

## 2.2 *A source of interdisciplinary research: new scientific problems and problems external to traditional disciplines.*

A useful approach to analyse the characteristics of interdisciplinary research focuses on the nature of the matters it tries to address. Interdisciplinary research typically deals with new problems, which, as such, do not necessarily fall into any pre-existing discipline; these are called exodisciplinary problems (Popper, 1963). Said new exodisciplinary problems are sometimes formulated by scientists based on their sheer intellectual curiosity, but they can also originate from outside the scientific community. This happens very often when scientific research has to find answers to questions arising from the needs of the state (which are frequently military needs), of the industrial sector, or of society in general. An example of this is the issue addressed by the Manhattan Project. The growing drive created by the needs of the state, of the industry, and of society leads to the ever higher occurrence of interdisciplinary research. This phenomenon tends to counterbalance, at least partially, the tendency towards a more and more fragmented disciplinary organisation of science and is opposed to the tendency towards specialisation in scientific work, which has characterised the last few decades. By its very nature, interdisciplinary research concerns new and complex problems, which can be solved thanks to the efforts of experts in natural science as well as technologists, scholars specialising in social science as well as researchers in the field of humanities. Situations of this kind often arise when the protection and enhancement of cultural heritage is concerned, as this matter involves

scholars from several disciplines: scientists and technologists in relation to restoration and preservation techniques; economists in relation to the promotion of cultural assets, the calculation of their value and of the costs society must bear to protect them; and experts in humanities in relation to the artistic and social content of cultural heritage.

## 3. INDICATORS FOR THE QUANTITATIVE MEASUREMENT OF INTERDISCIPLINARY RESEARCH.

### 3.1 *Similarities to measurement issues in disciplinary research.*

A procedure to measure and assess interdisciplinary research suited to acting as the basis for rational policies should obviously include quantitative methodologies, which are, by nature, more objective and allow policy makers to evaluate with greater transparency the effectiveness and efficiency of measures that have already been adopted or are about to be implemented. Many of the procedures and principles used in the measurement and quantitative assessment of interdisciplinary research are similar to the methodologies usually followed within the field of mono-disciplinary research (Klein J.T., 2008). Therefore, also in the case of interdisciplinary research, it is possible to use input and output indicators that are common in the measurement of research in general (Anzai et Al., 2012). For instance, the results of interdisciplinary research can be measured by counting the number of publications (and citations generated) arising from research activities concerning interdisciplinary issues performed either by a single scholar or by a group of scientists. It is also possible to