

## **Emerging Technology on Robotics and Nanotechnology in Surgery**

### **Abstract**

There is no way one can now doubt that emerging technology is not significant in the current society, especially in business and healthcare. Basically, the way people carry out business and live their lives would be totally different were it not for the ever changing technology. The emerging technology has had a very big impact on business today. Business associates are able to communicate across the world without having to incur other unnecessary costs like the ones for traveling to other countries. Web-conferencing and teleconferencing have become the element of an everyday life. The emerging technologies not only manifest themselves widely in the business sphere, but also impact the daily life and the society at large. In medication, more sophisticated technology has evolved to assist care-givers in a number of ways. Robotics is particularly important in assisting doctors as the latter carry out very intricate surgical procedures. Robots are made by nanorobotics technology. Taking the above-mentioned into account, the given paper will address the impact of emerging technologies, specifically Nanotechnology and robotics on surgery, business and society. The first part of the paper addresses these technologies to introduce the topic, while the second part discusses the technologies in relation to the specific sectors of application, namely, business and society. The paper will include concepts, ideas, benefits and analyses from journals and other relevant sources.

### **Introduction**

The advancement in technology that the world is witnessing today is very important because it affects the lives of people directly, which can occur in the sphere of healthcare, communication, business, and life in general. As the results of the expedite process show, the emerging technologies, production and delivery of products are very

easy to access, faster and more convenient than they used to be. Due to the rapid development of nanotechnology, the carte delivery in medicine is bound to be improved in the near future because nanotechnology is practically a result of a revolution in the sphere of genetics biotechnology.

Surgery and other surgery-related processes will be safer to carry out when robots are used for surgery. Basically, robots and nanorobotic technology is becoming increasingly in-demand in medicine. Nanotechnology is, hence, one of the three pillars that this paper is based on.

### **Definitions**

Walter F. Deal defines Nanotechnology as a way of manipulating or self assembly of separate atoms, or groups of molecules into structure that falls within the dimensions of 1 to 100 nanometers to be able to make devices that have vastly new or completely different characteristics (Deal, 2002, p. 21). However, it is also important to realize that there have been a lot of changes in the field of nanotechnology and that the old definition by Walter may not address all the aspect within the reach of nanotechnology (Deal, 2002, p. 21). Nanotechnology is, therefore, a scientific study of extremely tiny particles measured in nanometers, which have unique characteristics depending on their arrangement. The particles within the scope of nanotechnology can also be manipulated by experts so that the particles behave in a certain way, as Deal (2002, p. 21) emphasized it.

Robots are becoming very useful in the technical activities that require accuracy, include high risk and take much time. Davies describes Robots as mechatronics controlled by computers to carry out a wide range of tasks (Davies, 2005, p. 129). In medicine, mechatronics are used to carry out surgical procedures as programmed; it is quite peculiar that robots have sensors that assist them in their operations. A more

explicit definition of nanotechnologies in surgery could be that of Paolo Fiorini, made in 2009; the researcher explained the process of unifying minimally invasive technologies from surgery with teleoperation technology that enable dexterous surgical performance by manipulation of the tools in the body of a patient through very small incisions, according to what Fiorini (2009, p. 45) says.

### **Emerging Technologies: Impact of Robotics**

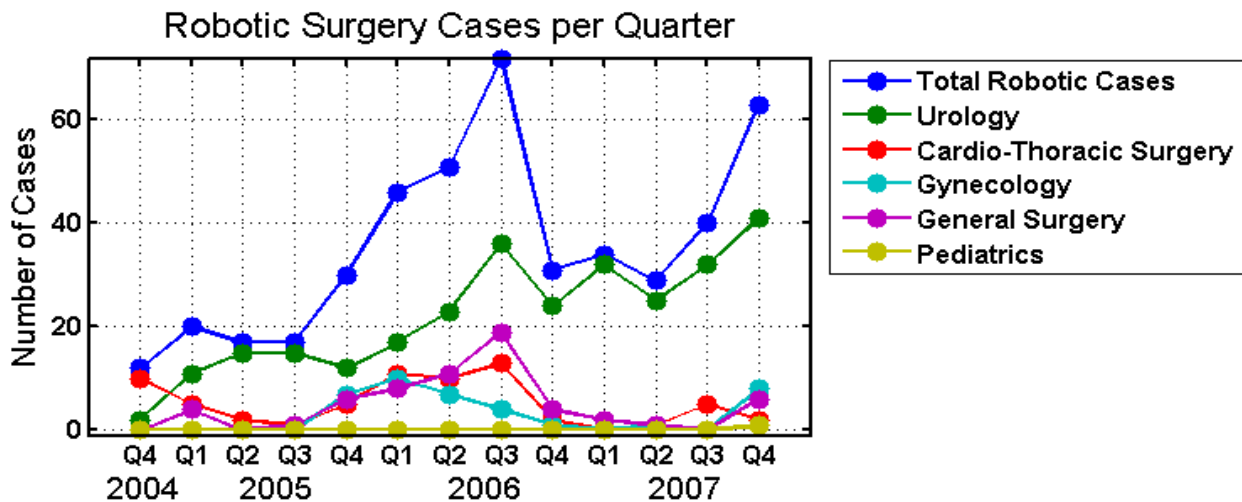
Robots are computer-powered machines that are used in surgery to help doctors perform surgical procedures. In the recent past, robots were used basically to hold the equipments while surgeons performed operations (Taylor & Dalton, 2000, p. 35). However, nowadays, robots are actively involved in the process of surgery. A new era is emerging in medicine in nanotechnology and nanodevices (Finlay, 2008, para.3). Robots offer better surgery processes that are less invasive, and are capable of performing long-distance operations. It's anticipated that in the future, nanotechnology and the development of the robot production will encourage more efficient use of nanotechnologies in surgery.

### **Impact of Robotics on Business**

As business is improved due to advancement in communication means, business in the field of robotics for surgery will experience equal growth. This is because exchange of information around the world has allowed sharing and technology spread very fast (Finlay, 2008, para.3). In the year 2009, World robotics website revealed that there was an increase in the sale of robot units by a margin of 33 percent from 2008 to 2009. Such findings can be extended to the yearly increase in sale of robots for the entire nation as being 33%; and this has a direct effect on the new technology being introduced (Taylor & Dalton, 2000, p. 35).

Indirect impact is associated with services organization like logistic and management firms, security firms and shipping services. Furthermore, when the growth is so rapid, spending is increased. This can have an influence on the government's resources (Finlay, 2008, para.4).

Graph 1: Robotics Surgery Cases Per Quarter – Urology, Thoracic and Gynecology



The Number of Robotics Used in processes of Surgery is progressively getting high in general. This means that businesses that deal with these equipment and technology are likely to experience equal momentum. Business in Robotics is going to boom.

The developing nations are a very good place to invest in new technology since they are also expected to make technology leap rather than go through a very slow process of developing such technologies, which may take a lot of time and money (Cavalcanti, 2003, p. 78).

### **Impact of Robotics in Surgery on the Society**

Currently, there are many robots in the medical industry, and their specifications are currently developed for performing surgery, where only minimally invasive processes of doing surgery are being encouraged. It is remarkable that the effects of the nanotechnologies are already evident; for instance, the scientists at Eberhard Karl

University have developed a robot that has two arms and is manipulated by a professional surgeon, while the operations are performed by experienced professionals (Howe & Matsuoka, 1999, p. 211). Allowing endoscopists to oversee the process and even teleoperate people means that the system offered by the developers of nanotechnologies is highly feasible. However, professionals also think that nanotechnology systems can expand to be applied to other sectors of medication. It must be taken into account that there are other laboratories that have adopted models for swift feedback in real time while carrying out invasive surgery, as Howe & Matsuoka (1999, p. 215) assert. It is important to mark that the invasive technique also combines visual and haptic, receiving feedback to help the robot-assisted process improve.

One of greatest developments is the Zeus system, as well as in the Da Vinci system, all of which have similar capacities though employ different strategies in robot surgery, the nanotechnological systems offer a wide range of possibilities for doctors. Modern hospitals are now equipped with video assisted visual screens and computer technologies. For instance, Da Vinci system was developed from telepresence machines invented for high security operation of NASA and the United States (Lanfranco *et al.*, 2004, p. 14).

It is also worth mentioning that Zeus systems have consoles controlled manually. The gadget has two arms that replicate the hands of a surgeon. However, there is a third arm that has a voice controlled robot endoscope for the visualization of the operation process (Lanfranco *et al.*, 2004, p. 14).

When robotics was introduced to surgery, a new trend in medical delivery was initiated. The introduction is targeting to improve the dexterity in a restricted space for the process of surgery, which will reduce spills and contamination due to open surgeries (Satava, 2002, p. 10). Endoscopic surgeries are the most performed by these

improvements and as such they are the ones with better success stories. The incorporation of three dimensional visions proves efficient in making the conventional open surgeries have minimal incisions. Nonetheless, when internal organs are not visible, more information is required in order to make decisions concerning the operation, since the delicate internal organs have to be protected (Satava, 2002, p. 10). One of the best ways to both conduct successful operations and avoid harming the other internal organs is to use the minimum of invasive methods, since the processes based on the use of excessive force could severely damage the body tissues, according to Satava *et al.* (2001, p. 489).

There are several benefits that robotics have brought to the fields of surgery in the sphere of medical care. One is that there is reduced number of personnel that are needed for one procedure to be carried out. Robots take up the duties of several people in the surgery room (Lanfranco *et al.*, 2004, p. 14), which means that in future even fewer people will be required in the surgery rooms to carry out an efficient surgery. The surgery distance is reduced considerably. Incorporation of the telecommunication technology and the speed of information transfer in the emerging technology, surgery can be carried out even when people are separated from each other, according to Satava *et al.* (2001, p. 489). One can claim with certainty that a surgeon can perform operations from another location, miles away from where the patient is. As the robot surgery has few incisions, and invasions, there is minimal trauma on the patient and, thus, translates to more rapid recovery (Satava, 2002, p. 10). It's obvious that small incisions inflicted by robot surgery heal faster. Holistic recovery of the patient, therefore, occurs faster, which reduces medical risks, excessive pain and any other complications, as Satava (2002, p. 10) marks.

Specifically, laparoscopy surgery depends on the modern robotics greatly. The emerging technology has enabled professionals in this field to overcome certain critical obstacles. Robotics increases the efficiency of the doctors' performance, recovers hand-eye synchronization and provides an ergonomic arrangement, allowing better observation of the operation process (Satava, 2002, p. 10).

Accessing information and sharing it at appropriate time in the medical care is very important. Unorganized patient records mean that there will be a lot of delays, confusion, and disorganization and overcrowding (Davies, 2005, p. 129), which will turn the healthcare chaotic. Thus, certain issues will be very difficult to solve; patient information, such as patient populations, illnesses, and side effects, as well as lab results are required at once in different departments, which increase the importance of robotics in surgery (Adhami & Coste-Mariene, 2002, p. 2965). Patients' safety will be compromised because several health conditions have different degrees of severity, and priority should be given to serious case, so that more people's lives could be saved. Adapting EMR can solve such problems as data can be accessed from anywhere in the hospital setting and even e-prescribing done (Adhami & Coste-Mariene, 2002, p. 2965).

Considering the safety, cost and convenience of using nanotechnologies, one can make sure that the idea of nanotechnology in building, engineering and surgery is very enticing and worth the investment. EMR will ensure that the patient's safety is guaranteed while at the same time eliminating the bulk of paper documents, refilling, storage and waster of time as one move from place to place shifting fields. Surgery can be done long distance by teleoperation (Adhami & Coste-Mariene, 2002, p. 2965).

### **Impact of Nanotechnology on Business**

The evolution of new technology is very critical and has been observe to impact a lot of aspects of human life. The GDP's of various nations have been greatly influenced

by the technology while others have seen better service delivery, as Davies mentions (2005, p. 129). Nanotechnology is gaining popularity since the world is on the way to establishing a model that will bring huge change in technology and make nanotechnology development increase exponentially. Nanotechnology is likely to impact the business affairs of many nations (Bachand & Montemagno, 2000, p. 179).

Nanotechnology can be described as manipulating matter at an atomic or molecular level. The process of manipulation is being observed as large-systems tactical competence, which only a highly productive society can allow. The development of nanotechnologies, therefore, means that the latter could be able to transform the sustainability and the wealth of these countries. A major concern is to create machines designed to tackle the future challenges (Bachand & Montemagno, 2000, p. 179). As the technology advances, the need for global markets to reassess the economies, the industries and the policies on the standards that have never been experienced before emerges.

A study conducted by the global Futures College to investigate the readiness and awareness of business persons concerning the economic impact and business benefit of nanotechnology was carried out in 1999. Several interviews were carried out across a wide range of business personalities in different sectors of economy ranging from health up to such spheres as manufacturing, information communication technology and real estate (Bachand & Montemagno, 2000, p. 179). The areas the new technologies embrace cover practically all spheres, from communication to robotics and life sciences.

The findings from the research indicated that awareness and rates of being ready were very low. Still, about 80 percent could define nanotechnology superficially. It's also evident that nanotechnology is still in its infancy and should be allowed to grow (Cavalcanti & Freitas, 2005, p. 117). Assessment of the awareness and readiness in

this context was very critical since before results could be drawn, there was need to assess the accelerated change and its impact on business ahead of time. Since the newly adopted technology is already a part of reality, being ready and aware of it means that the technology will be possible used in future; integral to this research, as Bachand & Montemagno (2000, p. 179) claim.

Considering the relative and varied issues of social adaptation, scientists have investigated some scenarios to offer further understanding of the importance of nanotechnology on business (Cavalcanti & Freitas, 2005, p. 117).

It's evident that nanotechnology integrates expansively into economy due to high rates of readiness, efficient planning and increased investments by business owners. As indicated, the viability of these emerging technologies is not easily accomplished as the technologies are still developing. Almost every aspect of humanity is affected by the developing technology(Cavalcanti & Freitas, 2005, p. 117) . About 35 nations have adopted the nanotechnology novelties, according to Roco. The sudden surge in nanotechnology useled to an increase in investments from \$430 million in 1997 to \$3 billion in 2003. It is estimated that at this rate, the overall sum will be over \$1 trillion by 2015. The benefit cannot be assessed commercially immediately, though. Sales are expected to increase as the technology is sold.

Major aspects that are to be observed include the global international affairs, trading leadership, integrated education, low labor problems and unemployment, sustainable economy, global patent headship, higher industrial competitiveness and plenty capital liquidity (Cavalcanti & Freitas, 2002, p. 743). In addition, a future outlook is very important for creating an ever increasing dominance in major markets and industries that result in investments and innovations. Nanotechnology assured

accelerated progress and confidence in growth of economy and improved quality of life to the entire country (Cavalcanti & Freitas, 2002, p. 743).

It must be mentioned that the nation-wide adoption of the new technologies is very slow. There are no adequate government policies across the world, which could encourage investment in national nanotechnology. Some of the obstacles in attaining business success include lack of skill, inadequate training or poorly educated, and liquidity insufficient (Cavalcanti & Freitas, 2002, p. 743).

### **Impact of Nanotechnology on the Society**

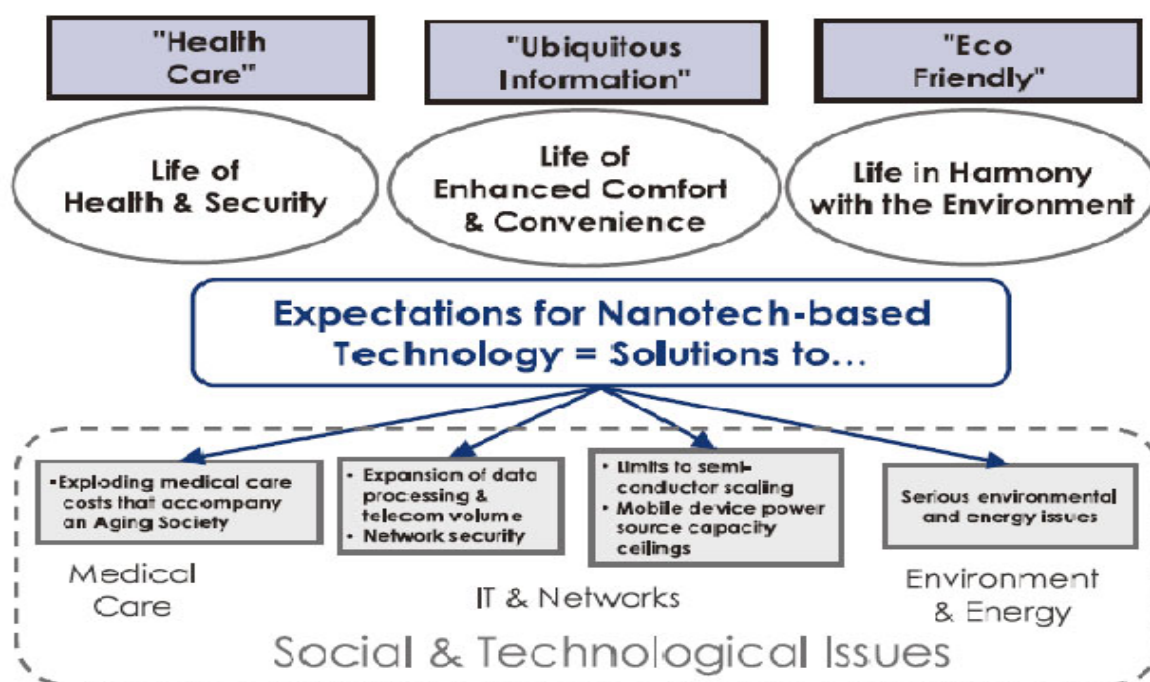
Nanotechnology impact can be evaluated in a number of ways in the society. As indicated early the problems of getting nanotechnology include lack of a very comprehensive adoption, integration and preparedness, hence, resulting in reduced post-industrial growth, negative competitiveness that translates to reduction in growth of the economy (Cavalcanti & Freitas, 2002, p. 743). It's expected that when fully adopted, nanotechnology will cause a surge of massive investment that will, in turn, induce economic growth. Problems of unemployment should be solved. Nanotechnology has a vast impact on the society, starting from the concept previously addressing awareness. However, the overall level of ignorance concerning nanotechnologies is also very high and, hence, people find it very difficult to make decisions concerning the use of the technologies, their merits and the control over the surrounding (Finlay, 2008, para.2).

Knowles E. quotes that opinion poll in UK conducted by Royal Society revealed that about 29 percent were aware of nanotechnology. Only 19 percent could define the term itself, which means that people are unaware of the phenomenon, as Knowles (2006, p. 25) marks; therefore, the knowledge of new technologies is to be enhanced. In many nations, societies are influenced by the type of politics that they play, which, in turn, is reflected in the way people vote. The policies could be very favorable to the

scientific growth and further researches; however, people are simply unaware of the existence of such technology, which distorts the progress (Knowles, 2006, p. 25).

Technology is spreading at a rapid pace, and people simply fail to follow it. Thus, the problems concerning nanotechnologies have to be aligned with ethical reasons, general understanding and regulation by the government (Sayers *et al.*, 2005, p. 1572). Financing the priorities is proper, since nanomaterials are present in consumer products most of the time whereas general knowledge concerning materials could be detrimental to a people's health (Knowles, 2006, p. 25). Environmental factors are very important in ensuring that environmental issues are addressed properly, especially emission of carbon gases.

Table 1. Impact of Technology on Society



A positive link to society is associated with investments and sales projects for nanotechnology products. Once the positive link is established, opportunities in employment, education and further research will emerge. It is important to be able to

maintain the balance between bad effects and positive outcomes, according to Knowles (2006, p. 25). For instance, nanotechnology in medical services can be very important to people in developing nation, this could be very expensive and at times even non-existent.

Basically, nanotechnology can be applied to almost every aspect of human necessities. Medical services will improve considerably as medics resort to using nanotechnologies in curing the population (Knowles, 2006, p. 25).

### **Conclusion**

The safety of patients and care delivery is a very important aspect in the modern society because of the increased concern about patient autonomy and his/her right to treatment. Surgery is a very important procedure for patients. Great care is needed, and the modern technologies have to be utilized. Nanotechnology and robotics in surgery are of unrivalled merits. Nanotechnology will completely revolutionize care delivery, as the benefits are obvious, yet the technology is only emerging. In addition, there are certain risks posed to environment, humanity and law regulation. Robotics has influenced business positively and improved surgical processes. However, despite the hailed benefits, it's important to take caution of the new technologies, since other external factors including political, economical and social concerns may jeopardize the achieved success.

### References

- Adhami, L., & Coste-Mariene, E. (2002). Positioning teleoperated surgical robots for collision free optimal operation. *ChIR Medical Robotic Group*, 3, 2962-2969.
- Bachand, G. D., & Montemagno, C. D. (2000). Constructing organic/inorganic NEMS devices powered by biomolecular motors. *Biomedical Micro devices*, 2, 179 – 184.
- Cavalcanti, C., & Freitas, R. A. (2005). Nanorobotics control design: A collective behavior approach for medicine. *IEEE Transactions on Nanobioscience*, 4(2), 133-140.
- Cavalcanti, A. (2003). Assembly automation with evolutionary nanorobots and sensor-based control applied to nanomedicine. *IEEE Transactions on Nanotechnology*, 2(2), 78 - 87.
- Cavalcanti, A., & Freitas, R. A. (2002). Autonomous multi-robot sensor-based cooperation for nanomedicine. *Int'l J. Nonlinear Science Numerical Simulation*, 3(4), 743-746.
- Davies, B. (2005). A review of robotics in surgery. Mechatronics in medicine group. *Proceedings of Institution of Mechanical Engineers*, 214, 129.
- Deal, W. F. (2002). Under the microscope: Nanotechnology. *The Technology Teacher Journal. Resource in Technology*, 62(9), 21-23.
- Finlay, P. A. (2008). Robotics in surgery. Retrieved from Electronics Channel: <http://tv.theiet.org/technology/electronics/1250.cfm>
- Fiorini, P. (2009). *Robotic surgery: Past results and current developments*. Verona, VR: University Of Verona.
- Howe, D. R., & Matsuoka, Y. (1999). Robotics for Surgery. Annual Reviews. *Biomedical Engineering* , 1, 211 – 240.

- Knowles, E. (2006). Emerging issues, nanotechnology: Evolving occupational safety, health and environmental issues. *Professional Safety Journal*, 5(3), 20-27.
- Lanfranco, A., Castellanos, A., Desai, J., & Meyers, W. (2004). Robotic surgery. A current perspective. *Annals of Surgery*, 239(1): 14 – 21.
- Satava, R. M. (2002). Surgical robotics: The early chronicles: A personal historical perspective. *Surgical Laparoscopy, Endoscopy & Percutaneous Techniques*, 12(1), 6–16.
- Satava, R. M., *et al.* (2001). Robotic surgery: State of the art and future trends. *Contemporary Surgery* 57(10), 489 – 499.
- Sayers, C., Lai, A., & Paul, R. P. (2005). Visual imagery for subsea teleprogramming. *IEEE International Conference on Robotics and Automation*, 2, 1568 - 1574.
- Taylor, K., & Dalton, B. (2000). Internet robots: A new robotics niche. *IEEE Robotics and Automation Magazine*, 7(1), 35–40.