X_G - cube**	= cube of matrices X_G
3.5.2.10	R_A	risk by A	==>	risk - cube	==>	**R_A - cube**	= cube of matrices R_A
3.5.2.11	DA	measure	==>	measure - cube	==>	**DA - cube**	= cube of matrices ΔA
3.5.2.12	Ï DA	cost of ΔA	==>	cost - cube	==>	**Ï DA - cube**	= cube of matrices ∉ ΔA
3.5.2.13	V_{DA}	value of ΔA	==>	value - cube	==>	**V_{DA} - cube**	= cube of matrices $V_{ΔA}$
3.5.2.14	$ROI_{ΔA}$	return on in-vestment by ΔA	==>	ROI - cube	==>	**ROI_{DA} - cube**	= cube of matrices $ROI_{ΔA}$

For convergence of the iterative proceedure both is required,
- the determination of one decisive λ i, j over all k λ i, j , which is accepted by all k - interests and
- the consistency of all simulated cybernetic flows F_A i, j over the entire environment U_A .

3.6 ROI / RIO - Compass

The ROI/RIO - Compass shows the return on investment, **ROI**, as a function of time for each one of the considered scenarios. The various scenarios differ in complying with triple-supportability, which refers to economical, ecological and social vulnerability and creates a sustainable development. The parameter - characterizing the scenarios in their degree of complying with sustainability, as understood by agenda 21 of the conference in Rio 1992 - is, in short, **RIO**.

At least on the medium and long term, there does not exist an alternative to sustainability, which holds as well for the management for the satisfaction of any interest. Short term profits are seldom or never of longevity, as indicated in fig. 6.

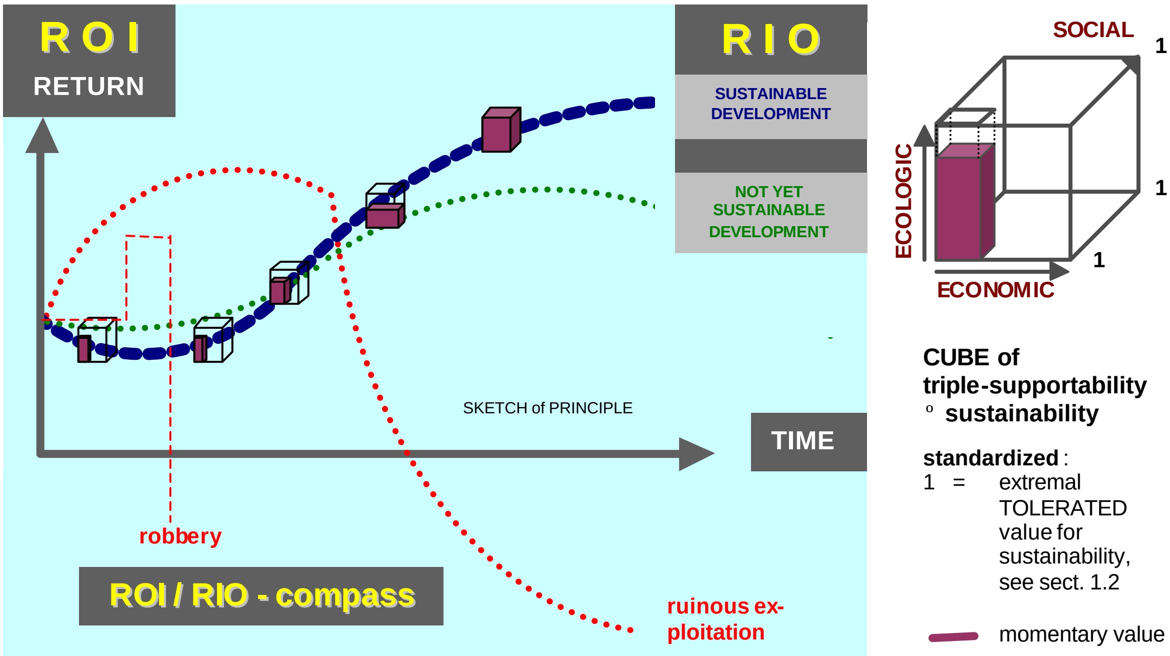


Fig. 6 *ROI / RIO - compass*

As such, the ROI/RIO - compass is a best suitable tool for decision makers of the private and the public sector. By means of the ROI/RIO - compass, they are in the position to tailor their commitment for sustainability - which is the only recommendable policy, since actually no alternative to sustainability does exist - as best fit to their needs and capabilities for investments.

Triple-budgeting, on which the ROI/RIO-compass is based on, is more and more realized as the best, because of triple-win procedure.

3.7 Triple-rating

Triple-rating means rating of economical, ecological and social performance, each described by an indicator. Such rating of the scenarios of the ROI/RIO - compass, describing the development of the return on investment, can be achieved by discounting each one of the scenarios under consideration.

Only a triple-rating, based on quantified, objective and traceable facts, will provide a sound ranking of strategies and management.

3.8 Priorities - as required by DRM

The above explained triple-rating of the scenarios, referring to their triple-return on investment, i.e. from economical, ecological and social point of view, decides about the rating of the projects, hence, about their ranking and the priorities to be set by DRM.

CHECKLIST F - short version

CAUSE : ....

MOMENTARY STATE : ....

SCENARIO : ....

1. MATTER (m)

1.1 Biotic matter (organisms)
1.1.1 Natural biotic matter
1.1.1.1 kernlose Einzeller (bacteria)
1.1.1.2 kernhaltige Einzeller
1.1.1.3 fungi
1.1.1.4 plants
1.1.1.5 animals
1.1.2. Artificial biotic matter
1.1.2.1 organisms, artificially generated (gen-technics)
1.1.2.2 cultures

1.2 Abiotic matter ("dead" matter)
1.2.1 gases
1.2.1.1 air
1.2.1.2 natural gases
1.2.1.3 artificial gases
1.2.2 liquids
1.2.2.1 water
1.2.2.2 natural liquids
1.2.2.3 artificial liquids;
1.2.3 solids
1.2.3.1 soil
1.2.3.2 natural solids
1.2.3.3 artificial solids

2. ENERGY (e)

2.1 mechanical energy
2.1.1 potential
2.1.2 kinetic

2.2 caloric, thermic

2.3 electric

2.4 electromacnetic
2.4.1 radioactive
2.4.2 solar
2.4.3 ....

2.5 nuclear

2.6 chemical
2.6.1 fossile
2.6.2 biologic
2.6.3 ....

3. INFORMATION (i) - *draft*

3.1 scientific
3.1.1 mathematical
3.1.2 physical
3.1.3 chemical
3.1.4 technical
3.1.4.1..planning
3.1.4.2 architectural
3.1.4.3 constructional
3.1.4.4 processing
3.1.4.5 manufacturing
3.1.4.6 ....
3.1.5 biological
3.1.6 medical
3.1.7 pharmaceutical
3.1.8 ....

3.2 humanistic
3.2.1 sociological
3.2.2 historical
3.2.3 political
3.2.4 juristical
3.2.6 journalistical
3.2.7 cultural
3.2.8 military
3.2.9 normative
3.2.10 philosophical
3.2.11 religious
3.2.12 ethical
3.2.13 economical
3.2.14
3.2.15

Version 27.01.00

Checklist A

for the case-specific characterization of the
CAUSE, ACTION (A) :

CAUSE, ACTION : ....
MOMENTARE STATE : ....
SCENARIO : ....

---

1. Boundary (envelopment) of cause, action (A), defined by :

- **1.1. Position** (coordinates)
- **1.2. Form** (geometry)
- **1.3. Volume** (requirement of space)
- **1.4. Characteristics** of the surface
  - 1.4.1. **physical**
    - 1.4.1.1. roughness
    - 1.4.1.2. ....
  - 1.4.2. **chemical**
    - 1.4.2.1. ad-, absorption-potential
    - 1.4.2.2. ....
  - 1.4.3. **visual**
    - 1.4.3.1. impression by view
    - 1.4.3.2. texture
    - 1.4.3.3. coulor
  - 1.4.4. ....
- **1.5.**

2. Emission (= normal-flow of matter, energy and information, which usually are coupled)

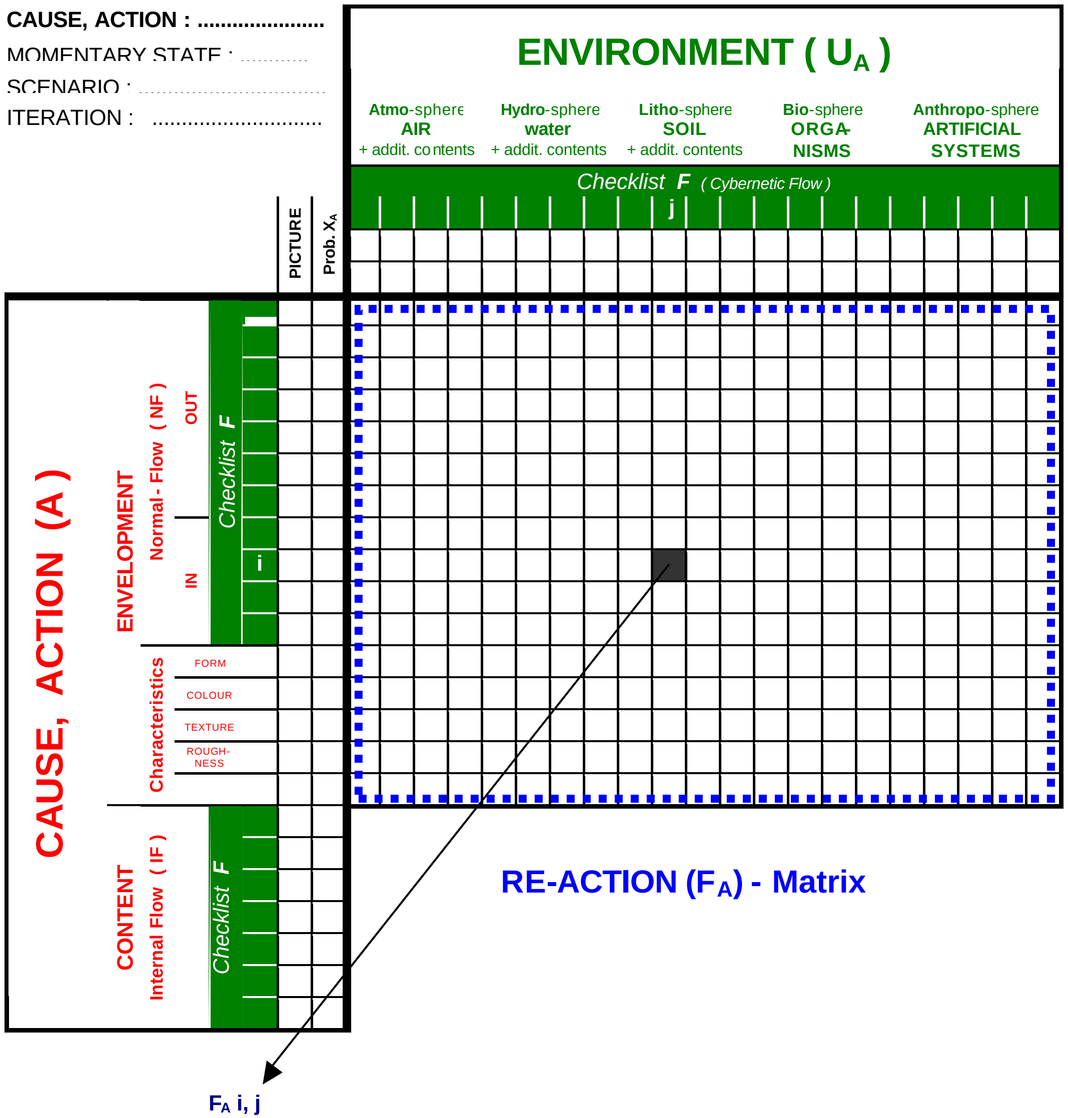
if emission :	negativ, A = SINK = supply	positiv, A = SOURCE = product, disposal
2.1. Matter (m)		
2.1.1. **biotic**		- product
2.1.1.1. organic	- seeds - food	(vegetable, animal)
2.1.2. **abiotic**		- product
2.1.2.1. gaseous	- fresh air	- used air (smell)
2.1.2.2. liquid	- drinking water	- sewage
2.1.2.3. solid	- resources	- garbage
2.2. Energy (e)		- product
2.2.1. gravitational		(current, heat)
2.2.2. thermal	- hydrocarbons	
2.2.3. chemical		
2.2.4. waves		
2.2.4.1. vibration		
2.2.4.2. gravity waves		
2.2.4.3. sound waves		- noise
2.2.4.4. electromagnetic	- current	- light, γ–radiation
2.2.4.5. radiation		- α–, β–radiation
2.3. Information (i)	- knowledge	- knowledge (-transfer)

- 2.3.1. **scientific**
  - 2.3.1.1. "exact"
    - 2.3.1.1.1. mathematical
    - 2.3.1.1.2. physical
    - 2.3.1.1.3. chemical
    - 2.3.1.1.4. ....
  - 2.3.1.2. descriptive
    - 2.3.1.2.1. biological
    - 2.3.1.2.2. earth-scientifical
    - 2.3.1.2.3. ....
  - 2.3.1.3. applied
    - 2.3.1.3.1. technical
    - 2.3.1.3.2. medical
    - 2.3.1.3.3. economical
      - finances
      - production
      - marketing
      - R + D
    - 2.3.1.3.4. military
    - 2.3.1.3.5. ....
- 2.3.2. **humanistic**
  - 2.3.2.1. sociological
  - 2.3.2.2. historical
  - 2.3.2.3. political
  - 2.3.2.4. normative
  - 2.3.2.5. ....
- 2.3.3. **media** (information, entertainment, commercial)
  - 2.3.3.1. local, regional
  - 2.3.3.2. national
  - 2.3.3.4. continental, intercontinental

3. Content

- **3.1. Matter** (m)
  - 3.1.1. **biotic**
    - 3.1.1.1. organic
  - 3.1.2. **abiotic**
    - 3.1.2.1. gaseous
    - 3.1.2.2. liquid
    - 3.1.2.3. solid
- **3.2. Energy** (e)
  - 3.2.1. gravitational
  - 3.2.2. thermal
  - 3.2.3. chemical
  - 3.2.4. waves
    - 2.2.4.1. vibration
    - 2.2.4.2. gravity waves
    - 2.2.4.3. sound waves
    - 2.2.4.4. electromagnetic
    - 2.2.4.5. radiation
- **3.3. Information** (i)
  - 3.3.1. **scientific**
    - 3.3.1.1. "exact"
      - 3.3.1.1.1. mathematical
      - 3.3.1.1.2. physical
      - 3.3.1.1.3. chemical
      - 3.3.1.1.4. ....

continuation : see 2.3.1

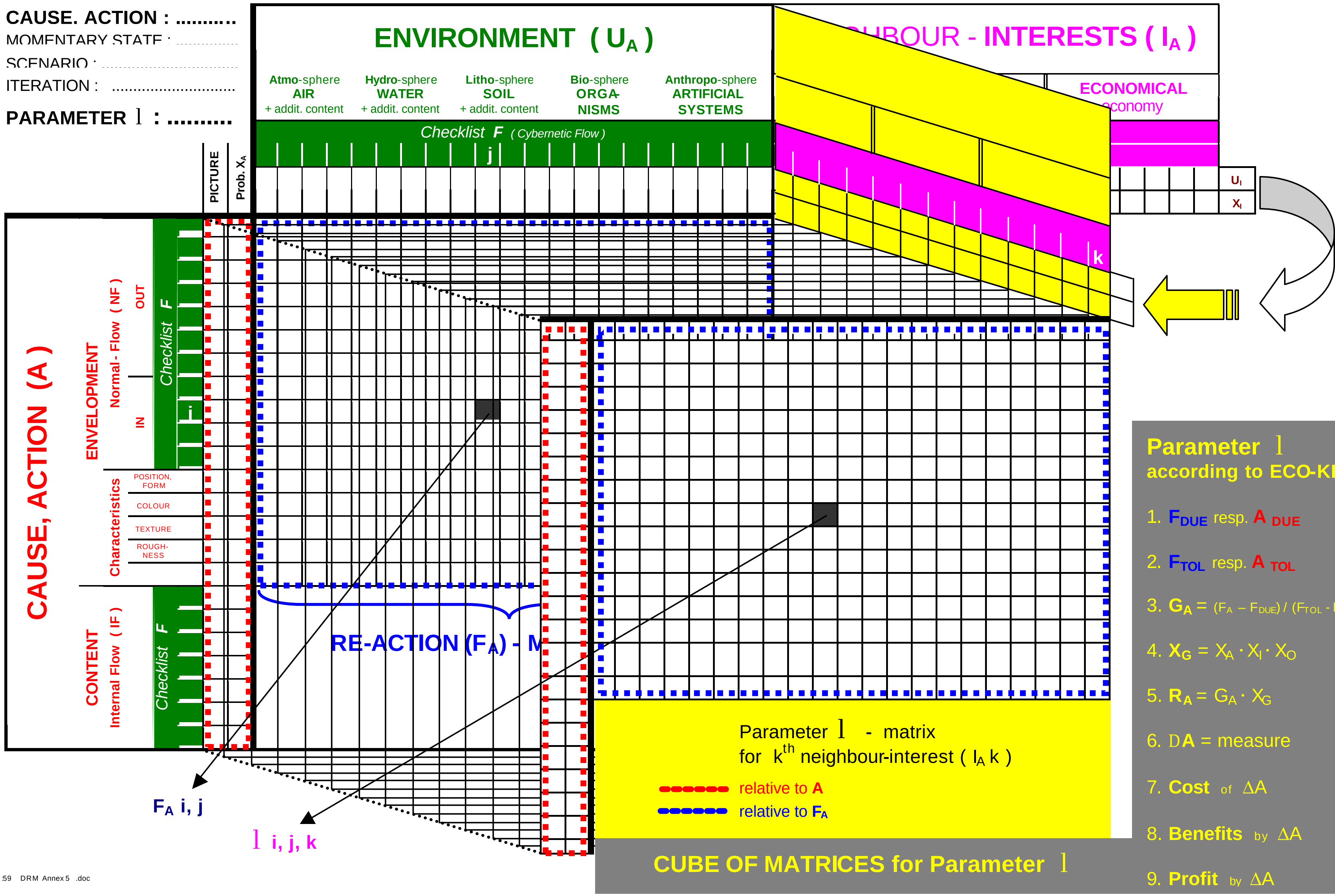

CAUSE, ACTION : ....
MOMENTARY STATE : ....
SCENARIO : ....
ITERATION : ....
ENVIRONMENT (U_A)
Atmo-sphere AIR + addit. contents
Hydro-sphere water + addit. contents
Litho-sphere SOIL + addit. contents
Bio-sphere ORGA-NISMS
Anthropo-sphere ARTIFICIAL SYSTEMS
Checklist F (Cybernetic Flow)
j
PICTURE
Prob. X_A
CAUSE, ACTION (A)
ENVELOPMENT
Normal - Flow (NF)
OUT
IN
Checklist F
i
Characteristics
FORM
COLOUR
TEXTURE
ROUGH-NESS
CONTENT
Internal Flow (IF)
Checklist F
RE-ACTION (F_A) - Matrix
F_A i, j

Checklist I_A

Neighbouring(*) Human **Interests**

Interest	Group	Criterion	Column	PERIMETER $U_{IA\,k}$	PROBABILITY $X_{IA\,k}$
ecological nature	**Intact Environment** content = $F_{m,e,i}$ resource	Self-regulation (l = local, r = regional, g = global)	l		
			r		
			g		
		Diversity	l		
			r		
			g		
		Dynamics	l		
			r		
			g		
		Precaution (relative to A)	recycling - potential		
			greenhouse - gas		
			energy - consumption		
			landscape		
social society	**Basic Needs** minimum to exist	Existence	life		
			housing, nutrition		
			family-life (descendants)		
		Safty versus	exterior by military		
			interior by law and order, civil protection		
			naturalevents (- hazards)		
		Health	physically		
			psychologically		
			condition, vulnerability		
	Quality of Life welfare	Edu-, Edification	school, continous learning, studying		
			cultural		
			religion		
		soc. Security	number of working places, apprentices		
			quality of working places		
		free time	recreation		
			sports (active), entertainment (passive)		
		old Age	nursing, therapeutical activity		
			occupation, recreation, distraction		
		Li-ber-ties	constitutional		
			physical, as mobility		
	Institutions, associations		private		
	Politics, authorities		public		
economical economy	**Use** of $F_{m,e,i}$ property, prosperity	own **Use**			
			citizen, stake-, stock-holder, staff		
	Neighbouring **- Uses**	IN-FLOW supply	hunting, fishing (professionally)		
			mining, mineral resources		
			agriculture, forestry		
			gas-, water-, energy - supply		
		PRODUCTION incl. service industry	industry : manufact., construct., building		
			media, cultural creation		
			banking, insurencies, fiduciaries		
			transport-, cargo-, mobility- services		
			tourism, leisure, sport, holiday, attraction		
			recreation, health		
			knowledge, designing, consulting		
			marketing, promotion, distribution		
		CON - SUMPTION expenditures	space : housing, manufactering, leisure		
			matter : food, non-food		
			energy : heat, fuel, light		
			informat. : educat., broadcast., publ.rel.		
		OUT-FLOW dis-posal	dumping, incineration, recycling		
		PRO-TECTION special use	life, property		
			landscape, nature, environment		
			heritage, culture		

(*) "Neighbouring" Interest = Interest on F within U_A of neighbour (k), whose perimeter of interest (U_I) is overlapping with U_A , see fig. 2.



Parameter λ according to ECO-KIT :

1. F_{DUE} resp. A_{DUE}
2. F_{TOL} resp. A_{TOL}
3. $G_A = (F_A - F_{DUE}) / (F_{TOL} - F_{DUE})$
4. $X_G = X_A \cdot X_I \cdot X_O$
5. $R_A = G_A \cdot X_G$
6. ΔA = measure
7. **Cost** of ΔA
8. **Benefits** by ΔA
9. **Profit** by ΔA

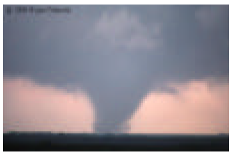
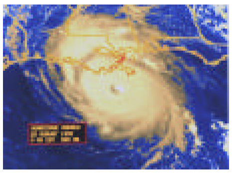
EXAMPLE

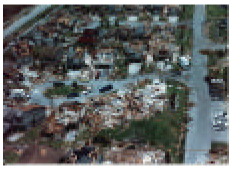
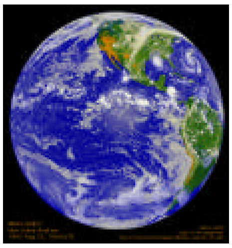
caribbean HURRICANE

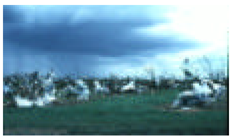
ANDREW

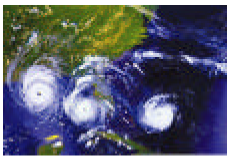
August 1992

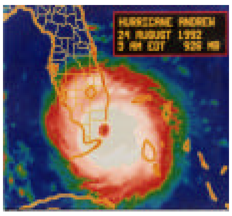
Devasteted MIAMI

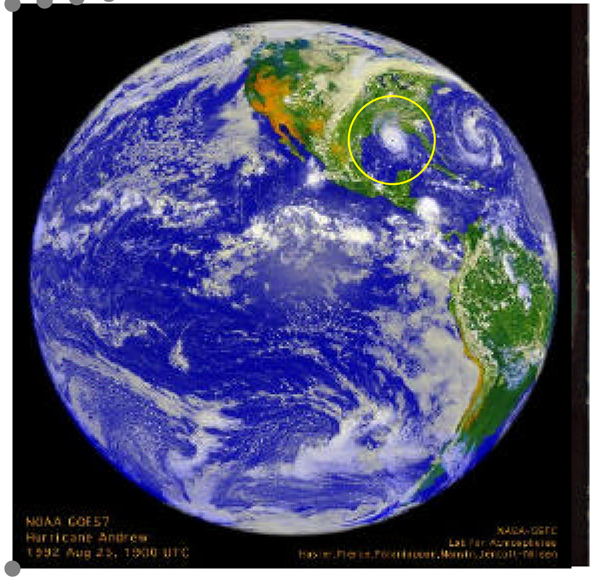




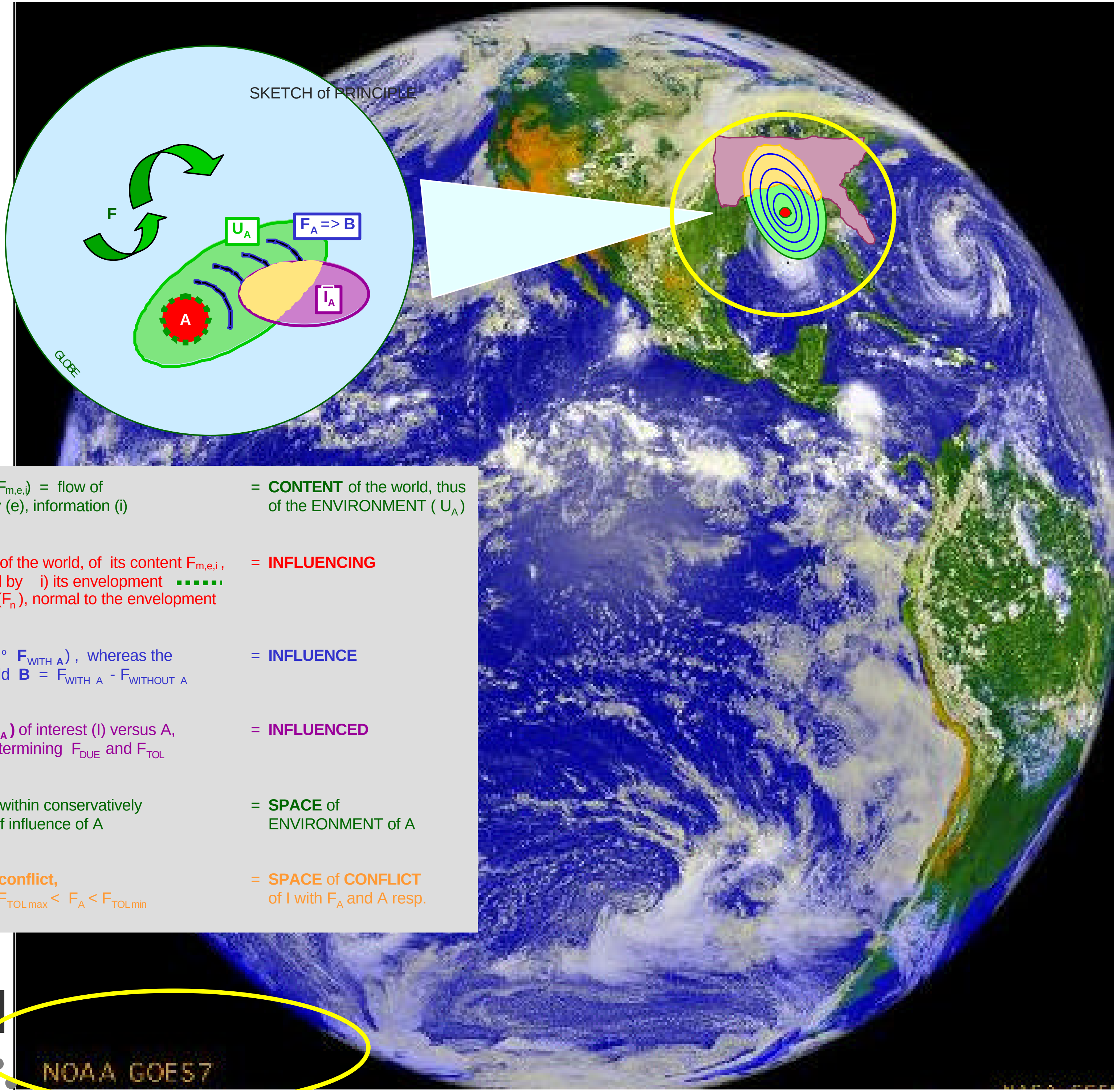






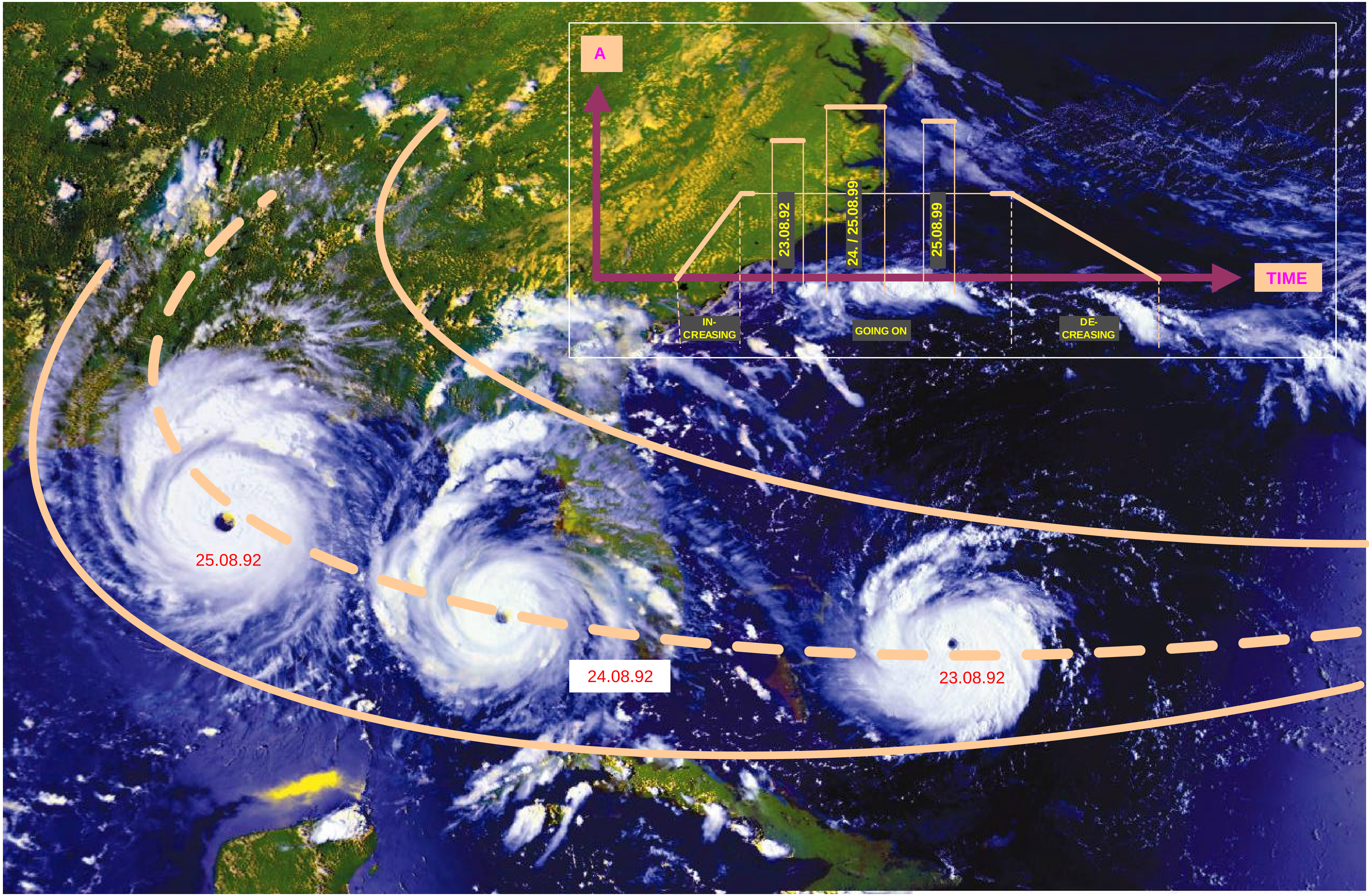






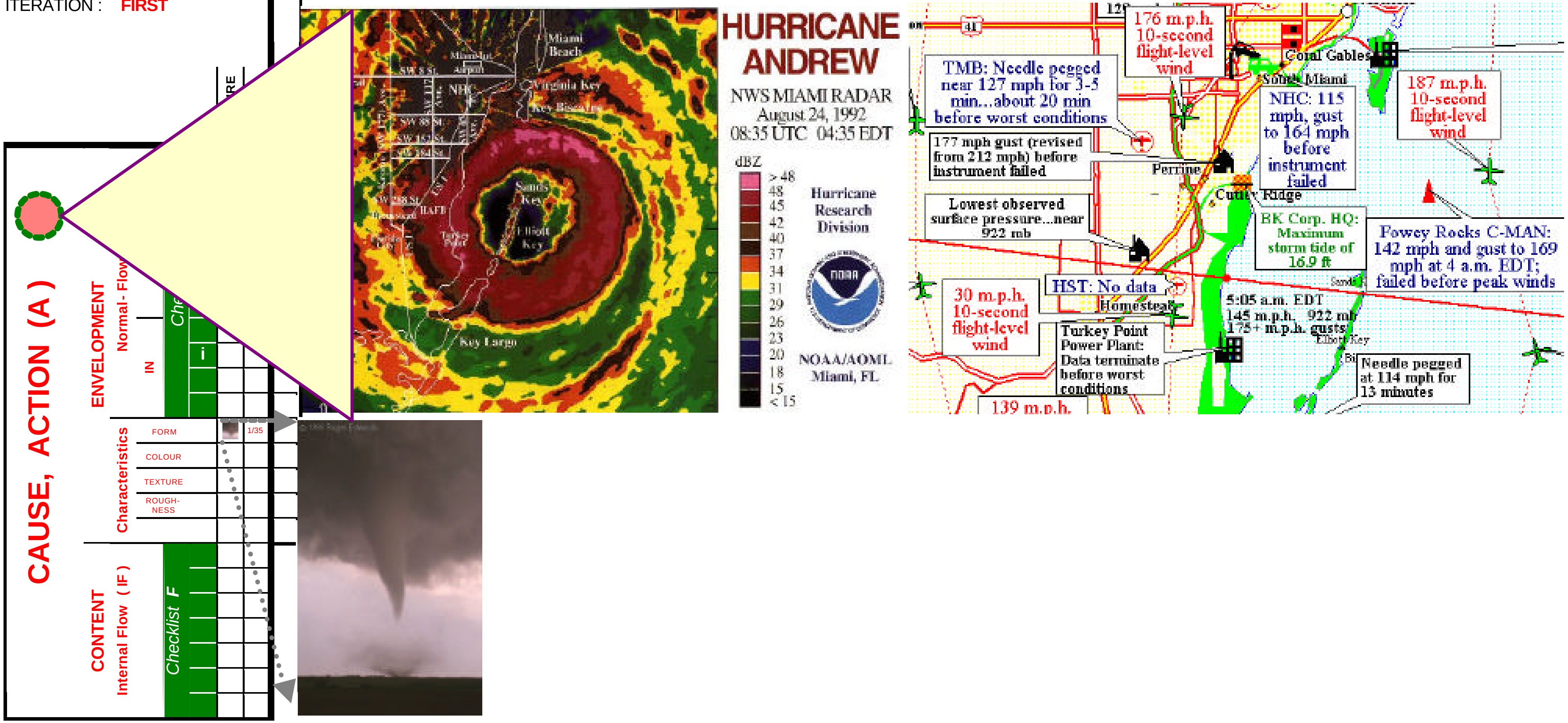
F =	FLOW =	**cybernetic flow** ($F_{m,e,i}$) = flow of matter (m), energy (e), information (i)	= **CONTENT** of the world, thus of the ENVIRONMENT (U_A)
A =	**ACTION, CAUSE** =	**disruptive factor** of the world, of its content $F_{m,e,i}$, A is characterized by i) its envelopment and ii) the flow (F_n), normal to the envelopment	= **INFLUENCING**
F_A	**RE-ACTION** due to A =	**impact** due to A (° $F_{WITH\ A}$) , whereas the change of the world **B** = $F_{WITH\ A}$ - $F_{WITHOUT\ A}$	= **INFLUENCE**
I_A =	**INTEREST** of neighbour of A =>	**vulnerability ($E_{I/A}$)** of interest (I) versus A, i.e. versus F_A , determining F_{DUE} and F_{TOL}	= **INFLUENCED**
U_A =	**ENVIRON-MENT** of A =	**part of the world** within conservatively assumed space of influence of A	= **SPACE** of ENVIRONMENT of A
=	**OVER-LAPPING** =	**area of potential conflict,** conflict results, if $F_{TOL\,max} < F_A < F_{TOL\,min}$	= **SPACE** of **CONFLICT** of I with F_A and A resp.

STEP 1 : Determination of SYSTEM

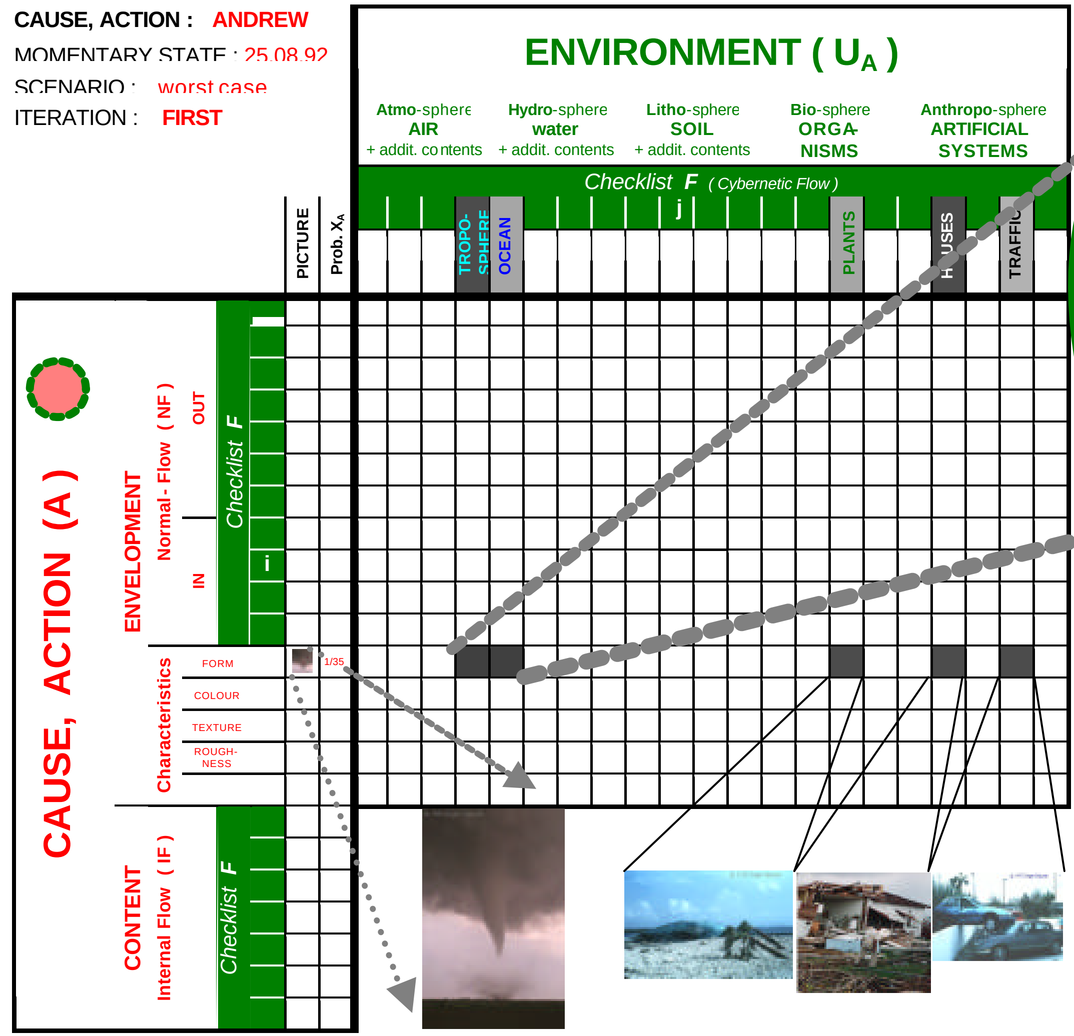


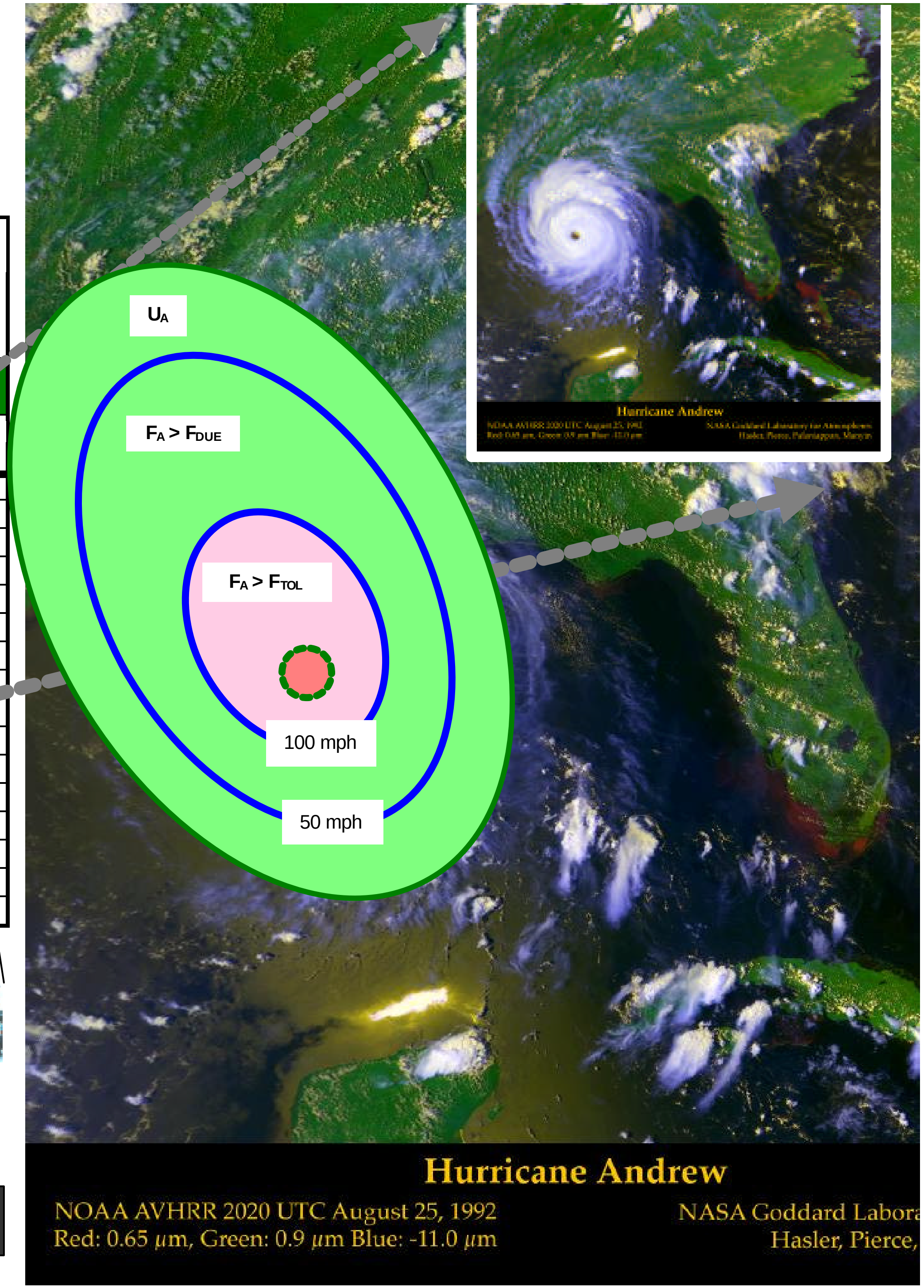
STEP 2 : Partition (Discretization) of TIME ==> MOMENTARY STATES

CAUSE, ACTION : **ANDREW**
MOM. STATE : 25.08.92 // 4 a.m.
SCENARIO : worst case
ITERATION : **FIRST**



STEP 3.1 : F_A = RE-ACTION on **24.08.92 ,** early in the morning at 04.00 a.m.





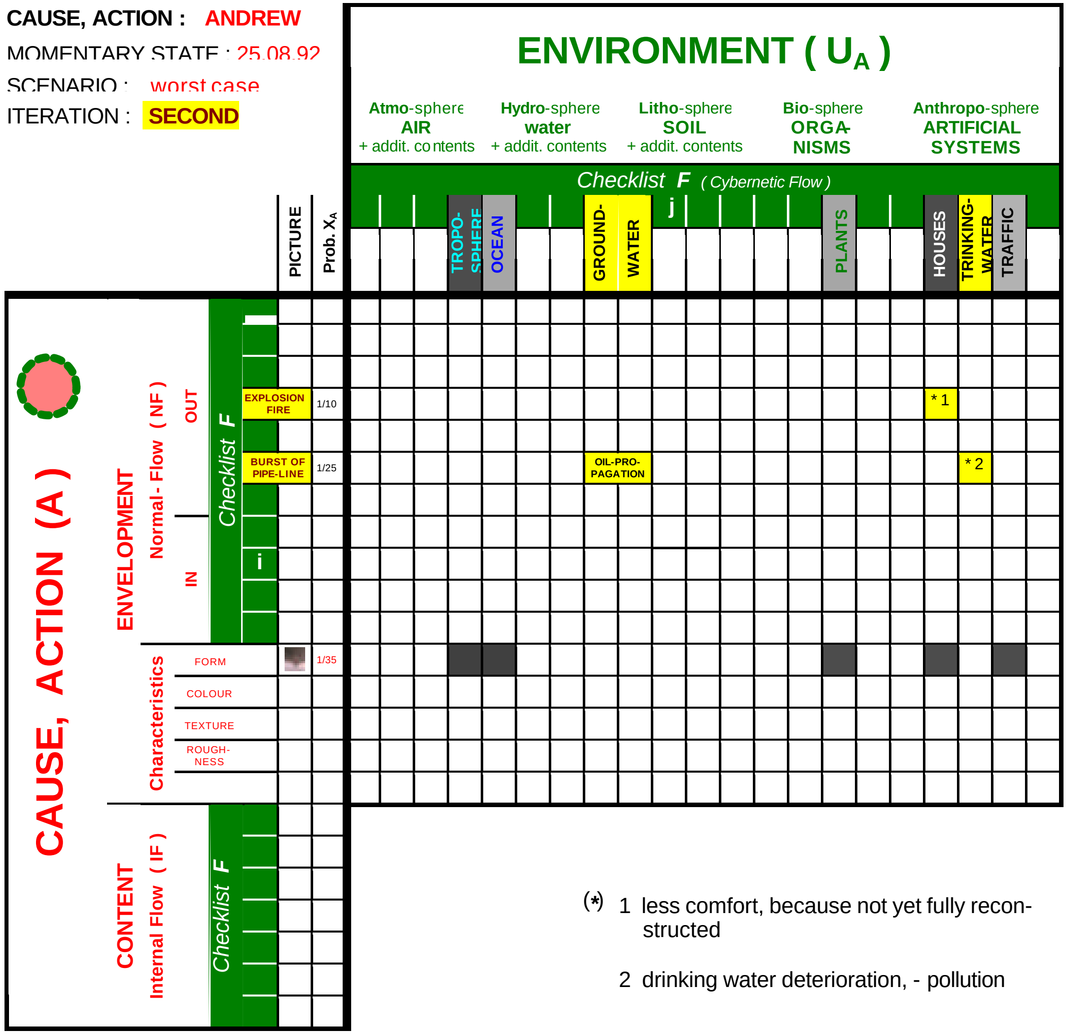
STEP 3.2 : F_A = RE-ACTION on 25.08.92; FIRST Iteration

CAUSE, ACTION : ANDREW

MOMENTARY STATE : 25.08.92

SCENARIO : worst case

ITERATION : **SECOND**

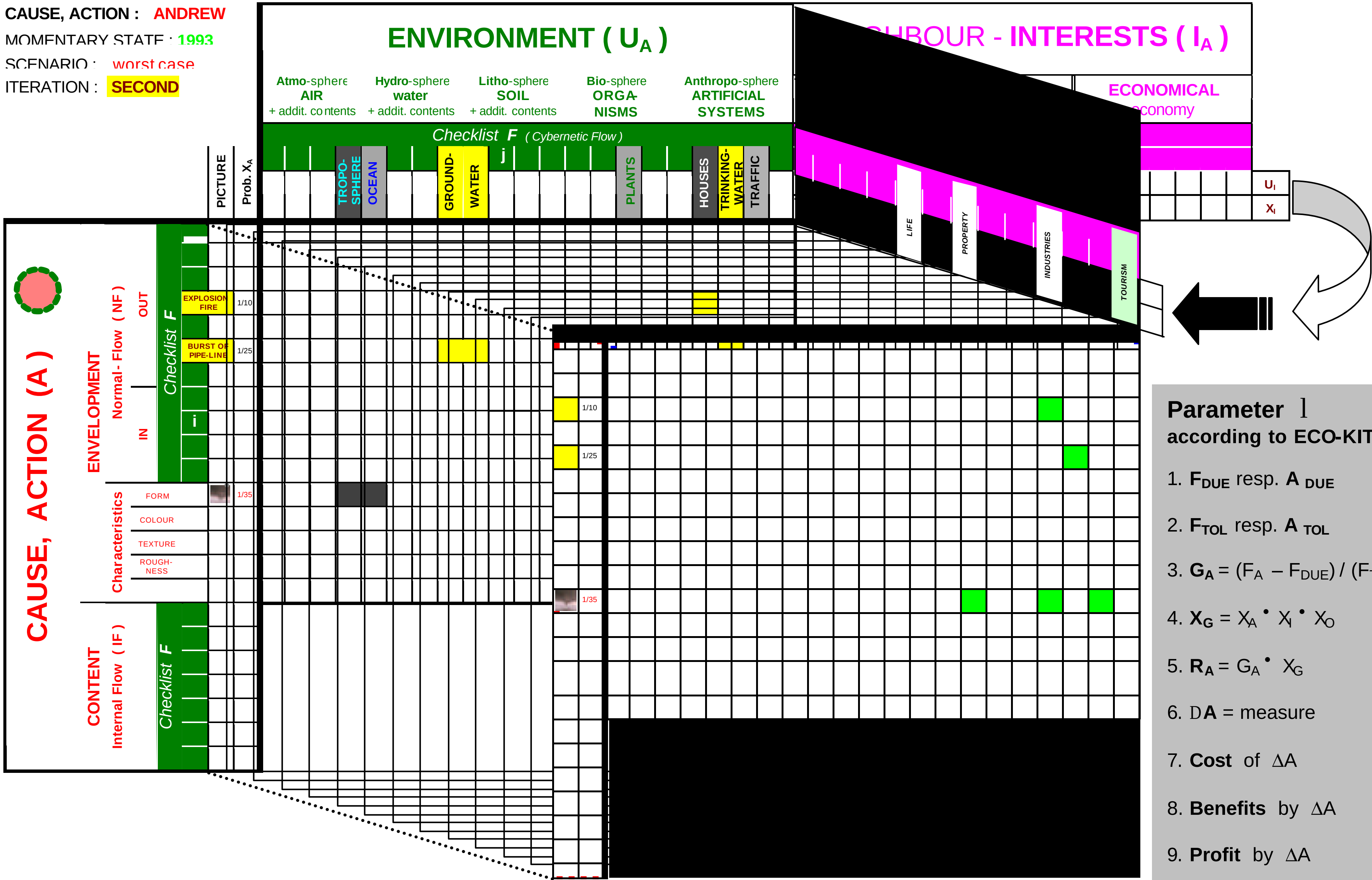


(*) 1 less comfort, because not yet fully recon-structed

2 drinking water deterioration, - pollution

STEP 3.3 : F_A = RE-ACTION on 25.08.92; SECOND Iteration

CAUSE, ACTION : ANDREW
MOMENTARY STATE : 1993
SCENARIO : worst case
ITERATION : **SECOND**



Parameter l
according to ECO-KIT :

1. F_{DUE} resp. A_{DUE}
2. F_{TOL} resp. A_{TOL}
3. $G_A = (F_A - F_{DUE}) / (F_{TOL} - F_{DUE})$
4. $X_G = X_A \cdot X_I \cdot X_O$
5. $R_A = G_A \cdot X_G$
6. D**A** = measure
7. **Cost** of ΔA
8. **Benefits** by ΔA
9. **Profit** by ΔA

STEP 4 : CUBE OF MATRICES for parameter l for 1993