

Sustainability Metrics and Disaster Risk Reduction

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JPJ, 2nd Meeting of EFDRR, Oct. 2011, Skopje, R. Macedonia

1. INTRODUCTION

1.1 Definitions

(a) Risk

$$R = C \cdot P$$

C- consequence, i.e. damage from the event

P- probability of the event

(b) Sustainability

“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”

(Our Common Future, Oxford Univ. Press, 1987)

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(c) Disaster risk reduction (DRR)

“The conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development”

(UNISDR, 2004)

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(d) European Forum for DRR

The first of the six EFDRR “focus areas” reads:

“Increased awareness on disaster risk reduction as an integral aspect of sustainable development ...”

(EFDRR, 2011)

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1.2 Aim

- To explore the applicability of sustainability metrics (indicators and response actions) to disaster risk analyses.
- To extend the corresponding metrics with additional (mental) dimension.
- To discuss some illustrative results for Macedonian condition.

2. SUSTAINABILITY / DISASTER RISK⁷ (S/DR) CORRELATION

2.1 Sustainability metrics

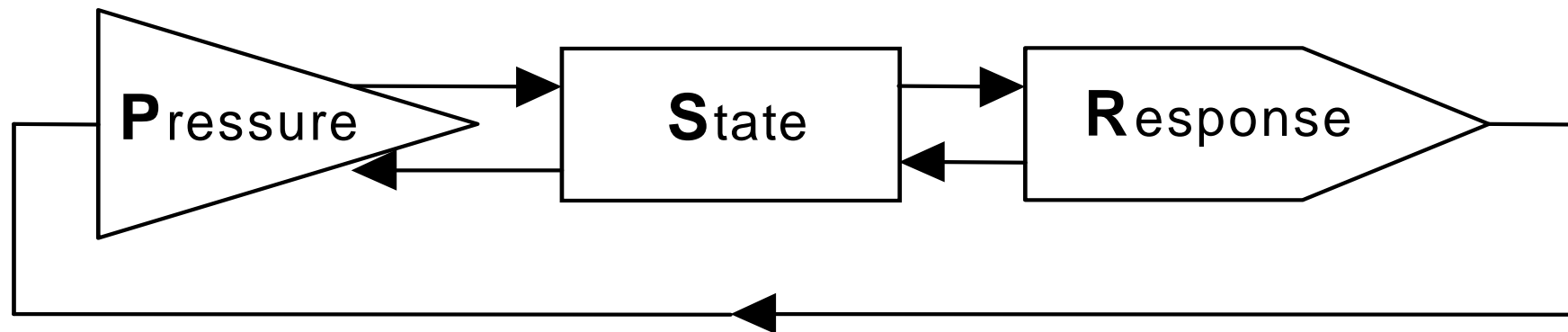
Metrics: sets of relevant measurable entities i.e. indicators (I) and response actions (RA).

ISD: Quantifiable parameters to measure and monitor changes (progress or degradation) in respect to sustainable development, thus signaling challenges or alarms.

RA: Measures to affect positively the indicators.

2.2 PSR model of sustainability metrics

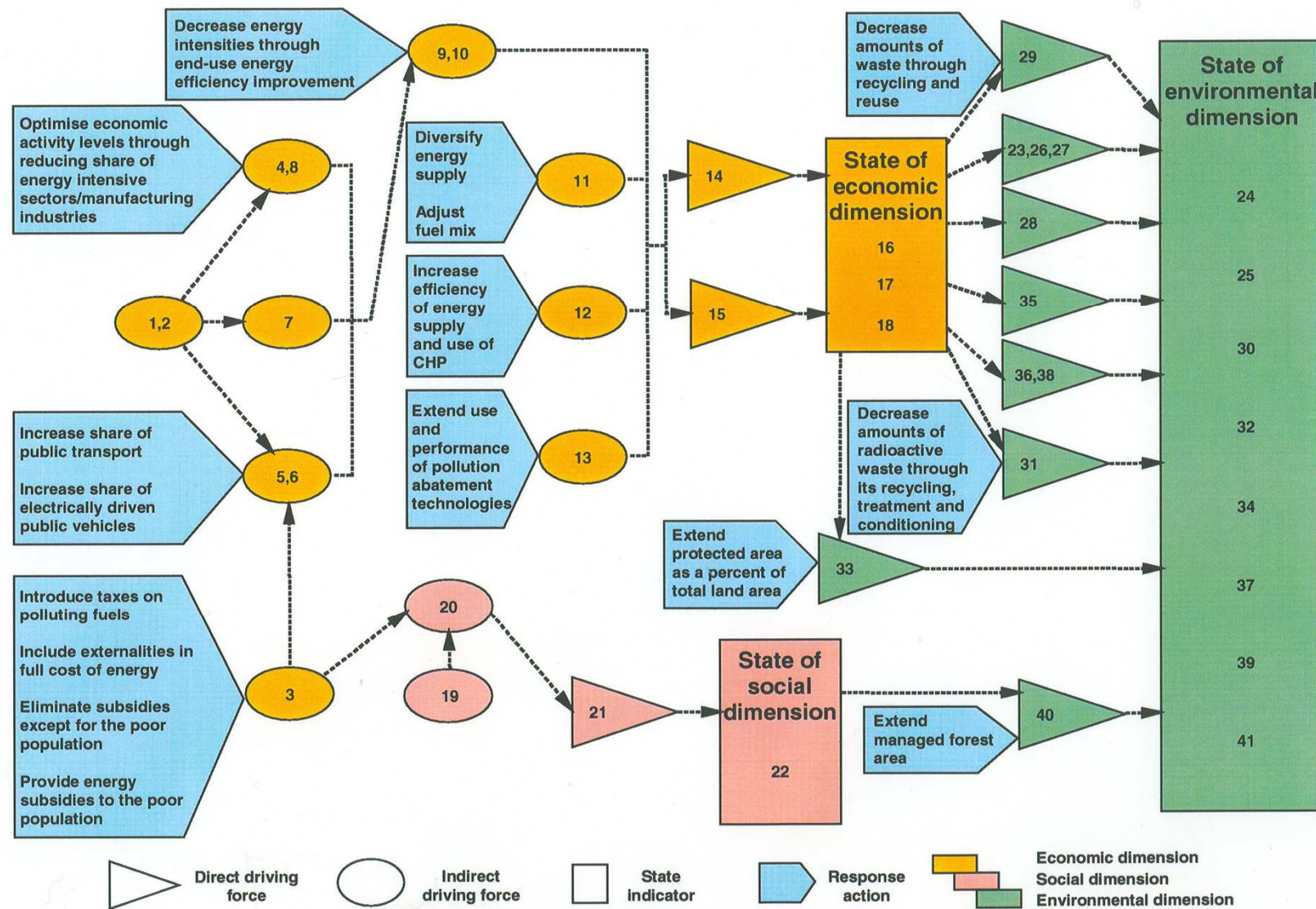
Pressure-state-response (PSR) framework,
as a multifeedback cause-effect pattern.



(Our Common Journey, US NAS, 1999)

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2.3 Common S/DR dimensions and indicators



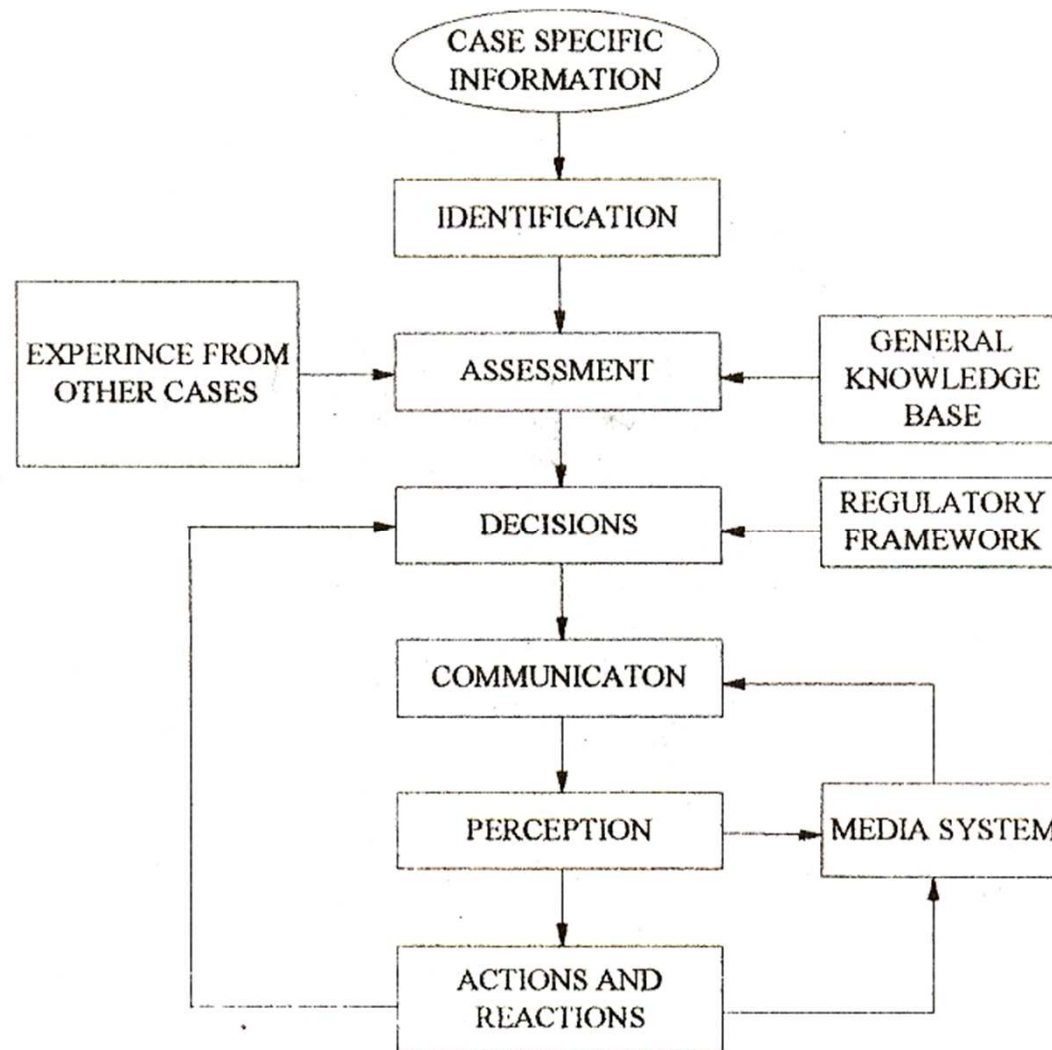
(IEA/IAEA/UNECE. 2001)

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3. RISK MANAGEMENT

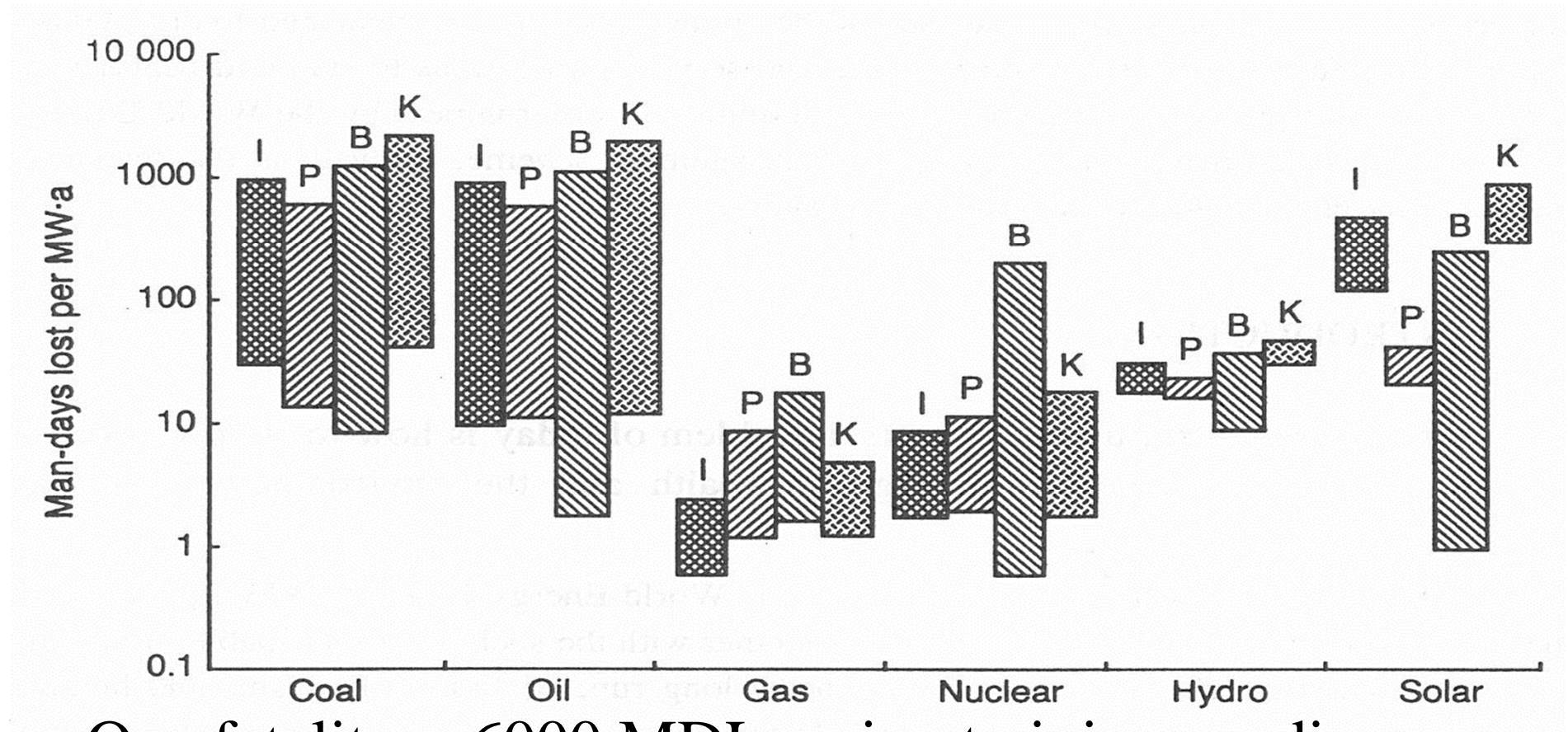
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3.1 Structure of risk management system



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3.2 Comparative health risk assessments



One fatality = 6000 MDL owing to injury or disease

*I – Inhaber, P – Pop-Jordanov, B – Birkhofer, K – Kallas and Papazoglou
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3.3 Fishbein's model of risk perception

$$A = \frac{1}{L} \sum_{k=1}^L \sum_{i=1}^N e_{ik} b_{ik}$$

A – mean attitude of group of people toward a certain object;

L – total number of people in the group;

N – total number of attributes (e.g. consequences);

e_i – mean evaluation of the attribute “ i ” on a desirability scale, from “bad” (-3) to “good” (+3);

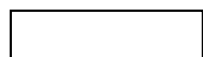
b_i – mean belief that the object (e.g. coal plant) is characterized by the attribute “ i ”, from “false” (-3) to “true” (+3).

Attitude toward coal plants

Attribute	Evaluation e_i -3 3	Belief of belonging b_i 3	Contribution to attitude $(e \times b)_i$ 9
1. Having impact on people's health			
2. Accidents to affect large number of people			
3. Producing dangerous wastes			
4. Being harmful to future generations			



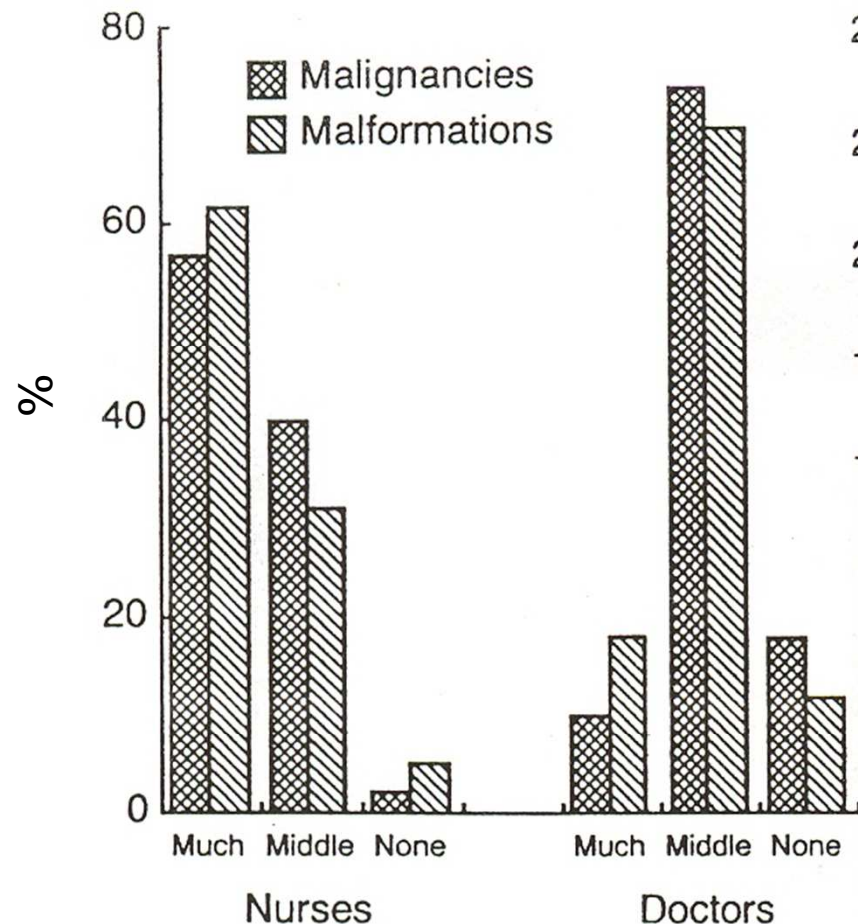
Employees



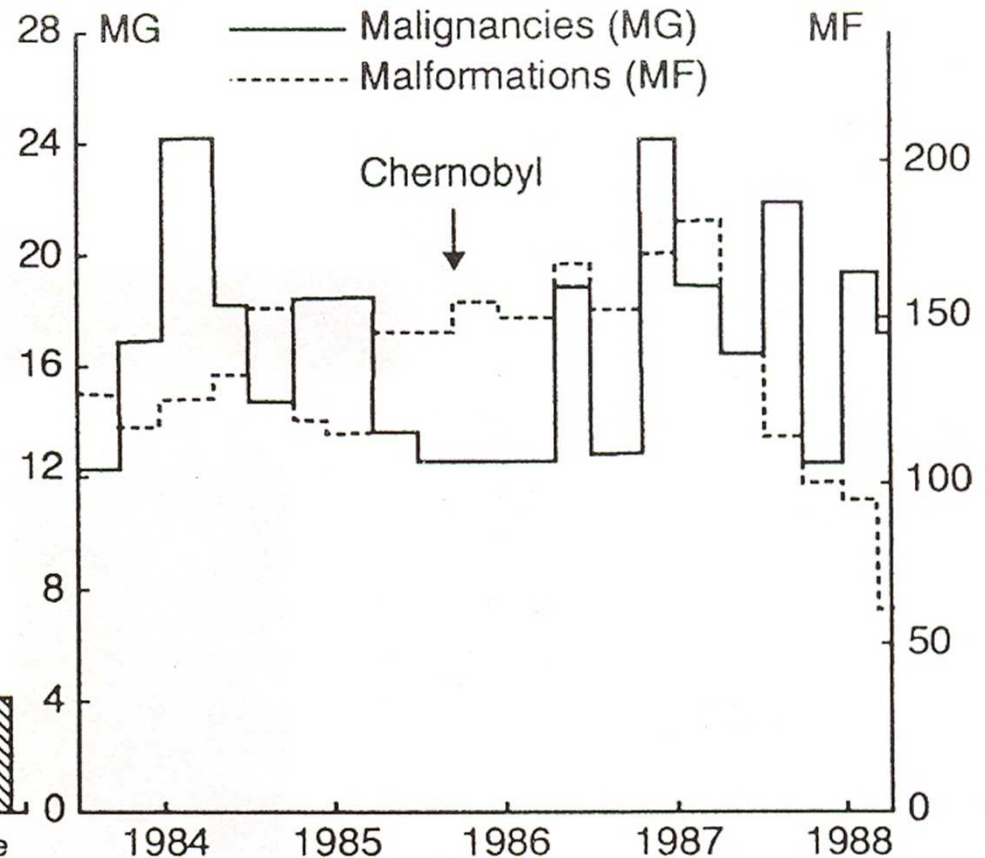
General students

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3.4 Opinions and facts about nuclear radiation



Opinions of pediatric staff in Skopje concerning the increase of malignancies and malformations of children in this region after the Chernobyl accident



Factual incidence of malignancies and malformations of children in the Skopje region before and after the Chernobyl accident

(Pop-Jordanova and Pop-Jordanov, IAEA, 1996)

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4. MENTAL DIMENSION

4.1 Chernobyl one decade later

“Significant health disorders and symptoms, such as anxiety, depression and various psychosomatic disorders attributable to mental stress (but not to radiation) are widespread among the population of the region. These are among the major legacies of the accident...”

(IAEA Yearbook, 1996)

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4.2 Chernobyl two decades later

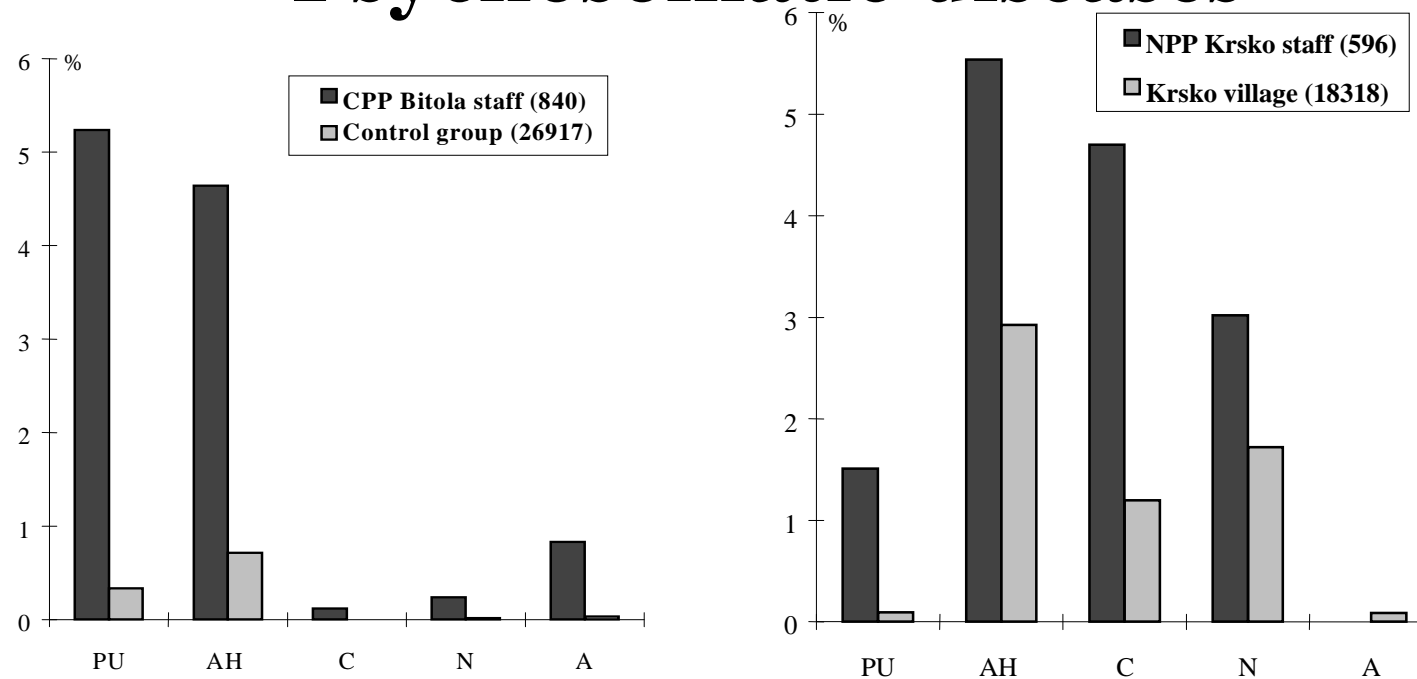
“Alongside radiation-induced deaths and diseases, the report labels the mental health impact of Chernobyl as ‘the largest public health problem created by the accident’ and partially attributes this damaging psychological impact to a lack of accurate information.”

(Chernobyl’s Legacy, UN Report, 2005)

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4.3 Occupational stress \Rightarrow Psychosomatic diseases

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PU - Peptic ulcer AH - Arterial hypertension
C - Colitis N - Neurodermatitis A - Asthma

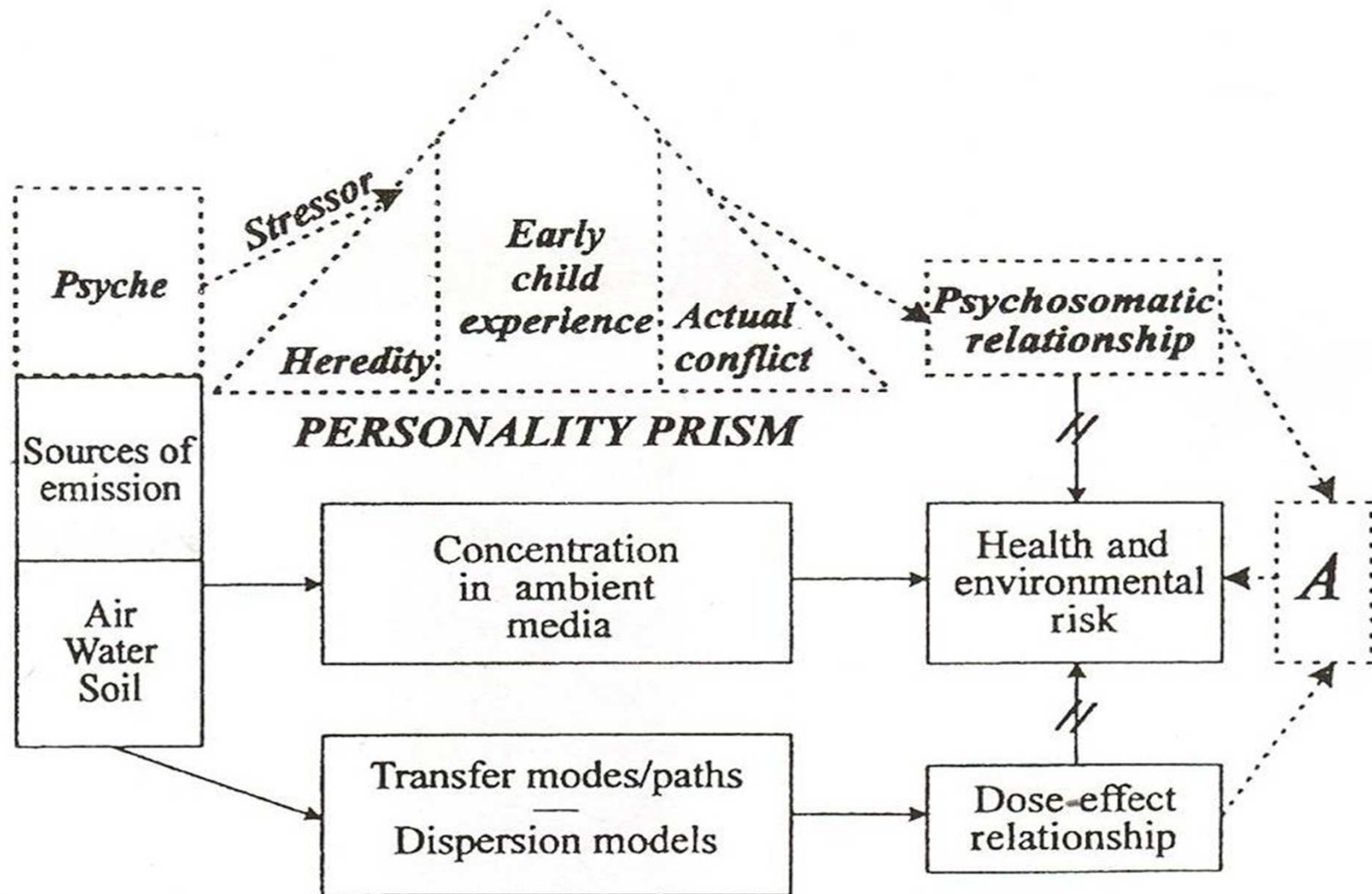
Incidence of psychosomatic diseases due to normal operation of power plants (% of the total number of patients in the group)

(Pop-Jordanova and Pop-Jordanov, IAEA, 1996)

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Modified risk pathway

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Full line: standard; dotted line: extended

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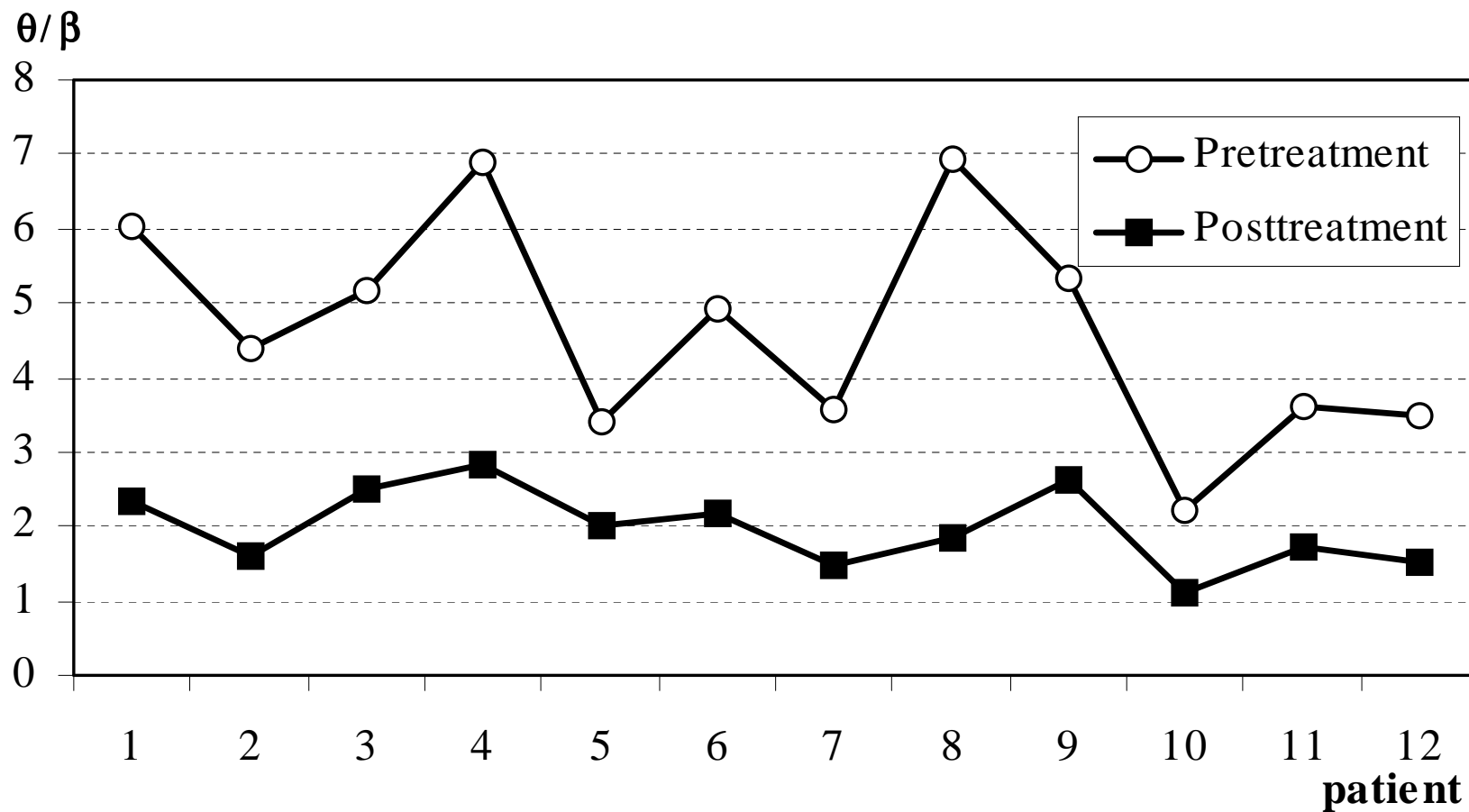
4.4 Information overflow \Rightarrow Organizational attention deficit disorder

Symptoms of OADD:

- An increased likelihood of missing key information when making decisions.
- Diminished time for reflection on anything but simple information transactions such as e-mail and voice mail.
- Difficulty in holding others attention.
- Decreased ability to focus when necessary.

(Davenport & Beck, Harvard BS Press, 2001)

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Mean theta/beta ratio as attention deficit indicator
(*EEG biofeedback treatment, 40 sessions*)

(*Pop-Jordanova et al., 2005*)

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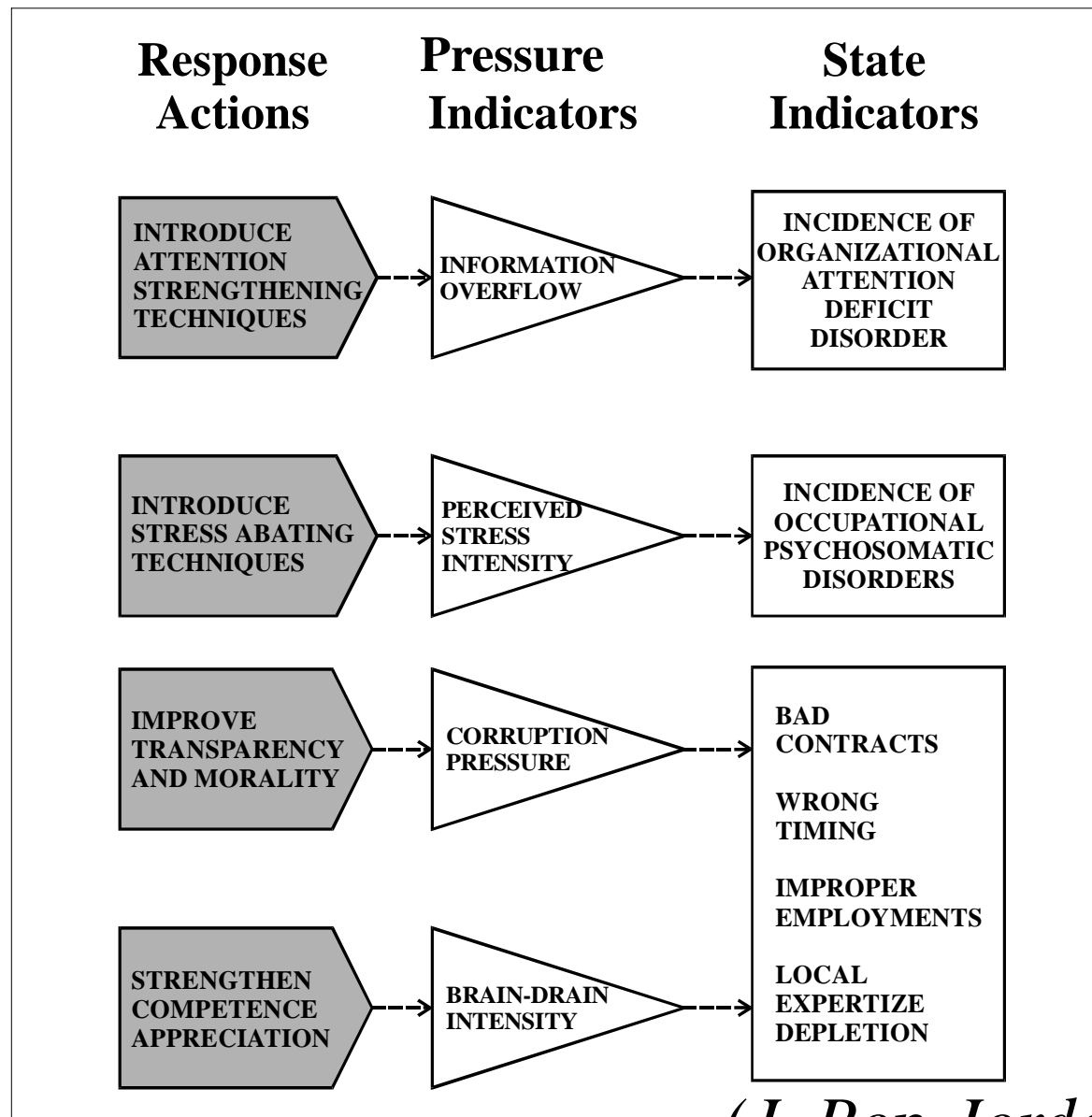
4.5 Corruption pressure \Rightarrow Degraded returns

E.g. detrimental privatization of large plants:

- Non-transparent and controversial sale of companies
- Premature privatization of the national electric power utilities

4.6 PSR Mental metrics

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(J. Pop-Jordanov, 2003)

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4.7 Global responsibility

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“It sounds absurdly, but the problems of cancer and solar power plants would probably have been solved already, if they were promising possibilities for mass human destruction.”

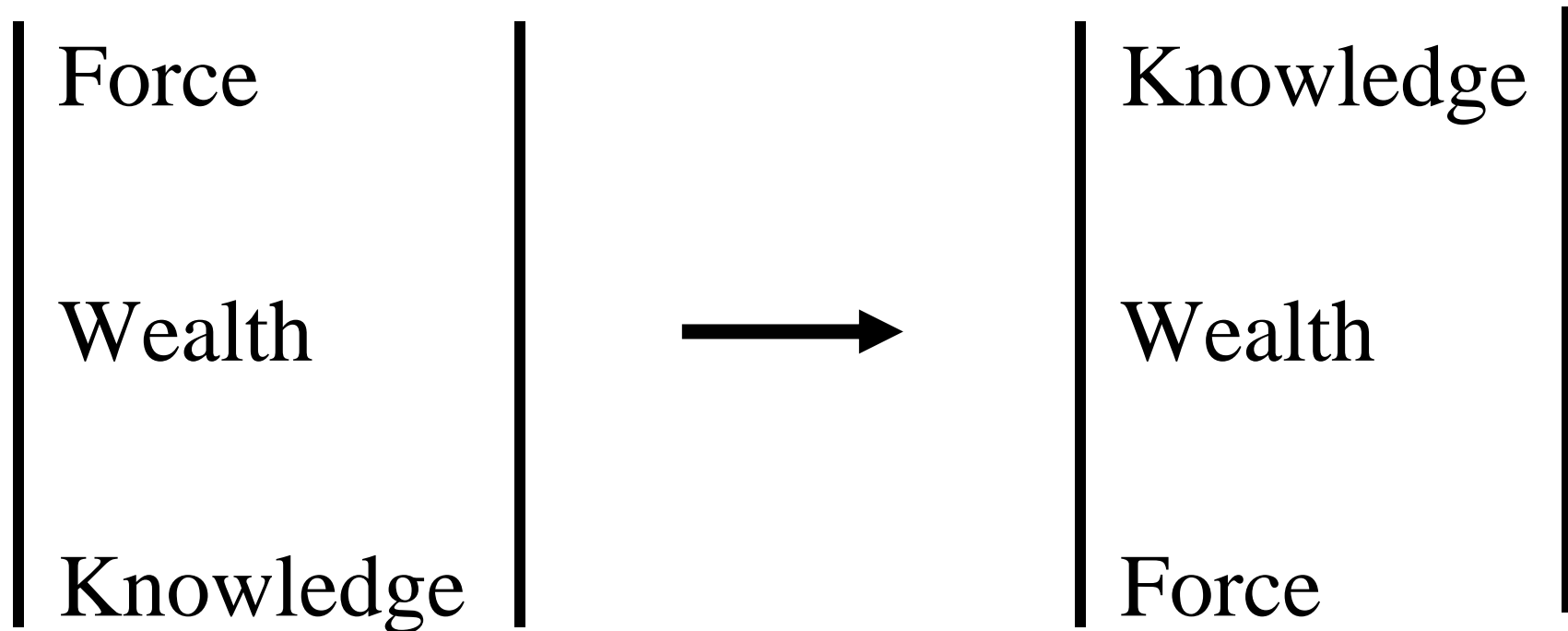
(Pop-Jordanov, 1974)

“Nuclear energy has reached its maturity several years ago; but, how is with our maturity, as individuals and societies, to manage it properly.”

(Pop-Jordanov, 1985)

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A shift in the state of-the-art-and-mind matrix is needed:



5. Conclusions

- In managing the disaster risk, the PSR model of sustainability metrics could be effectively used.

- Thereby, along with the standard dimensions of sustainability (economic, social and environmental), the mental dimension should be also considered.

- In particular, the pressure indicators related to psychological stress, information overflow and corruption pressure, together with the corresponding response actions, should be taken into account.

- Finally, a vision toward global paradigm shift in human values ranking is needed.

References

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- Our Common Future (1987). WCED, World Commission on Environment and Development, Oxford University Press, Oxford.
- UNISDR (2004). Living With Risk: A Global Review of Disaster Reduction Initiatives, United Nations International Strategy for Disaster Reduction, p. 17.
- EFDRR (2011). European Forum for Disaster Risk Reduction, p. 15. www.unisdr.org/europe/.
- Our Common Journey (1999). NAS, National Academy of Sciences, National Academy Press, Washington, D.C.

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- UNECE (2001). Indicators for Sustainable Energy Development, A Collaborative Project, ENERGY/2001/8.
- Pop-Jordanova N, Pop-Jordanov J (1996). Psychosomatic and substitutional effects: comparative health risks from electricity generation. In: Electricity, health and environment, IAEA, Vienna, pp 177-187.
- IAEA Yearbook (1996). International Atomic Energy Agency, Vienna, p. D51.
- Chernobyl's Legacy, UN Report (2005). Chernobyl: the true scale of the accident, World Health Organization www.who.int/mediacentre/news/releases/.

- Davenport HT, Beck CJ (2001). The Attention Economy, Harvard Business School Press, Boston, Massachusetts
- Pop-Jordanova N, Zorcec T, Markovska-Simoska S (2005). Neurofeedback treatment of children with ADHD, Contributions, MASA, XXVI 1: 71-80.
- Pop-Jordanov J (2003). Indicators for sustainable energy development from a negentropic perspective, Original Paper, Clean Techn. Environ. Policy 5, p. 273-278.
- Pop-Jordanov J (1974) Ontoloske, gnoseoloske i aksioloske komponente filozofije u savremenim fizickim i tehnickim naukama, Univerzitet Danas, Beograd, 15, 3: 4, 31-34.
- Pop-Jordanov J (1985). On evaluating risks from energy technologies, Contributions, MASA, VI 2, MANU, p. 81.