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Ethical and Social Implications of Nanotechnology

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Abstract:

In this paper we discussed the impact of nanotechnology and fundamentals of nanotechnology and some expectations about its social significances, environmental effects, health effect and the ethical issues, it rises the outcomes are shortened in numerous themes related to the economic social field. Society is at the beginning of a revolution that will renovate the customs in which materials and products are created. The opportunities that will develop in the future will depend significantly upon the ways in which a number of challenges are met. As we design systems on a nanoscale, we develop the capability to redesign the structure of all materials natural and synthetic along with think again the new opportunities of the re-establishment of any and all materials. Nanoparticles are more toxic in comparison to the bulk chemicals because due to the increased surface to volume ratio the number of molecules present on the surface also increases that enhances the intrinsic toxicity. Few articles dealing specifically with ethical reflections of nanotechnology have been published so far does not imply that the ethical discussion of nanotechnology needs to start from scratch. And to establish this, nanotechnology can draw on matters already considered by researchers within the area of ethics and by ethical boards. It is argued that an inspiring approach to the ethics of nanotechnology is supposed to claim that a restricted number of simple ethical principles are mostly accepted. Society is at the threshold of a revolution that will transform the ways in which materials and products are created. About two million workers will be employed in nanotechnology industries and three times that many will have supporting jobs. Despite the many benefits of nanotechnology, there are potential risks and ethical issues involved in its implementation. There's a concern that some nanoparticles could be toxic because elements at the nanoscale behave differently than they do in their bulk form and these particles could easily cross the blood-brain barrier. Thus, it completely depends upon us that we use this technology as a bliss or curse.

Keywords- *Nanotechnology, Revolution, Ethics, Bliss, Curse, Challenges.*

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Introduction

The branch of technology that deals with dimensions and tolerances of less than 100 nanometers, especially the manipulation of individual atoms and molecules and nanotechnology is a method involving manipulation of matter at the atomic and molecular scale; seeing matter at the atomic and molecular scale, and taking advantage of the unique capabilities and properties of structures fabricated at the atomic and molecular scale. In short, nanotechnology refers to the convergence of several disciplines and applied technologies dealing with particles and structures having dimensions in the range of a nanometer.

How it started

The ideas and theories after nanoscience and nanotechnology taking place with a talk titled "There's Plenty of Room at the Bottom" by physicist Richard Feynman at an American Physical Society meeting at the California Institute of Technology on December 29, 1959, long before the term nanotechnology were used. In his talk, Feynman described a process in which scientists would be able to manipulate and control individual atoms and molecules. Over a decade later, in his explorations of ultraprecision machining, Professor Norio Taniguchi coined the term nanotechnology. It wasn't until 1981, with the development of the scanning tunneling microscope that could "see" individual atoms that modern nanotechnology began**. (www.non.gov.)**

As we design systems on a nanoscale, we develop the capability to redesign the structure of all materials–natural and synthetic–along with rethinking the new possibilities of the reconstruction of any and all materials. Such increases in design power present significant social and ethical questions. To support sustainable, ethical, and economic nanotechnological development, it is imperative that we educate all nanotechnology stakeholders about the short-term and long-term benefits, limitations, and risks of nanotechnology. Nanotechnology, like its predecessor technologies, will have an impact on all areas. For example, in healthcare, it is very likely that nanotechnology in the area of medicine will include automated diagnosis. This, in turn, will translate into fewer patients requiring physical evaluation, less time needed to make a diagnosis, less human error, and wider access to healthcare facilities. And, with nanomedicines, if the average human lifespan increases, the larger number of elderly persons requiring medical attention will likely result in increased health expenditures.6 It is essential for nanotechnology stakeholders to strive to achieve four social objectives **(Khan 2015).**

It has to to be clear on what nanotechnology is before we can appreciate the ethical and social questions that arise therein. Nanotechnology is a new category of technology that involves the precise manipulation of materials at the molecular level or a scale of approximately 1 to 100 nanometers – with a nanometer equaling one-billionth of a meter – in ways that exploit novel properties that emerge at that scale. How small exactly is a billionth of a meter? As one journalist had put it, "If a nanometer were somehow expanded to appear as long as the nose on your face, then a red blood cell would appear the size of the Empire State Building, a human hair would be about two or three miles wide, one of your fingers would span the continental United States, and a normal person would be about as tall as six or seven planet Earths piled atop one another and working at the nanoscale, it turns out that ordinary materials can have unexpected properties, about which we are still learning. At the nanoscale, important physics begins to play a key role in the behavior of materials, and the large surface-to-volume ratio of components means that they are much more reactive. So, for instance, things that are brittle at the ordinary scale may possess super strength at the nanoscale, and things that do not normally conduct electricity now might at the nanoscale, among other surprising changes to physical and chemical properties. As a particular example of how properties change with scale, aluminum is used ubiquitously to make harmless soda cans, but in fine powder form, it can explode violently when in contact with air. But it is not only about the size: by precisely manipulating common elements at the nanoscale, scientists can fashion new materials. For example, carbon atoms bound together in a relatively-loose configuration may create coal or graphite found in pencils; in a tighter configuration, carbon makes diamonds; and an even more precise configuration, it creates carbon nanotubes, one of the strongest materials known to man, estimated to be up to 100 times stronger than steel at one-sixth the weight, nanotechnology is projected to enable such things as smaller, faster processing chips that enable computers to be inserted in our clothing or even in our bodies, medical developments for affectedly less-invasive surgical procedure and more-targeted drug supply, lighter, stronger ingredients that make transportation safer and energy-efficient and new services experiences such as energy weapons and lighter suit of armor and numerous other improvements. Some even predict that nanotechnology will extend our life cycle by hundreds of years or more by supporting cellular repair, which might slow, halt, or reverse the aging process. And because nanotechnology may assist us to influence individual atoms – the very constructing blocks of nature – some have predicted that we will be able to

create virtually anything we want in the future. Today, however, research is still continuing on the basic science, so we are years and possibly decades away from most of the fantastic nanotechnology products that have been predicted if they ever come to fruition at all. Nevertheless, companies are beginning to productize more of their research to create commercially-viable applications based on nanomaterials. These nanotechnology products are quickly entering the marketplace today, from stain-resistant paints to scratch-resistant paint to better sports equipment to more effective cosmetics and sunblock. In fact, Procter & Gamble, as one example of a leading consumer goods company, announced in 2006 that it is looking to incorporate nanotechnology into its products (O'Donnell, 2006). Other notable companies made similar statements recently as well, such as BASF's plan to invest US$221 million in nanotechnology research and improvement over just the next three years **(James, 2006)**

Effects of nanotechnology on the society

As it is well known, the proportions of nanoparticles match with some of the biological molecules like proteins or nucleic acids. Therefore, when the nanoparticles come into contact with the tissues or the fluids of the body, they get absorbed easily. The absorbance phenomenon depends upon the surface energy and surface properties of the individual nanoparticles. These immersed nanoparticles reach the target sites like the liver, blood cells, heart etc. The size, shape, surface properties, solubility, the chemical composition of the nanoparticles control the mechanisms for the nanoparticle toxicity. The nanoparticles are more toxic in comparison to the bulk chemicals because due to the increased surface to volume ratio the number of molecules present on the surface also increases that enhances the intrinsic toxicity. Some studies show that the toxicity of the material varies along with the shape. In one study it was found that the CNTs were more toxic for lungs in comparison to the quartz particles. It does not solely depend on the shape, however; there are other factors like chemical composition also affects the reactivity. Solubility is one of the most important factors affecting the interaction of nanoparticles with bio-molecular arrangements. The particles with high solubility can be ruined while the particles with low solubility could store within the system and stay there for a long time **(Purohit et al. 2017).**

In short, the fact that only a few articles dealing specifically with ethical reflections of nanotechnology have been published so far does not imply that the ethical discussion of nanotechnology needs to start from scratch. Nanotechnology can draw on matters already considered by researchers within the area of ethics and by ethical boards since the establishment of the academic discipline of bioethics.

Review of Literature

Roco (2003), discussed the main reason for developing nanotechnology is to advance broad societal goals such as improved comprehension of nature, increased productivity, better healthcare, and extending the limits of sustainable development and of human potential. His paper outlines societal implication activities in nanotechnology R&D programs. The US National Nanotechnology Initiative annual investment in research with educational and societal implications is estimated at about $30 million (of which National Science Foundation (NSF) awards about $23 million including contributions to student fellowships), and in nanoscale research with relevance to environment at about $50 million (of which NSF awards about $30 million and EPA about $6 million). An appeal is made to researchers and funding organizations worldwide to take timely and responsible advantage of the new technology for economic and sustainable development, to initiate societal implications studies from the beginning of the nanotechnology programs, and to communicate effectively the goals and potential risks with research users and the public.

Roco and Bainbridge (2004), his paper is based on judgments expressed by leading industry, academe and government experts at a U.S. National Nanotechnology Initiative (NNI) sponsored the meeting. The results were summarized in various themes related to economic impacts and commercialization; social scenarios; technological convergence; quality of life; ethics and law; governance, public perceptions, and education.

Lewenstein (2005), discussed what counts as a social and ethical issue and a typical list includes privacy, environmental health and safety, media publicity, and other apparently unrelated issues. In this article surveys those issues and suggests that concerns about fundamental concepts of ethics, such as fairness, justice, equity, and especially power, unite the various issues identified as 'social and ethical issues' in nanotechnology. The ability to see ethics of objectivity, fairness, justice, and especially power – in short, the key social interactions that shape the co-existence of science and society – in so many aspects of nanotechnology suggests they can provide the framework on which to build a broader definition of 'social and ethical issues'. Indeed, the attempts to define 'social and ethical issues' narrowly is itself an exercise of power that can prevent us from understanding how central social issues are to the development of scientific knowledge and its

implementation through technology in the modern world. Thus at the same time that we congratulate the nano community for embracing studies of 'social and ethical issues', we should be wary of the attempt to draw boundaries between those issues and 'technical' ones. As I have tried to show in this paper, the 'top-down' attempt to separate some social issues from others hides from us the degree to which power operates as a unifying principle across many issues. Even more so, the attempt to separate social and ethical issues from other areas of nanotechnology research shields us from understanding the ways that equity, justice, and power are inherent elements of science and technology. We must allow 'social and ethical issues' to emerge from the bottom up, through the nano community, wherever they appear. He was concluded by noting that nanotechnology may not be any different than any other area of emerging science and technology.

Khan (2015), Studied that the projected impact of nanotechnology has been touted as a second industrial revolution—not the third, fourth, or fifth because despite similar predictions for technologies such as computers and robotics, nothing has yet eclipsed the first. In the United States and in many other countries, numerous partnerships among industry, university, and government have been created to facilitate the research, development, and commercialization of nanotechnology advances. Such a collaboration is expected to bring about the next generation of nanotechnology-based products and new markets with a promise of job creation and economic development. According to the National Science Foundation (NSF), products incorporating nanotechnology will contribute approximately $1 trillion to the global economy by the year 2015. About two million workers will be employed in nanotechnology industries and three times that many will have supporting jobs. Despite the many benefits of nanotechnology, there are potential risks and ethical issues involved in its implementation. There's a concern that some nanoparticles could be toxic because elements at the nanoscale behave differently than they do in their bulk form and these particles could easily cross the blood-brain barrier. Society is at the threshold of a revolution that will transform the ways in which materials and products are created. How will this revolution develop? The opportunities that will develop in the future will depend significantly upon the ways in which a number of challenges are met. As we design systems on a nanoscale, we develop the capability to redesign the structure of all materials—natural and synthetic—along with rethinking the new possibilities of the reconstruction of any and all materials. Such a change in our design power represents tremendous social and ethical questions. In order to enable our future leaders to make decisions for sustainable economic nano-technological development, it is imperative that we educate all nanotechnology stakeholders about the short-term and long-term benefits, limitations and risks of nanotechnology. The social implications of nanotechnology encompass so many fundamental areas such as ethics, privacy, environment, and security. This paper presents an overview of new and emerging nanotechnologies and their societal and ethical implications to address 21st Century challenges and issues. The discussion includes a range of different types of nanotechnologies and their potential social and ethical implications on society. The paper also highlights the approaches used to teach Science, Technology and Society (STS) courses at DeVry University, Addison, the paper has suggested approaches to the challenges of educating the next generation of engineers and technologists about the promises and perils of this exciting technology. Nanotechnology has the potential to change society, positively or adversely. Because it will affect everyone, all members of society–all stakeholders–should have a voice in its development and commercialization phases. Presently, nanotechnology is in its infancy, and there is a lack of knowledge about its effects on humans and the environment in its applications in the areas of food, agriculture, and medicine. As humankind marches forward, the key question is: How should we manage the risks and uncertainties of this emerging technology.

Purohit et al. (2017), mentioned the study of the basics of nanotechnology and some expectations about its social consequences, environmental effects, health effect and the ethical issues it raises. Certain features of nanotechnology have been found that are likely to be imperative in determining its impact on the areas of society and environment. More importantly, responding to the challenge of nanotechnology will require confronting "philosophical" questions about the sort of society we wish to create and the role that technology might play in creating it and better authority of technological innovation in the field of nanotechnology with clearer sustainability objectives and higher quality environmental risk and life cycle assessment are required. In many ways, the nanotechnology is an example of attempted technological-fix to problems that in reality require social, economic and political solutions. We are therefore concerned that rather than providing real solutions to our vital problems, nanotechnologies will shore up a new wave of industrial expansion that will magnify existing resource and energy use and exacerbate environmental destruction. Ultimately, the various test of the nanotechnologies will be their benefit for human beings, as measured by economic growth, improved health and longevity, environmental

protection, strengthened security, social vitality, and enhanced human capabilities.

Conclusion In the present paper, we give an overview of nanotechnology and its applications and discussed its social and ethical implications and the challenges of nanotechnology are much related to the ethical challenges of biotechnology, and that the ethical problems of these fields have been analyzed by researchers within the area of ethics. In this paper, we suggest that even though only a few articles dealing specifically with the ethical issues of nanotechnology have been published so far, this knowledgebase may be a worthy starting point and groundwork for a discussion of an ethical mirror image on nanotechnology. Moreover, it is argued that an inspiring approach to the ethics of nanotechnology is the supposed to claim that a restricted number of simple ethical principles are mostly accepted. In this paper, we focus on the societal implications of nanotechnology and the humanities and the social sciences have an acute function regarding the implementation of new technologies which for illustration contains asking fundamental questions like what impact will this new technology have on humanity? Will this new technology impact the realization of a good life? The aim of posing these questions is not to build trust and acceptance in the public, but to make a serious assessment of new technology so that the public may make an up-to-date judgment. Ethics may be looking at as a co-player firstly conversing the needs and objectives of the society, and moreover serving as a structure to guide society on the way to these aims. The objective for integrating the humanities and the social sciences may also be to create interdisciplinary environments, where for instance ethicists and nanotechnologists are in daily information flow simplifying ethical reflection as an integral part of the research process of nanotechnology

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