usually use managing indicators such as number of patents filed, number of licenses granted and earnings from royalties. This shows that the financial benefit is the main objective of the enterprise. If making the technology available to society in general were the objective of universities, they would put any generated knowledge in the public domain and allow others to use and improve upon that technology. Even if high investment is needed to put the invention in the market and we assume that patents facilitate putting inventions to use, third parties may still have the possibility to patent manufacturing process or specific uses of such technology in a way that investing in commercialization is also promoted.

However, much of the knowledge generated by universities is widely disclosed and placed in the public domain, as they are able to appropriate the benefits of research only to a limited degree, and only a limited portion of such knowledge in the field of nanotechnology can be patented. That knowledge, considered as valuable by the market, may include basic laws of physics or chemistry but also, and most importantly, the description of mechanisms and theoretical foundations on why nanostructures enjoy different properties compared to equivalent normal sized structures and the models and methodologies to predict such behavior.

It is strange that open patent licenses, similar to those now popular for software, are not widely used by more universities and publicly founded research projects teams. In any case, it is clear that people and organizations working in basic research have less control on how that information is later exploited, whether to impede its use or to oblige developers of new technology incorporating that knowledge to allow its use under an open license.

3. Non patentable knowledge

According to the EPC, there is no requirement for the applicant to explain why the invention works or to provide a theoretical model to allow the public to understand the functioning of the invention. The only requirement regarding disclosure is to include in the patent description the information needed to allow a person skilled in the art to put the invention at use.[30] In this way, much information related to the invention stays out of the patent document. However, in some cases the applicant may be forced to disclose the theory behind the invention to fulfill the disclosure requirement. EPO's case law indicates that "if the invention seemed, at least at first, to offend against the generally accepted laws of physics and established theories, the

30 EPC, Article 83, Disclosure of the Invention, requires that "the European patent application shall disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art".

disclosure should be detailed enough to prove to a skilled person conversant with mainstream science and technology that the invention was indeed feasible (i.e. susceptible of industrial application)."[31] This decision may demand a stricter requirement of disclosure from the applicant in cases where theories and scientific laws are not yet well established, as may be the case of nanotechnology, requiring the applicant to disclose more information in order to allow others to reproduce the invention. It should be noted however, that the mentioned requirement may be closely related to the disclosure and the industrial applicability requirement and the applicant may need to include the information on the functioning of the invention to prove the industrial applicability of it, in addition to the requirement of Article 83. In line with this idea, and also on the point of industrial applicability of scientific knowledge to be considered a patentable invention, the Technical Board of Appeal at the EPO (TBA) ruled that "In cases where a substance […] was identified, and possibly also structurally characterized and made available through some method, but either its function was not known or it was complex and incompletely understood, and no disease or condition had yet been identified as being attributable to an excess or deficiency of the substance, and no other practical use was suggested for the substance, then industrial applicability could not be acknowledged. […] Even though research results might be a scientific achievement of considerable merit, they were not necessarily an invention which could be applied industrially."[32] This case shows that the EPO may oblige the applicant to disclose the information needed to understand the functioning of complex invention to consider them patentable, a requirement that is not essential in some other fields of technology.[33] What impact do these criteria have on patentability of nanotechnology?

One of the reasons nanotechnological inventions are so revolutionary is because they open a new world of properties not available under the law of physics recognized for normal scale matter. In some cases these properties seem to be against the generally accepted laws of physics and established theories, meaning that if it is necessary for the public to reproduce the invention, the results of the basic research would be necessary to be disclosed. In this way, in order to fulfill the disclosure requirement, a nanotechnological invention needs to be described in a detailed way, including an explanation on the basic functioning of the invention, explanation that may involve the disclosure of basic non-patentable knowledge. This means that even when disclosed, the basic general scientific knowledge that made the invention possible to work would not be allowed to be protected or included in claims of the patent but requested to be disclosed to allow others to reproduce the invention. These facts may cause the applicant to choose different protection

31 T 870/04.

32 *Id.*

33 This issue is further discussed in Chapter V "Industrial Applicability" of this Thesis.

methods, for example trade secrets in combination with patents, to cover the different aspects of the invention.

It is interesting to note the position of the US Patent & Trademark Office (USPTO) in this respect. The USPTO does not require the applicant to explain why the invention works but only to disclose the invention in a complete way, including the best mode known by the inventor at the moment of filing, to allow others to reproduce the invention.[34] While both approaches, USPTO and EPO, may appear similar in theory, perception on the completeness of disclosure to allow the person skilled in the art to reproduce the invention may vary. This variance may be present among different technology fields related to nanotechnological inventions.[35] Consequently, depending on the jurisdiction, applicants may be allowed to avoid disclosing important knowledge about the theory behind the invention or in other cases applicants may be forced to disclose more than that which is standard in other technology fields.

In cases where disclosure of basic knowledge is not necessary to comply with the disclosure requirement, researchers may decide not to disclose this new and inventive but non-patentable knowledge until they develop a range of useful applications to have the possibility to get patents and assure more control over a technology of general applicability. In this way, the researchers may decide to keep the knowledge secret until the most promising patentable applications have been patented. Even after that, if the knowledge is valuable enough and the disclosure requirement is low, they may decide to delay the disclosure of the information. The appropriate strategy to follow will depend not only on the researcher and the institution (not all researchers are interested only in the inmediate economical benefit of their research, many others base their reputation and carrier on scientific publications) but also on the future development by the EPO of the disclosure requirement threshold in the nanotechnological field.

To summarize, the system appears designed to reach a balance between excluding from patentability the basic and general information that is susceptible to use as fundamental general knowledge, for example scientific theories, and at the same time to allow patents on the application of those concepts provided that they are useful and have a technical character, even if they can be applied in general and various fields. It is of value to draft legislation that can be flexible enough to

34 *See*, In re Cortright, 165 F.3d 1353 (Fed. Cir. 1999). Nevertheless, note that the disclosure requirement, as defined in 35 U.S.C. §112, requires the applicant to provide a written description supporting the claims of the patent, the disclosure of the invention in a complete form to enable a third party to reproduce the invention and the disclosure of the best mode known by the inventor at the moment of filing the patent application. Also in the US, these requisites may be more difficult to fulfill in the case of nanotechnological inventions.

35 Wagner, R. Polk, *Of Patents and Path Dependency: A Comment on Burk and Lemley*. Berkeley Technology Law Journal, Vol. 18, p. 1341, 2004.

consider particularities and complexities of each field of technology, but when this flexibility is created by the unclear definition of terms like the distinction between *invention* and *discovery*, the interpretation of the patenting rules, in hands of the administrative authorities, may be based on arguments out of policy considerations and in this way, the system may be jeopardized in a way contrary to the objectives that it pursues.

4. Ethical concerns on nanotechnology and the impact on patentability issues

Discoveries are not the only subject matter excluded from patentability. According to EPC "[…] patents shall not be granted in respect of inventions the commercial exploitation of which would be contrary to *ordre public* or morality […]".[36]

Some products incorporating nanotechnological inventions have started to raise concerns on risks for the health of the people exposed to those materials. Nanoparticles is an area of main concern, for the reason that they can penetrate into the gas exchange region of the lungs, impeding in some cases the organism to defend against the presence of the strange substance.[37] Self-duplicating nanorobots, are also mentioned as a future concern from an environmental perspective, even when these devices are far from reality today.[38]

Environmental and public health concerns that may appear in connection with nanotechnology resemble the European experience with asbestos.[39] Learning from the experience of this case, some commentators believe that "consumers are involuntarily exposed to unlabeled nanomaterial ingredients in products, without being informed of potential risks [whereas] nanomaterials are disposed of and released into the environment despite unknown impacts and inadequate means to

36 EPC, Article 53(a), Exceptions to patentability. This provision is in line with TRIPS Agreement, Section 5, Article 27, Paragraph 2. TRIPS Agreement allows members to exclude from patentability inventions in order to protect " […] *ordre public* or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment […]".

37 *See,* Commission de l'Ethique de la Science et de la Technologie, Ethic, Risk and Nanotechnology: Responsible Approaches to Dealing with Risk, 2008.

38 *Id.*

39 Asbestos is the name given to a group of naturally occurring minerals. This product was broadly used during decades as thermal insulator in buildings, to find later the high risk of disease the material causes for people exposed to it, obliging to invest millions in isolating or replacing the textile from all buildings. For example, the EPO headquarters, along the Isar river in Munich, Germany, was partially closed for the period 2008-2010 for asbestos removal.