Tutorial title: **Methodology of Measurement**

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Abstract

Measurement is a complex activity, far more complex than suitably connecting and reading an instrument. Broadly speaking, any measurement, regardless of the field of application, can be regarded as a bridge between the empirical world and the information world. Its role is to provide objective and inter-subjective information about properties of empirical objects, phenomena or events.

In the tutorial the features characterizing an information acquisition and representation process as measurement are presented and discussed.

The acquisition of information about physical quantities by means of sensors historically fostered the interpretation of measurement as a merely experimental activity. Conversely, measurement always requires suitable descriptive activities to be performed prior of the execution of experimental activities to ensure both their correct implementation and the interpretation of the obtained information.

A conceptual framework highlighting the various activities involved in a measurement is illustrated and analyzed. In such a framework, synthesized in Fig.1, measurement is envisioned as a three-level hierarchically structured process constituted of stages (planning, execution and interpretation), each one composed of activities performed through multiple tasks. A loose temporal sequence drives the execution of tasks (black arrows in the diagram), but the systematic presence of feedback (white arrows) emphasizes the complexity of the whole process.

The framework is based on the following widely accepted assumptions:

- measurement is not a self-motivating activity, but it is rather a goal-driven process: obtained information is usually employed as relevant input when deciding the best actions to be performed to achieve established goals, while satisfying given conditions;
- any empirical property can be, in principle, measured by performing logically equivalent steps;
- models are unavoidable in measurement, and they are co-determined by the measurement goals.

The conceptual framework depicted in Fig.1 can be very useful for the accomplishment of methodologically correct measurements of physical or non-physical quantities.

Some practical examples will be provided to show the effectiveness of this approach.

At the end of this tutorial the attendee will be able to answer such questions as: Which informative empirical processes can be considered measurements? How do I determine an adequate model for my measurement? How do I estimate the quantity of information I achieve through measurement?

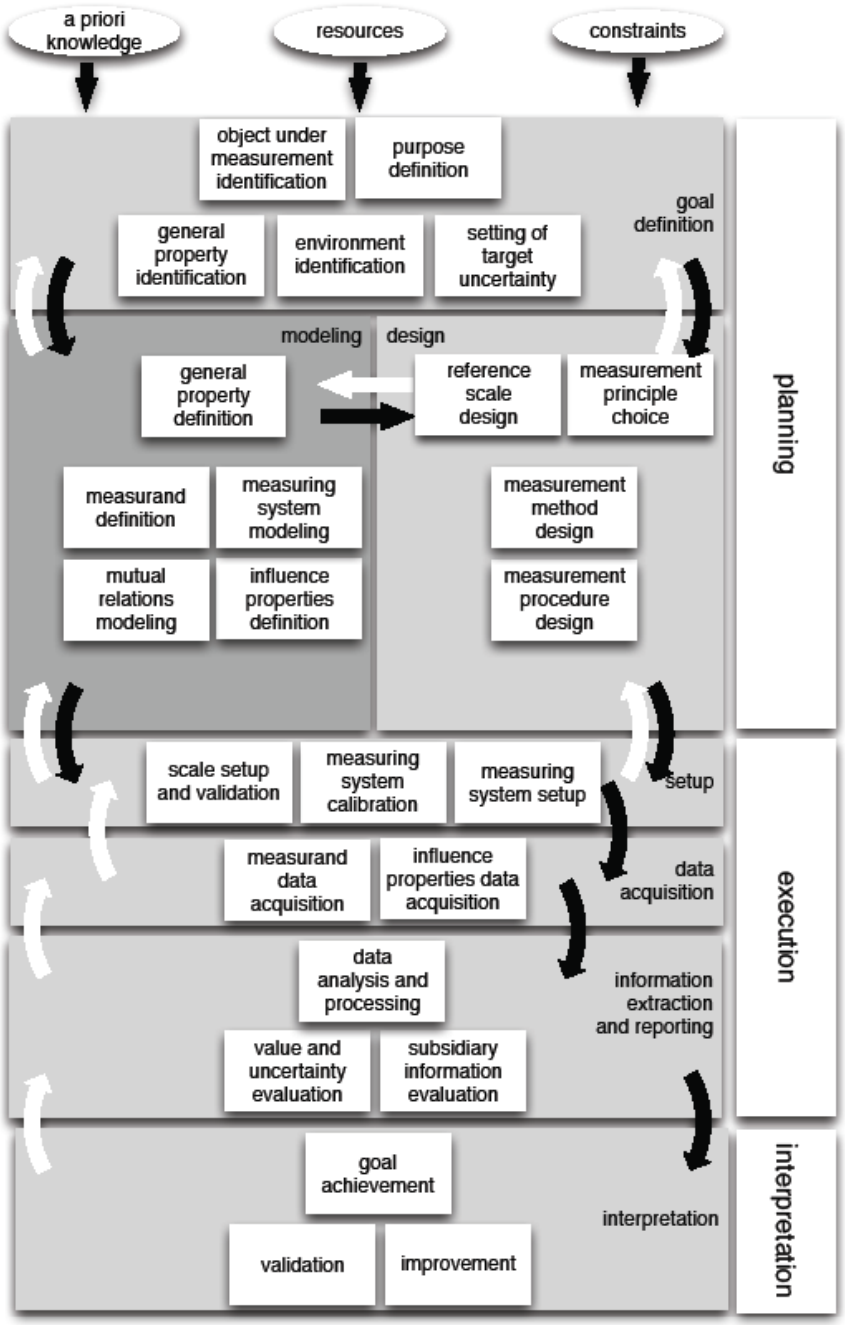

Fig.1. Model representing different activities involved in a measurement