Survey and brain storming studies about machines, constructions, human and environmental risk consideration in the careers of the Universidad Politécnica of Madrid

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GIE: RiesgoMat (RiskMetrics)

There have been many research results related to risk assessment during the past several decades. However, practical applications of these remain scarce. The slow growth in interest, particularly in academic studies, in rigorous risk assessment and uncertainty analysis, signals a need to re-examine the risk assessment education to our students.

The Technical University of Madrid (UPM) includes schools and science faculties that are now in a quick EEES Bologna Plan Metamorphosis getting into masters degrees, and doctorate structures. **(Figures 1,2).**

Probabilistic risk assessment (PRA) is one analysis strategy usually employed in science and engineering. This PRA is a systematic methodology to evaluate risks associated with a complex engineered technology entity.

In each engineering field theories were built about hazards scenarios and how to cover for important risks, and engineers must get that the system they handle obtain production with safety for persons and with decent economic results in spite of risks. For that reason, risks must be considered in planning, in realization and in operation, and safety margins must be taken but a reasonable cost.

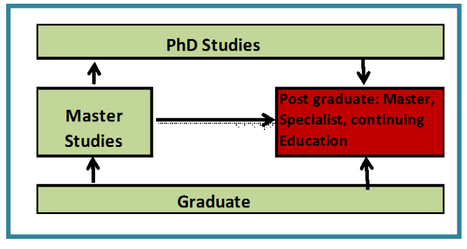

Figure 1

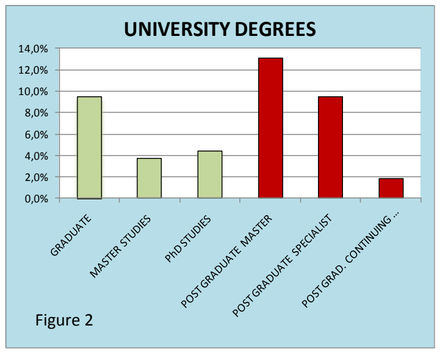

Figure 2

The authors have done and are following field surveys about risks considerations in the careers in UPM, making deep analysis of curricula taking into account the new structures of degrees in the EEES Bologna Plan, and they have considered the risk structures offered by diverse schools of Decision Theories.

	UNIVERSITY DEGREES	RISK SUBJETS	%
GRADUATE	84	8	9,5%
MASTER STUDIES	54	2	3,7%
PhD STUDIES	45	2	4,4%
POST GRADUATE MASTER	84	11	13,1%
POST GRADUATE SPECIALIST	116	11	9,5%
POST GRAD. CONTINUING EDUCATION	269	5	1,9%
TOTAL	652	39	6,0%

DISCUSSION

Even considering that the UPM is, essentially, a group of engineering colleges, as we can see above authors have found out that only a few schools have included uncertainty analyses and risk assessment courses in their curricula. However risk is partially considered in diverse technical subjects into procedures for evaluation of hazards for planning and design, or of quality control, and into studies of demand.

Maybe this little interest to teach uncertainty analysis in the university curricula is due to the way risk assessment education is delivered, as many direct engineering applications are first studied and solved in deterministic ways, and risks for the real wide applications are handled in different specific ways, such as in planning, design, construction, operation and management.

Recognizing the importance of this issue, the UPM with the Ministry or Rural and Marine Environment have created the CEIGRAM, whose activity is oriented to development and innovation, diffusion and training in the scope of agricultural and environmental analysis and risk management. These risks for farms are climatic, and also from plagues and diseases, and from instabilities in markets that are in CE commercial systems and linked to others. These risks are followed and moderated for a third of agro production volume through a Spanish Agro Insurance system and model. There are varied Soils and Climates, and risks with water are in part controlled by dams and canals. At longer term risks depend on evident climatic changes, disposable crops, soil conservation and also on markets regulations and demand.

SOME REFERENCES

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CONCLUSIONS :

The authors recommend to improve the teaching about risk, and that may include subjects especially oriented for each career, school or faculty, including elaboration and presentation formats, using probabilistic models and estimations, and adapted multi-criteria decision models.

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SOME ANALYSIS

In UPM risk is partially considered in diverse technical subjects of main importance. To have sound engineering mental schemas direct engineering applications are studied and solved in deterministic ways, linked to Physics, Chemistry, and Natural Sciences, and to the state of art in production and services. Risk and uncertainties exist, and at first safety conditions are kept by quality control schemas, and by taking positions in a safety side using correct models, as for machines or for constructions, with enough safety margins as with small safety coefficients.

Adaptation to reality, in planning, construction, production and operation must consider risk properly, and that has procured diverse formats to consider important risks of natural or human origin. Omission of a severe risk prevision can cause a catastrophe, such as a fall of building or dam by a main structural error, accident in transport as with aeroplane or ship (Titanic...), not envisaging tsunamis for nuclear reactors, etc ....

Some effects and hazard scenarios, human or natural, are uncertain but are considered by cautious design or safety margins, or by safe uses in construction sites or in use of machines, equipments and vehicles and lines for transport, or for energy, nuclear, etc .... The action of weather, rivers, waves in coasts, is risky but is studied by measures and probabilistic models calibrated from data from permanent stations. Risk in technical business comes also from real changes in markets, products and prices, that depends on evolutions sometimes sudden, also from financial macro-economy as in recent years (from 2011), and from population and history as in North Africa now, or by environmental degradations, extinction of resources or natural or human induced climatic changes. Planning for urbanism and traffic used several scenarios to evaluate profit from new projects of roads or train new systems that also are multi-criteria from economy, environment and acceptation.

Several fields would beneficiate from special teaching of subjects for considering and handling with risk, incorporating formats of Decision Theories that use diverse Operations Research instruments, which must be intended or applicable to real applications in the studied Degree. That includes if risk and costs are relevant models with possible scenarios having elicited subjective probabilities, or measured if possible, may be with subjective utility functions, and/or multi-criteria decision methods such as discrete MCDM, if costs are considered against environment.

For the especial scopes of the ETS of Agro Eng. of UPM and of the related CEIGRAM, the risks are agricultural and of related agricultural analysis. The corresponding Ministry groups now the administration for Agriculture that includes crops and cattle, phishing with aqua-cultures and food, being with EC Commission in Brussels, and forests that now depend in part of the 17 Autonomías and that include a diversity of natural reserved areas with various status, having their special risks such as fire. That Ministry includes environment, the rivers grouped in Confederaciones for main basins and other grouped areas, with the policies for use of water, and marine coasts and harbours.

Spain has varied quite irregular climates in rather different regions, with valleys through plateaux surrounded by chains of mountains that collect much of rains, with river flows regulated by systems of dams and canals.