

# FUNDAMENTALS OF MEASUREMENT THEORY

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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 symbolic world. Its role is to provide quantitative information – called measurement result - to symbols representing predefined empirical quantities.

To perform any measurement process we have to accomplish both conceptual and experimental activities. Indeed, descriptive activities are always required to ensure a correct implementation of experimental activities and interpretation of the obtained results.

A measurement model can be drawn, in which different conceptual processes and feedback paths are explicitly identified, as shown in Fig 1. This model is based on the widely accepted assumption that any measurement is not a self-motivating activity, but it is rather a goal-driven process. Indeed, the measurement results are often employed as relevant inputs in a decision-making activity aimed at identifying the best actions needed to achieve established goals while satisfying given conditions.

Fig. 1 show also that before performing experimental activities we need to identify and to model the measurement context, that is the measured object, the measurand, the measurement environment, the measuring system and the measurement method.

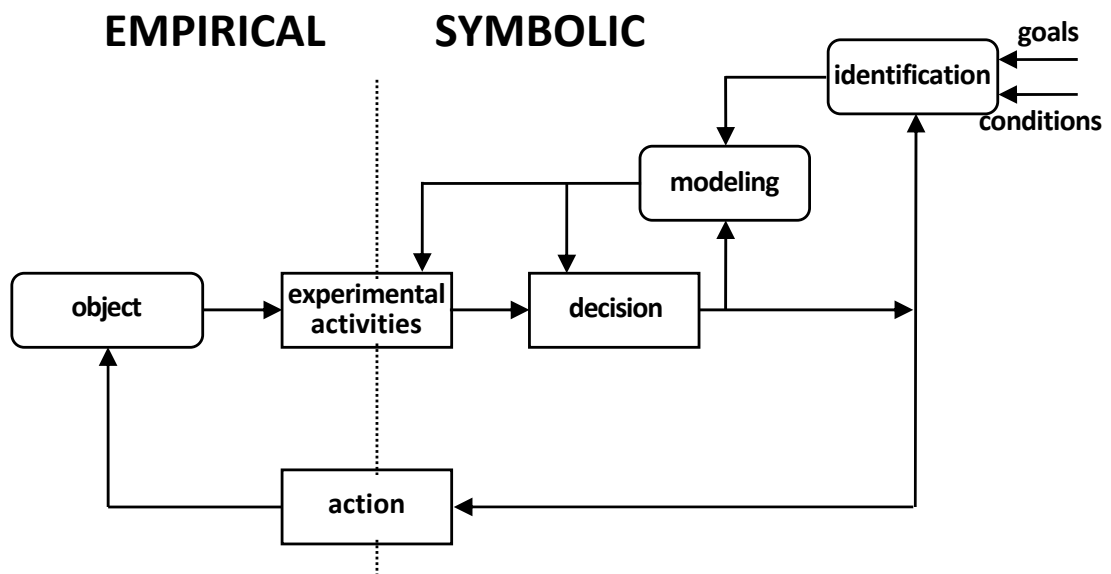


Fig.1. Model representing different activities involved in a measurement

The conceptual framework depicted in Fig.2 is very useful for supporting methodologically correct measurements of both physical or non-physical quantities. In particular, the modern concept of measurement uncertainty is analyzed in detail in the tutorial by referring to the Guide to the expression of uncertainty in measurement (GUM).

At the end of this tutorial the attendee will be able to answer such questions as: what is a measurement? How do I determine an adequate model for my measurement? How do I estimate the limits of the information I achieve through measurements?

### **Target audience**

The target audience of the tutorial are graduated students and researchers in the different scientific and engineering fields who want to approach measurements with a solid theoretical background.

### **Biography**

Dario Petri received the M.Sc. degree (summa cum laude) and the Ph.D. degree in Electronics Engineering from the University of Padova, Italy, in 1986 and 1990, respectively. From 1990 to 1992 he was an assistant professor at the Department of "Electronics and Information Engineering" of the same University. In 1992 he joined the University of Perugia, Italy, as an associate professor. He has been elevated to full professorship of Measurement and Electronic Instrumentation in 1999. In 2002 he joined the Department of "Information Engineering and Computer Science" at the University of Trento, Italy, where he was the chair of the International Ph.D. School in "Information and Communication Technology" from 2004 to 2007 and the chair of Information Engineering study programs from 2007 to 2010. At present he is the head of the Department.

Dario has chaired the Italy Chapter of the IEEE I&M Society from 2006 to 2010. Currently he is the Vice Chair of the IEEE Italy Section. Also, he has been a General co-chair of the summer Ph.D School "International Measurement University" (IMU) of the IEEE I&M Society from 2008.

Dr. Petri is an author of over two hundred papers published in international journals or in proceedings of peer reviewed international conferences. He is an Associate Editor of the IEEE Transactions on I&M and a Fellow member of the IEEE.