The Role of Nanotechnology in Enhancing Environmental Sustainability an Exploratory Study on Pharmaceutical Industry in Egypt

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Abstract
The objective of the research is to examine the Role of Nano Technology (NT) in enhancing Environmental Sustainability (ES). The research population consists of all employees at Pharmaceutical industry in Egypt. Due to time and cost constraints, the researcher adopted a sampling method to collect data for the study. The appropriate statistical methods such as Alpha Correlation Coefficient (ACC), Confirmatory Factor Analysis (CFA), Multiple Regression Analysis (MRA), were used to analyze the data and test the hypotheses. The research has reached a number of results, the most important of which are: (1) poor standards upon which to choose, review and evaluate the new technology used, especially in the field of NT (2) there is no effective system sufficiently for the logistics management of the raw materials that are used in the field of NT, (3) the nature of the production processes and the machines used are not commensurate with keeping pace with the changes related to the raw materials that are used in the field of NT, (4) some of the products provided by Egyptian pharmaceutical companies have an impact on the environment, which requires legislative rules regulating work in such products, (5) the management and employment that is used and worked in the field of NT is not sufficiently skilled that can deal with the risks of NT and control it in Egyptian pharmaceutical companies, (6) the scientific progress is only the result of continuous research in the areas of scientific research that is based on drawing knowledge, developing institutions and developing products through spending on areas of scientific research, (7) weak private financing of technology in general, and NT in particular, (8) the lack of clarity of technological policies, (9) the increase in the sales especially consumer products in the Arab markets, which leads to the depletion of Arab money and its waste on the consumer side.

The study referred to a number of recommendations, the most important of which are: (1) the need to pay attention to the culture of NT by following scientific articles in the field of NT, and attending conferences and workshops related to NT in the Egyptian pharmaceutical industry, (2) focusing on the importance of having a strategic plan in the Pharmaceutical companies in Egypt about NT, in addition to its importance to provide sufficient financial resources to cover the strategic plan, (3) the importance of good selection, review and evaluation of the new technology that is used in pharmaceutical companies in general, and in the field of NT in particular. This is in addition to the necessity of these companies being keen to follow the latest technology in the field of NT and trying to increase productivity and reduce costs in the pharmaceutical industry in Egypt, (4) focusing on the existence of a logistic management system for various materials in the field of NT, and the need to follow up global experiences of raw materials in the field of NT. This is in addition to the need to recycle the waste products of Egyptian pharmaceutical companies, (5) the need to pay attention to providing machines and equipment with multiple characteristics that can deal with the changes that occur in the raw materials that are used in Egyptian pharmaceutical companies, (6) focusing on the necessity of a unique quality of products to the local and global market, provided that these products can obtain the ultimate consumer confidence.

Keywords: *Role of Nanotechnology, Environmental Sustainability, Pharmaceutical Industry*

1. Introduction

Nanotechnology (NT) is one of the advanced forms of technology, and it has a fundamental impact on many areas, the most important of which are medicine (Rebort & Freitas, 2016), agriculture (Tejpal, 2015), libraries (Simon & Mick, 2012), and learning (Ban & Kocijanic, 2011), chemistry (Steven & Krajcik, 2007), consumer products (Jason, 2008), dentistry (Maria et al., 2016) and early detection of viruses and diseases (Nikalje, 2015).

Ideas and concepts began to form for NT before it was used. Physicist Richard Feynman proposed at a meeting of the American Physics Society at the California Institute of Technology on 1959, with a topic titled: There's Plenty of Room at the Bottom. Also, Professor Norio Taniguchi created the term NT. In 1981,

NT began with the development of the Scanning Tunneling Microscope, through which individual small atoms could be seen (Picraux, 2018).

NT is a technique studying, understanding, and monitoring matter with dimensions ranging from 1 to 100 nanometers. NT can be used in different scientific fields, such as: physics, chemistry, biology, materials science, and engineering (Robert & Freitas, 2016).

NT relates to the basic understanding of physical, chemical, and biological properties, and the control of these properties to create functional materials and systems with unique capabilities (Maria et al., 2016).

NT has many uses and areas of application, for example in the field of medicine, where NT is used in the rapid and accurate detection of viruses, the expansion of vessels, and the improvement and strengthening of anti-bacterial activity, in addition to nano medicines that can be used to detect diseases in the early stages (Niltalje, 2015).

NT provides many benefits that come in many areas of life. NT helps to improve many technological and industrial sectors such as information technology, energy, medicine, national security, environmental science, and food safety. Also, commercial products rely on NT. For example, a transparent nano-layer on computer screens, camera, glasses, and windows can help make it water-resistant, anti-reflective, scratch-resistant, or conductive of electricity (Picraux,2018).

NT has entered into consumer products, especially in resisting stains in clothing and fabrics. Nanocrystals have been used to make invisible sunscreen. Silver-nanocrystals have been used to kill bacteria and prevent infection (Nikalja, 2015).

The technological development in the storage of electronic computer is witnessing a great development, and with the development in NT, manufacturing at the micro level will achieve a tremendous progress in the storage capacity of data. This creates an integrated library with a very simple size, where millions of trillions of pieces of data are placed. The development of electronic computer technologies may help in the production of smaller devices and genetic electronic computers (Stanshevskaya, 2012).

The development in new products that use NT is growing at a very fast pace than is the case in ongoing research in its safety field, and defenders in this technology admit that there are types of them that are very dangerous, so the NT does not differ from any other technology that excels in it. Benefits over risks (Herrington et al., 2009).

The application of NT is a comprehensive industrial revolution, as well as a scientific revolution for the twenty-first century that will lead to a comprehensive change in the world (Khalawey, 2008).

NT is reaching its full potential to contribute to building modern societies. We need a great effort from the workforce and trained in NT research. It is also necessary to develop related industries and strengthen programs to prepare and provide human resources in the field of NT (Fonash, 2001).

Environmental Sustainability (ES) is one of the dimensions of sustainable development. In other words, the dimensions of sustainable development are environmental sustainability, social sustainability, and economic sustainability (Nguyen et al., 2018; Tooranloo, et al., 207; Adeoye, 2017; Kucukoglu & Pinar, 2016; Rensburg, 2015; Fulekar et al., 2014; Spangenberg, 2013; Eltayeb, 2011; Romiguer, 2011; Rasmussen, 2011; Potts et al., 2010; Bounhiss, 2010; Pavlova, 2009; Winkler, 2006; Harris, 2000).

Achieving sustainability does not only mean the sustainability of existing resources, but more importantly is finding sustainable alternative resources that do not carry environmental and social damage, and do not cause economic and financial problems. Sustainability can only be achieved through three main pillars. They are economic, environmental, and social. Sustainability has become one of the topics that attracts the attention of all organizations in the 21st century (Fulop & Hernadi, 2013).Achieving ES is a pre-requisite for economic, social and environmental systems. The beginning of interest in ES was part of the concern for the necessity of sustainable development. It is based on three basic pillars. They are economy, society, and the environment. ES system preserves natural resources and avoids the excess depletion of renewable resources in order to meet the needs and desires of present and future generations. ES has been within the evolution of sustainable development. (Israel, 2005).

The importance of ES is highlighted in protecting the natural resources necessary to ensure the protection of human beings such as water, air and land, so that they do not lead to their degradation, and this can be done by combating pollution, reducing energy consumption and protecting the available resources. (Smouts, 2005).

Organizations play an important role in preserving the environment, by reducing resource consumption and reducing waste generation and pollution in addition to its impact on the natural resources. The organizations' contribution affects their performance, their reputation, and the ideal way to use available resources through the reuse of environment-related products (Rebitzer et al., 2004).

This study is structured as follows: Section one is introductory. Section two presents the literature review. Section three presents the research model. Research questions and hypotheses are presented in section four. Section five explains the research strategy. Hypotheses testing is provided in section six. Section seven handles the empirical results. Finally, section eight presents the main recommendations of the study.

2. Literature Review

2.1. Nanotechnology

2.1.1. Nanotechnology Concept

The concept of NT began in 1959. It remained a theoretical concept until 1981. Scientists have discovered what is known as the tube microscopy method, which is a microscopic examination with a special technological method that is not done through normal vision through a microscope. Using this method, scientists were able to see the very small particles (Khalawey, 2008).

NT is the infinitely small world, because the word nano is originally from Greek. In other words, the word NT is an expression derived from the Greek word nanos. It refers to a dwarf or finite thing in small or tiny. It is a scale equivalent to one millionth of a millimeter, and one over a billionth of a meter, which is equal to one in ten thousandth of the thickness of a human hair (Mazeed & Abas, 2011).

NT is a set of theories and applications that allow the production and processing of nano scale nano materials (Edith, 2012).

The application of NT will entail a massive and significant reduction in the cost of production, an accurate knowledge of the details of the composition of materials, as well as an accurate knowledge of the engineering of the materials to be made and the strong control of atoms (Khalawey, 2008).

In South Korea, the government of former President Kim Dae-Jung announced in July 2001 that it had allocated a budget of about $1.14 billion to spend on NT applications within ten years. In China, there are reports that the spending allocations for NT research at the end of 2005 were $2 billion. The least spending Asian countries in this area are India, which did not exceed $26 million (Benson, 2007).

US President Bill Clinton granted $ 495 million to the US initiative in NT before he left the White House. This is the largest amount allocated to this research, in terms of supporting NT and considering it an essential part of American scientific excellence globally (Khalawey, 2008).

NT is a set of tools, technologies, and applications that relate to the manufacture and installation of a particular structure using very small scales. NT is a science that specializes in researching and developing modern things and methods of size within the framework of the nano scale. NT is a scientific application that handles the production of things by aggregating them from their basic components such as atom and molecule (Mazeed & Abas, 2011).

NT is the technique whereby materials components at the atomic and molecular levels can be treated separately and regrouped to form modified materials with better properties and specifications (Fahrner, 2004).

NT is the complete and accurate control of the production of materials by controlling the interaction of the particles involved in the reaction, directing these molecules through the production of a specific substance. This type of reaction is known as molecular synthesis, placing the atoms during the reaction in their correct or appropriate place (Mazeed & Abas, 2011).

NT is the technology by which materials components at the atomic and molecular levels can be treated separately, and reassembled to form modified materials with better properties and specifications (Tanigachi, 1974).

NT is an advanced form of technology, and it has a fundamental impact on most industries and all areas of society. It is used in medicine, industry, energy and environmental protection (Khalawey, 2008).

NT is the science of coordination between biological, physical, chemical, mechanical, and electronic sciences, materials science and information technology, in order to study the structural structures of living

and marine matter. Due to the information and communication revolution, new relationships have begun to emerge as a result of the tremendous development in the field of NT, biotechnology, and nano-biology (Khalawey, 2008).

The twenty-first century will be distinguished by the connection between the fields of physics, life science and computers, which means the development of science to give us an unprecedented ability to control matter, life, and intelligence. In the conference held by US government agencies on NT, it was pointed out that it is necessary to follow up the evaluation of what is being accessed first, in order to ensure the use of available financing in order to provide the technology to the consumer (Khalawey, 2008).

2.1.2. Nanotechnology Dimensions

The dimensions of NT are NT culture, strategic plan, technology selection and evaluation technology, the nature of raw materials, the nature of machines and production processes, the quality of the products, and talented management (Stobie, 2003; Kahlawy, 2008).

1. Paying attention to NT culture, the beginning of entering the NT field is preparing the appropriate climate for it to have an awareness and interest in the importance of spreading the NT culture.
2. The strategic plan, it is the basis of technology management, and that NT depends primarily on government funding, and therefore it is predominantly strategic.
3. Choosing, reviewing and evaluating technology, as there are three basic stages that the process of applying technology in the field of NT goes through, which is selection, review, and evaluation until technology is used on a sound basis.
4. The raw materials used, as the nature of NT deals with the components of the materials, so the quality of the relationship with suppliers and the ability to manage raw materials through logistical management is the key to success in managing this type of technology.
5. The nature of machines and production processes, as the machines that work in the field of NT must be flexible, since they deal with different components, which leads to ease of dealing with them.
6. The quality of the products offered, as dealing through technology requires the extraction of a distinct and different quality of products that contribute to productive, economic and social development in light of not harming the environment and public health in the country.
7. Talent management, as it attracts skilled worker in the field of NT and that has the ability to deal with the risks and control that result from the use of this type of advanced technology.

2.2. Environmental Sustainability

2.2.1. Environmental Sustainability Concept

Environmental sustainability is the preservation of the absorptive capacity of the ecosystem in a manner that contributes to meeting the current and future needs of community members and not to harm future generations (Bibri, 2018).

Environmental sustainability is concerned with finding solutions to environmental problems. It creates a safe environment for all members of society. Therefore, all organizations must pay attention to the continuous improvement of the environmental aspect, and this can be implemented through green human resource management practices (Tooranloo et al., 2017).

Environmental sustainability is concerned with protecting the natural resources used to meet the special needs of members of society, and reducing environmental pollution operations. Environmental sustainability programs are linked to raising awareness of its importance on the one hand, and preserving the environment on the other hand (Kucukoglu & Pinar, 2016).

Environmental sustainability is making decisions and minimizing the negative impacts of human activities. This is in addition to taking measures to use non-renewable resources wisely and fairly for future generations (Yuan, 2013).

Environmental sustainability is the ability to reduce the negative effects of human behavior on the environment on the one hand, and to regulate the positive impacts on the other hand. This can be achieved by designing a set of programs that protect the environment (Cai et al., 2013).

Environmental sustainability is to reduce the negative impacts of human activities on the environment, and to take measures that use the available resources in a fair manner to fulfill the needs of present and future generations (Yuan, 2013).

Environmental sustainability is the preservation of natural services at required levels due to the existence of a fundamental relationship between these services and human well-being, and the tangibility of this relationship is the essential feature of preserving ecosystems (Molddan et al., 2012).

Environmental sustainability is a condition of balance, flexibility, and interconnectedness that allows to meet the needs of human society, provided that these needs do not exceed the capacity of the systems supporting them, and that work continues to renew the services needed to meet the different needs of community members (Morelli, 2011).

Environmental sustainability is one of the basic conditions for achieving practical balance in society, as well as achieving interconnection among members of the human community (Morelli, 2011).

Environmental sustainability is a set of practices that contribute to preserving the quality of the environment in the future, in order to meet the needs of present generations without harming the needs of future generations (Attah, 2010).

Environmental sustainability is the ability of the planet to withstand the human element by absorbing the waste and radiation that a person creates to provide them with all the natural and energy resources they need. Environmental sustainability is based on leaving the earth in good condition for future generations, and if a person maintains his activity and performance without wasting natural resources, this leads to achieving natural sustainability for present and future generations (Dadds & Veaables, 2005).

Environmental sustainability is the ability to conserve things or qualities that are considered valuable in a tangible environment, and to rationalize the consumption process (Sutton, 2004).

Environmental sustainability is the ability to preserve the qualities that are considered to be of value in the physical and social environment, including the preservation of human life through the preservation of water or air, and the continuity of movement in society without the depletion of non-renewable resources (Sutton, 2004).

Environmental sustainability is represented in maintaining a stable base of natural resources and avoiding excessive depletion of renewable and non-renewable resources, as well as protecting the biological type, air balance, and other natural ecosystems that are not classified as economic resources (Harris, 2000).

Environmental sustainability is associated with preserving natural resources from unregulated consumption, reducing the effects of pollution in all its forms, diversifying energy sources, increasing the area suitable for the livelihood of members of society, reducing the presence of the desert, and providing safe water for both consumers and the environment (O'Brien 1999).

Environmental sustainability is the preservation of natural capital in society, whether for present or future generations (Goodland, 1995).

2.2.2. Environmental Sustainability Dimensions

The dimensions of environmental sustainability are reducing environmental pollution, rationalizing the consumption of available resources, preserving human health, and using renewable natural resources (Dawood & Salman, 2016; Lang, 2007, Zain et al., 2008).

2.2.2.1. Reducing Environmental Pollution

Environmental pollution problems have worsened in recent years and interest has increased in trying to find ways to reduce them (Dawood & Salman, 2016).

Environmental pollution is a comprehensive phenomenon in the globe threatening all ecosystems, including plants and animals, as well as human society itself. It is necessary to identify its sources and reduce them. This requires that scientific bodies and international organizations put in place regulations that monitor the process of environmental pollution (Dawood & Salman, 2016).

The Global Environmental Monitoring System (GEMS), established in 1972 on the proposal of the Scientific Committee For Environmental Problems (SCEP) of the International Council for Science Unions (ICSU), is one of the most important organizations that monitor significant sums annually to monitor the global environment. It was the first global environmental monitoring work at the World Environment Conference held in Stockholm in 1972 and now includes 142 countries, all of which are concerned with environmental monitoring (Dawood & Salman, 2016; Katyal & Satake, 2002).

2.2.2.2. Rationalizing the Consumption of Available Resources

Wasting environmental resources is one of the factors that interfere with achieving environmental sustainability. Therefore there must be good management of natural resources in a manner that leads to the

exploitation of available resources in an economic manner that meets the desires and needs of current and future generations (Dawood & Salman, 2016).

The use of natural resources is what leads to the occurrence of environmental problems in all parts of the world. Therefore, it must be used in a way that preserves the environment on the one hand, and meet the needs of generations on the other hand. So, the environmental impacts of the use of natural resource reserves must be taken into account (Dawood & Salman, 2016; Muilerman & Blonk, 2001; Watson et al., 2000).

2.2.2.3. Preserving Human Health

Human health has its roots in the environment. The environmental conditions affect human characteristics, as they affect their growth, disease or prevention, treatment, nutrition and other aspects related to human age. Environmental impacts associated with human health are called Ecological Health (Dawood & Salman, 2016).

The most problems facing the world are how to maintain human health. The biological factors present in the environment such as water, food, air, and others greatly affect human health, which leads to the early death of millions of people. Therefore, methods for assessing the impact on environmental health must be developed (Dawood & Salman, 2016).

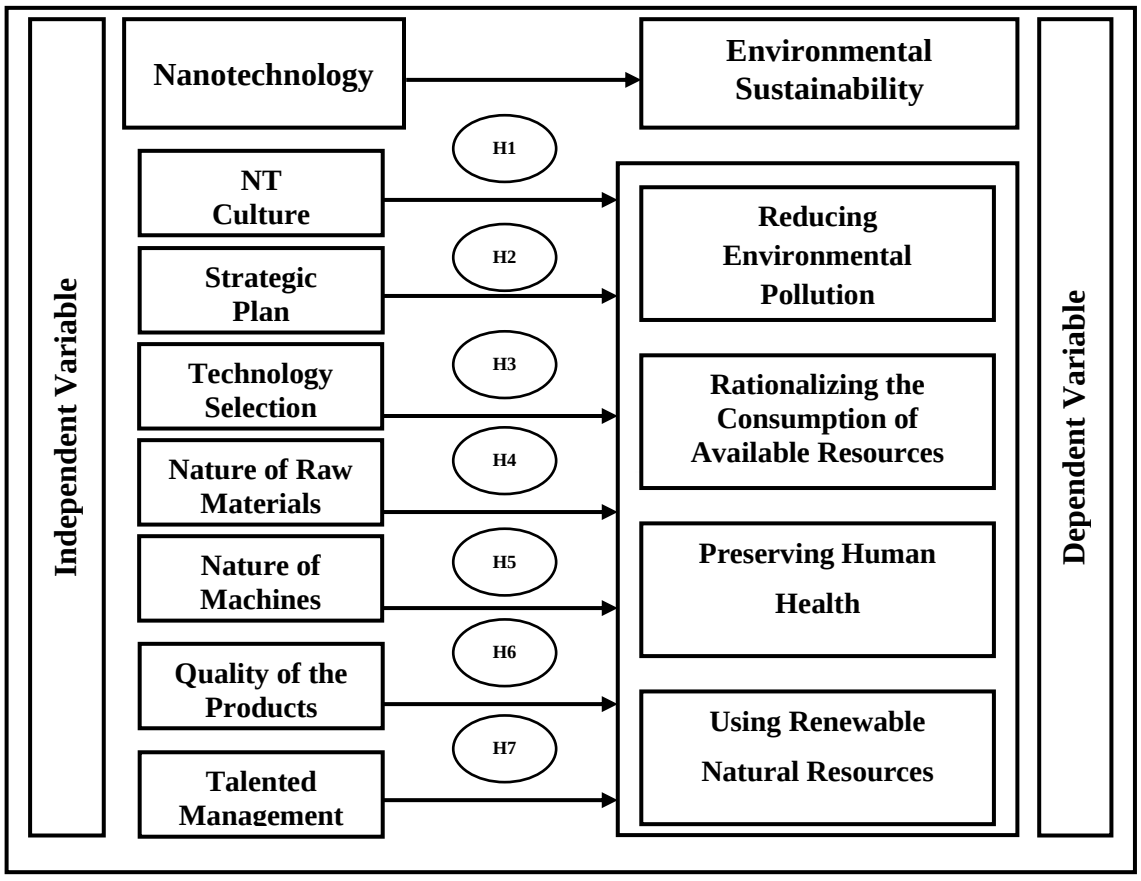
2.2.2.4. Using Renewable Natural Resources

Renewable environmental resources are materials whose balance does not end with just use. This balance remains usable for multiple times and for long periods of time if this environmental source is exploited appropriately, and it has not been exposed to overuse in a manner that leads to its deterioration. (Dawood & Salman, 2016).

Renewable energy sources are characterized by their constant exploitation without leading to their exhaustion. Also, renewable energy sources are resources that can be used to produce energy again, such as geothermal energy, etc. These sources are called alternative energy. In general, renewable energy plays an important role in facing environmental and economic threats that pose a threat to the environment in general, and the organisms that inhabit it in particular. (Dawood & Salman, 2016; Panwar et al., 2011).

3. Research Model

Figure (1) Proposed Comprehensive Conceptual Model



The diagram shows that there is one independent variable of NT. There is one dependent variable of ES.

NT is measured in terms of NT culture, strategic plan, technology selection and evaluation, the nature of raw materials, the nature of machines and production processes, the quality of the products, and talented management (Stobie, 2003; Kahlawy, 2008).

ES is measured in terms of reducing environmental pollution, rationalizing the consumption of available resources, preserving human health, and using renewable natural resources (Dawood & Salman, 2016; Lang, 2007, Zain et al., 2008).

4. Research Questions

The research problem has two sources. The first source is to be found in previous studies. There is a lack in the number of literature review that dealt with the analysis of the relationship between NT and ES. This called for the researcher to test this relationship in the Egyptian environment.

In light of the review of previous studies towards NT, literature has shown that NT has been used in the field of medicine for the purpose of detecting viruses and improving anti-bacterial activity, and the emergence of the so-called Nano-Factory for the manufacture of corn flour. This leads to the emergence of a new revolutionary model in the field of health care for human beings (Robert & Freitas, 2016).

Another study is concerned with the application of NT in the field of agriculture and sensors to quickly detect the causes of diseases in plants, toxins and other pollutions. In addition, NT plays a dangerous role in the field of safe pesticides (Tejfal, 2015).

Another study indicated that NT was applied in the field of libraries in terms of self-circulation service, self-return service, fine payment, storing, theft detection, collection management, inventory processing, items location, and patron privacy (Simon & Mick, 2012).

Another study is concerned with experimenting with some activities in order to introduce students to the nature of NT, in addition to designing curricula in NT for teachers in order to qualify them to work efficiently in this field. The results demonstrated the effectiveness of incorporating the subject of NT into the curricula at the secondary and intermediate levels. In addition to that there is necessity of applying NT education in the elementary stage, and adding some topics related to NT in the curricula of middle and secondary education as compulsory subjects such as engineering and technology (Ban & Kocijanic, 2011).

There is another study concerned with grouping investors in order to face the risks and challenges of NT, in addition to facing scientific uncertainty regarding the results of the application of NT (Gregory, 2008).

Another study indicated that risk management in NT is identifying many uncertainties in terms of risk, return, and future of NT application. Given that all of these things are predominantly uncertain, the principles of traditional risk management, feasibility study, cost-benefit analysis are not all appropriate in how to deal with NT (Marchant et al., 2008).

There is another study that indicated the necessity of examining the labor market in the field of NT to obtain highly trained labor in this field. This is in addition to learning about the role of universities in training current workers (Stephan et al., 2008).

Another study concluded that attention should be paid to converting theoretical contributions into practical contributions or commercial inventions that are used scientifically and commercially. This field will be fertile for multiple categories such as legal, patent holders, scientists, researchers, business managers and technology transfer specialists (Matthew, 2008).

Another study indicated the importance of having a framework for NT, the necessity and importance of government funding for this field of advanced technology, and that this be in a legal framework that regulates work in this area and intelligence (Khalawey, 2008).

Another study indicated that NT became related to consumer products, which led to the emergence of a field of NANO. This is an area of NT related matters, as trademark registration can be used as a tool for NT protection (Jason, 2008).

There is another study concerned with technology management in general, and in the field of engineering, science and management related to new technology, and how to benefit from it in achieving the strategic goals of the organization in particular. The technology management includes several dimensions,

the most important of which are the definition of technology, its selection, acquisition, absorption and investment in it (Khalawey, 2008).

Another study is concerned with the talent of management in using technology in order to achieve the low cost of money and time in achieving the goals of the organization. Large organizations are interested in choosing their leadership in terms of knowledge, their functional location, their experiences and skills, and most of all talent. Given that talent is the highest level in the classroom, and that the organization cares about talent, this means that it is concerned with strategy (Khalawey, 2008).

Another study indicated that there are many researchers in the field of chemistry who are familiar with chemical concepts due to the nature of their studies, but they lack a link with NT (Steven & Krajcik, 2007).

Another study indicated the necessity of drafting laws that transcend national borders in the field of NT, in addition to develop a series of strategic considerations that must be considered when designing these laws (Kenneth et al., 2006).

There is another study that dealt with the problems of designing and operating micro chemical plants used in production in terms of categorizing the design problems of microscopic plants into two problems, the first is related to the design of micro processing processes. The second is related to the design of microscopic plants as a whole. The features of the micro systems are explained for each sub-problem that must be solved by process system engineers, and then summarize the features of instrumentation problems and control of fine chemical plants (Hasebe, 2003).

Another study indicated that there is a problem in the process of NT evaluation in twenty Swiss organizations of different sizes from different industries, and most of these organizations are keen to provide NT in their products and processes (Bucher et al., 2003).

As for the ES, literature has shown that the role of environmental sustainability in adopting the use of smart cards in Taiwan universities, based on the premise that higher education institutions are the main engine for change in achieving a sustainable environment in society in general, and on campus in particular (Ho et al., 2015).

Another study focused on the importance of environmental sustainability in higher education in order to increase financial returns as a result of internal operations in higher education institutions (Afriyie, 2015)

Another study discussed the effect of university education on the extent to which designers contribute to achieving sustainable design. This is in addition to the importance of the role of environmental situations in general, and environmental education in particular (Rider & Elliott, 2015).

Another study related to the role of environmental sustainability in improving academic results among the various university education institutions through the maximization of environmental resources contributes to improving academic results. This leads to maintaining the sustainable development of university educational institutions. (Park et al., 2013).

Another study is concerned with measuring the effectiveness of the environmental management system (ISO 14001) in enhancing environmental sustainability. The environmental management programs play an important role in improving environmental performance and achieving sustainable development goals (Marambanyika & Mutekwa, 2009).

Another study focused on how to guide a sustainable development strategy framework that can be used to try to integrate sustainability into environmental management systems to achieve and succeed in sustainability (Ahmed et al., 2009)

Another study focused on analyzing the different environmental policies that a number of developed and developing countries have relied on and the effects on society. This is in addition to highlighting the most important successful policies upon which some countries practicing sustainability relied on (Attah, 2010).

Another study focused on the importance of partnership in higher education in order to achieve sustainability. The comprehensive approach to sustainable development in higher education provides confidence among decision makers, which leads to the possibility of implementing sustainable development in its three dimensions which are economic, social and environmental (Johnston, 2007).

There is also another study concerned with the role of environmental education in achieving sustainable development, based on the importance of sustainable education in developing students' skills through focusing on human and natural resources of society that contribute to enhancing student awareness of the educational process and responding efficiently to its requirements. (Scott, 2008).

As a result of the discussions given above, the research questions of this study are as follows:

Q1: What is the relationship between NT (NT culture) and ES at Pharmaceutical industry in Egypt?

Q2: What is the nature of the relationship between NT (strategic plan) and ES at Pharmaceutical industry in Egypt?

Q3: What is the extent of the relationship between NT (technology selection and evaluation) and ES at Pharmaceutical industry in Egypt?

Q4: What is the nature and extent of the relationship between NT (the nature of raw materials) and ES at Pharmaceutical industry in Egypt?

Q5: What is the extent of the relationship between NT (the nature of machines and production processes) and ES at Pharmaceutical industry in Egypt?

Q6: What is the relationship between NT (the quality of the products) and ES at Pharmaceutical industry in Egypt?

Q7: What is the nature of the relationship between NT (talented management) and ES at Pharmaceutical industry in Egypt?

5. Research Hypotheses

In the light of a review of previous studies towards NT, literature studies has shown that NT has been applied in the field of dentistry and biomedicine. Studies have shown that nano materials can be used to renew bone, skin, and tissues in teeth. There are also many advantages to using natural or artificial organic nanostructures for dental implants and tissue regeneration (Maria et al., 2016).

Another study indicated the importance of applying NT in the field of agriculture, as it plays an important role in detecting diseases on the one hand, and the massive development of safe pesticides on the other hand. It was also pointed out that there are some concerns about the safety of applying NT to humans, as there are some potential points of exposure of the human element to nano materials present in agricultural food chains, which raises its problem in health and the environment, so an effective strategy in managing risks from technological developments (Tejpal, 2015).

Another study was concerned with the application of NT at the secondary and intermediate levels for the purpose of introducing students and teachers to the nature of NT. This is important for knowledge of developments in the field of technology, as it is important for teachers so that they can benefit from this field in order to perform their work efficiently and effectively. The results reached the importance of applying NT at the secondary and intermediate levels, in addition to the primary stage and the necessity of adding compulsory subjects such as engineering and technology in the various educational stages (Ban & Kocijanic, 2011).

Another study is related to different approaches to group all investors with the aim of working together in a new government system to meet the challenges of NT and the risk and lack of scientific certainty of the results of its application (Gregory, 2008).

Another study indicated that it is necessary to suggest a method for sharing and cooperating in how to manage risk in NT, given that traditional risk management methods will not be valid, and therefore there must be a method suitable for managing technology in the future. In this regard, we can use some similar cases that have proven successful in the field of technology (Marchant et al., 2008).

There is also another study that indicated the determination of the demand for highly trained workers in the field of NT. The study concluded that the demand for this type of employment is still small. So, universities must play their role in the field of training and qualification of workers in the field of NT (Stephan et al., 2008).

There is another study concerned with the talent component in management to achieve the success of the organization, and successful management depends on the culture that is placed in the organization, ease of application, integration among its members, sharing data, ease of use of available capabilities and resources, and ease of using information, which ultimately leads to achieve the organization objectives efficiently and effectively (Khalaweg, 2008).

Another study indicated that NT became fast and related to consumer products, which led to the emergence of trademarks and patents, or what is known as NANO, and that relates to the aspects surrounding NT, and registration of the trademark, which made fraudsters in the field of NANO on the shelf

(Jason, 2008).

Another study is concerned with how to manage technology in multiple fields in order to benefit from it in achieving the strategic goals of the organization. The dimensions of technology management are the existence of a strategic plan for the organization in the field of technology, finance, and the efficiency of its management, assessing its risks, and using auditors and accountants to assess the efficiency of technology management in the organization (Khalaweg, 2008).

Another study indicated the need to provide a framework for NT and how to build it, with the need to focus on the importance of government funding for this type of technology in the presence of a legal framework governing this area (Khalaweg, 2008).

Another study concluded that the theoretical contribution should be transformed into commercial biological inventions that will be used in all fields, whether at the level of researchers, business managers, and specialists in technology transfer (Matthew, 2008).

Another study is interested in knowing the extent of students in the concepts and technology of nano science in the field of chemistry, and it became clear that students are more understanding of chemical concepts, they lack the link to nano science and NT techniques (Steven & Krajcik, 2007).

Another study indicated the need to take into account the dangers of NT, determine the extent of legal permissibility, and the need to emphasize the importance and flexibility of laws related to overcoming legal limits in the field of NT. This is in addition to the need to consider that NT is beneficial despite full knowledge of it, and for this it is necessary to study some legal models that have been designed in some technologically similar situations (Kenneth et al., 2006).

Another study referred to the report of the future of NT project implemented in 2004. The study and analysis addressed the methodological issues related to the classification of the scope and its impact on the results, and the use of data, getting to know the future and making some important recommendations (Andersen, 2005).

Another study indicated that a general framework for NT evaluation was reached through a scientific approach based on the use of artificial intelligence technology, decision-making technology, and technology building in industrial organizations (Bucher et al, 2003).

As for the ES, literature has shown relationship between university and environmental sustainability. The study concluded that although there is a great deal of awareness among students towards university sustainability, they lack interest and participation in achieving environmental sustainability (Ho et al. 2015).

Another study is concerned with analyzing the relationship between environmental sustainability and financial return. The study concluded that the interest in achieving environmental sustainability contributes to increasing financial returns in university education institutions as a result of its internal operations (Afriyie, 2015).

Another study emphasized the relationship between partnership between university education institutions and environmental sustainability. The study found that partnership in higher education contributes significantly to achieving sustainable development. In addition, the coherent approach between university education institutions contributes to achieving sustainable development, whether economic, social, or environmental. (Johnston, 2007).

Another study focused on the relationship between environmental education and sustainable development. The study concluded that developing students' skills during the educational process contributes to increasing environmental awareness, and thus familiarity with the importance of the environmental sustainability for society (Scott, 2008)

Another study focused on analyzing the relationship between environmental sustainability and academic outcomes for university educational institutions. The study concluded that the continuous development of the environment contribute significantly to improving academic results in university education and thus achieving a sustainable environment for the university educational institution (Park et al., 2013).

Another study is concerned with analyzing the relationship between environmental management systems and environmental sustainability. The study concluded that the environmental management system plays an important role in improving environmental performance. The study also indicated that there is a

conflict of environmental legislation that organizations must adhere to in protecting the environment and not damaging it (Marambanyika & Mutekwa, 2009).

Another study focused on integrating the sustainability process into environmental management systems. The study found that the available EMS is the tool or means by which it can be used to implement environmental agendas in an effective manner, which leads to the integration of the sustainability process in environmental management systems (Ahmed et al., 2009).

Another study emphasized the relationship between environmental sustainability and sustainable growth. The study found the importance of environmental sustainability in improving economic activities on the one hand, and solving environmental degradation problems on the other hand. The study also indicated that an increased focus on environmental sustainability can harm economic activities, as well as a focus on achieving economic growth that can lead to health risks and increase the process of environmental degradation in society (Attah, 2010).

The following hypotheses were developed to decide if there is a significant correlation between NT and ES.

H1: There is no statistically significant relationship between NT (NT culture) and ES at Pharmaceutical industry in Egypt.

H2: NT (strategic plan) has no significant effect on ES at the industrial companies in Egypt.

H3: There is no relationship between NT (technology selection and evaluation) and ES at Pharmaceutical industry in Egypt.

H4: NT (the nature of raw materials) has no significant impact on ES at Pharmaceutical industry in Egypt.

H5: There is no relationship between NT (the nature of machines and production processes) and ES at Pharmaceutical industry in Egypt.

H6: There is no statistically significant relationship between NT (the quality of the products) and ES at Pharmaceutical industry in Egypt.

H7: NT (talented management) has no significant effect on ES at Pharmaceutical industry in Egypt.

6. Research Population and Sample

The population of the study is 4783 employees at the pharmaceutical industry in Egypt. This sector includes five companies. They are Delta for the Pharmaceutical Industry, Egyptian International Pharmaceutical Industries (Eipico), Pharma Sweden, Egypt Otsu, and Egyptian Chemicals and Drugs. The random sampling was used for collecting the primary data. The following equation determines the sampling size (Daniel, 1999):

$$n = \frac{N \times (Z)^2 \times P\,(1-P)}{d^2\,(N-1) + (Z)^2 \times P\,(1-P)}$$

Accordingly, the sample size has become 355 employees at the pharmaceutical industry in Egypt.

Table (1) Distribution of the Sample Size

Egyptian Pharmaceutical Companies in Egypt	Employees	Percentage	Sample Size
1. Delta for the Pharmaceutical Industry	1500	31.4%	355X 31.4%= 112
2. Egyptian International Pharmaceutical Industries (Eipico)	1833	38.3%	355X 38.3% = 136
3. Pharma Sweden	850	17.8%	355 X17.8% = 63
4. Egypt Otsu	350	7.3%	355X 7.3% = 26
5. Egyptian Chemicals and Drugs	250	5.2%	355X 5.2% = 19
Total	**4783**	**100%**	**355X 100% = 356**

Source: Personnel Department at Pharmaceutical Industry in Egypt, 2018

Table (2) Characteristics of Items of the Sample

Demographic Variables		Frequency	Percentage
1. Gender	Male	170	57%
	Female	130	43%
	Total	**300**	**100%**
2. Marital Status	Single	85	28%
	Married	215	72%
	Total	**300**	**100%**

3. Age	From 30 to 45	190	63%
	Above 45	110	37%
	Total	**300**	**100%**
4. Educational Level	University	180	60%
	Post Graduate	120	40%
	Total	**300**	**100%**
5. Period of Experience	From 5 to 10	210	70%
	More than 10	90	30%
	Total	**300**	**100%**

7. Procedure

The goal of this study was to identify the role of NT in affecting ES. A survey research method was used to collect data. The questionnaire included four questions, relating to NT, ES and biographical information of employees at Pharmaceutical industry in Egypt. About 355 survey questionnaires were distributed. Multiple follow-ups yielded 300 statistically usable questionnaires. Survey responses were 84%.

8. Research Variables and Methods of Measuring

The 28-item scale NT section is based on Dawood & Salman, 2016; Lang, 2007, Zain et al., 2008. There were eight items measuring NT culture, four items measuring strategic plan, four items measuring technology selection and evaluation, four items measuring the nature of raw materials, four items measuring the nature of machines and production processes, four items measuring the product quality, and four items measuring talented management

The 25-item scale ES section is based on Stobie, 2003; Kahlawy, 2008. There were four items measuring reducing environmental pollution, six items measuring rationalizing the consumption of available resources, six items measuring preserving human health, and five items measuring using renewable natural resources

9. Data Analysis and Hypotheses Testing

9.1. Coding of Variables

Table (3) Description and Measuring of the Research Variables

Main Variables		Sub-Variables	Number of Statement	Methods of Measuring Variables
Independent Variable	Nanotechnology	NT Culture	4	Stobie, 2003; Kahlawy, 2008
		Strategic Plan	4	
		Technology Selection	4	
		Nature of Raw Materials	4	
		Nature of Machines and Production	4	
		The Quality of the Products	4	
		Talented Management	4	
Total NT			**28**	
Dependent Variable	Environmental Sustainability	Reducing Environmental Pollution	8	Nguyen et al., 2018; Tooranloo, et al., 2017; Adeoye, 2017; Rensburg, 2015; Spangenberg, 2013; Eltayeb, 2011; Romiguer, 2011
		Rationalizing the Consumption of Available Resources	6	
		Preserving Human Health	6	
		Using Renewable Natural Resources	5	
Total ES			**25**	

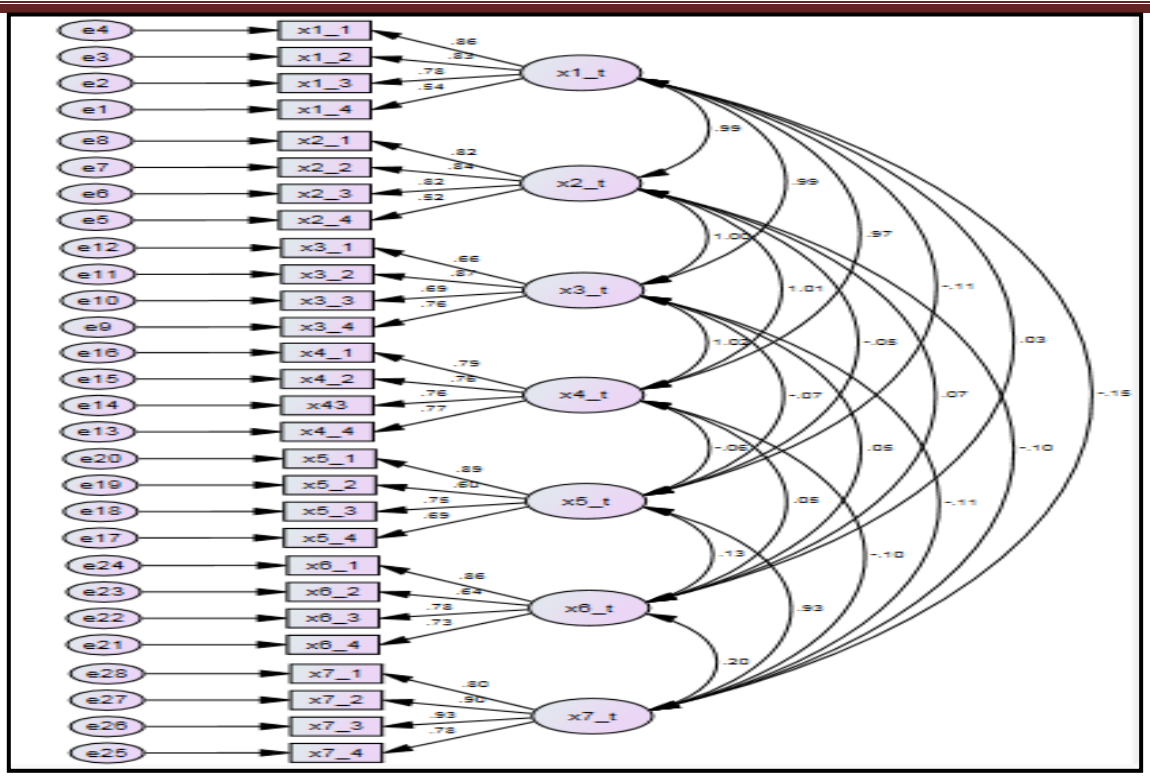
According to Table (3) the research consists of two main variables. The first is NT (independent variable). The second is ES (dependent variable). Each variable consists of sub-variables.

9.2. Construct Validity

9.2.1. Nanotechnology

The researcher used Confirmatory Factor Analysis (CFA) for NT. This variable consists of seven dimensions. The total number of NT is 28 statement. This can be illustrated by the following figure:

Figure (2) CFA For NT



Source: AMOS, V.23

From the previous figure, it is clear that all the statement of NT are greater than 0.50, which corresponds to GFI. This is a good indicator of all other statistical analysis. The quality indicators for NT can be illustrated in the following table:

Table (4) Quality Indicators for NT Using AMOS Analysis

Test the Quality of the Model Acceptance Condition (Daire et al., 2008)	Test Value
X^2 / Degree of freedom >5	725.822
P. value > 0.5	0.000
Goodness of fit Index (GFI) > 0.90	0.845
Tuker-Lewis Index (TLI) > 0.95	0.923
Comparative Fit Index (CFI) > 0.90	0.933
Normed Fit Index (NFI) > 0.90	0.885
Incremental Fit Index (IFI) > 0.95	0.933
Relative Fit Index (RFI) > 0.90	0.867
Root Mean Square Residual (RMR) < 0.5	0.401
Root Mean Square Error of Approximation (RMSEA) < 0.5	0.064

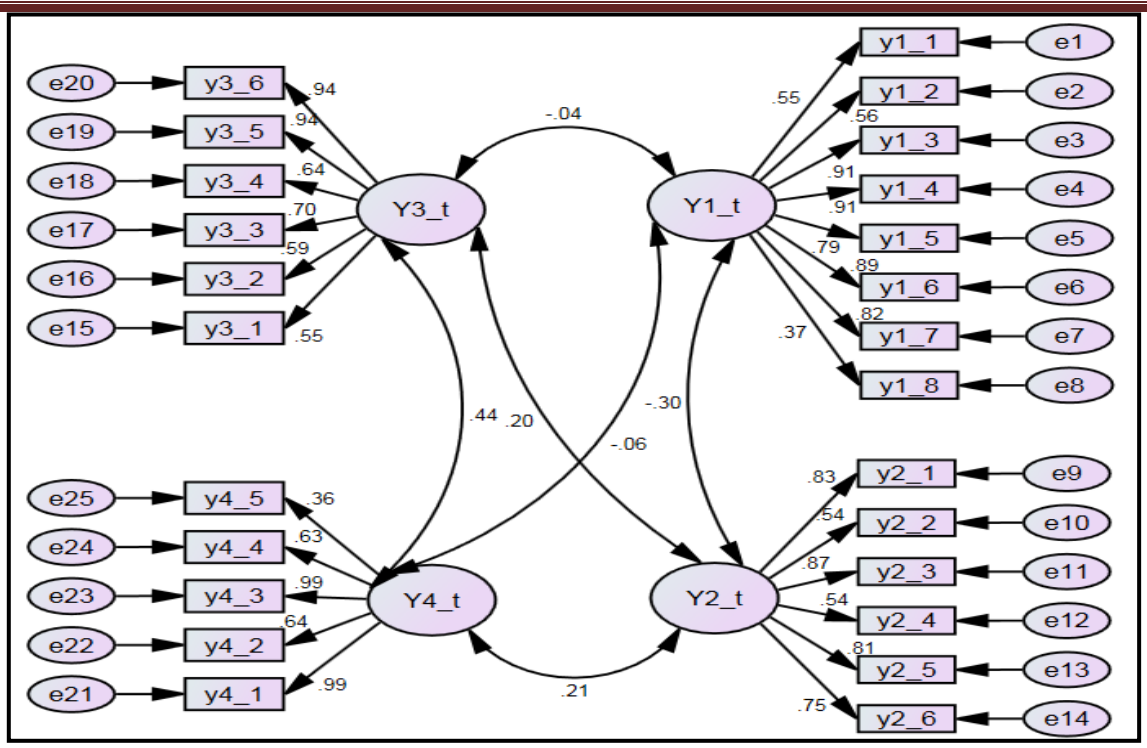
Source: AMOS, V.23, 2015

In light of the above-mentioned indicators, it is clear that the previous indicators are good for making all other statistical analysis.

9.2.2. Environmental Sustainability

The researcher used CFA for ES which consists of four dimensions. The total number of ES is 25 statement. This can be illustrated in Figure (2).

Figure (3) CFA For ES



Source: AMOS, V.23, 2015

According to Figure (2), it is clear that all the statement of ES are greater than 0.50. This is a good indicator of all other statistical analysis. The quality indicators for ES can be illustrated in the following table:

Table (5) Quality Indicators for ES Using AMOS Analysis

Test the Quality of the Model Acceptance Condition (Daire et al., 2008)	Test Value
X^2 / Degree of freedom < 5	3442.956
P. value > 0.5	0.000
Goodness of fit Index (GFI) > 0.90	0.645
Tuker-Lewis Index (TLI) > 0.95	0.561
Comparative Fit Index (CFI) > 0.95	0.606
Normed Fit Index (NFI) > 0.90	0.588
Incremental Fit Index (IFI) > 0.95	0.608
Relative Fit Index (RFI) > 0.90	0.541
Root Mean Square Residual (RMR) < 0.5	0.201
Root Mean Square Error of Approximation (RMSEA) < 0.5	0.199

Source: AMOS, V.23, 2015

In light of the above-mentioned indicators, it is clear that the previous indicators are good for making all other statistical analysis.

9.3. Descriptive Analysis

Table (6) shows the mean and standard deviations of NT and ES

Variables	The Dimension	Mean	Standard Deviation
Nanotechnology	NT Culture	2.66	0.927
	Strategic Plan	2.71	0.931
	Technology selection	2.68	0.920
	Nature of Raw Materials	2.84	0.940
	Nature of Machines	3.50	0.962
	The Quality of the Products	3.47	1.011
	Talented Management	3.41	0.981

	Total Measurement	**2.55**	**0.544**
Environmental Sustainability	Reducing Environmental Pollution	4.10	0.846
	Rationalizing the Consumption of Available Resources	2.74	0.958
	Preserving Human Health	2.78	0.922
	Using Renewable Natural Resources	2.69	0.807
	Total Measurement	**3.18**	**0.457**

According to Table (6), most of the respondents identified the NT culture (M=2.66, SD=0.927), strategic plan (M=2.71, SD=0.931), technology selection and evaluation (M=2.68, SD=0.920), the nature of raw materials (M=2.84, SD=0.940), the nature of machines and production processes (M=3.50, SD=0.962), the quality of the products (M=3.47, SD= 1.011), talented management (M=3.41, SD=0.981), and total NT (M=2.55, SD=0.544).

Regarding to SD, most of the respondents identified the reducing environmental pollution (M=4.10, SD=0.846), rationalizing the consumption of available resources (M=2.74, SD=0.958), preserving human health (M=2.78, SD=0.922), using renewable natural resources (M=2.69, SD=0.807), and total SD (M=3.18, SD=0.457).

9.4. Evaluating Reliability

Table (7) Reliability of NT and ES

Variables	Dimension	Number of Statement	ACC
Nanotechnology	NT Culture	4	0.838
	Strategic Plan	4	0.830
	Technology selection	4	0.827
	Nature of Raw Materials	4	0.853
	Nature of Machines	4	0.829
	The Quality of the Products	4	0.839
	Talented Management	4	0.913
	Total Measurement	**28**	**0.893**
Environmental Sustainability	Reducing Environmental Pollution	8	0.890
	Rationalizing the Consumption of Available Resources	6	0.871
	Preserving Human Health	6	0.886
	Using Renewable Natural Resources	5	0.863
	Total Measurement	**25**	**0.792**

Table (7) presents the reliability of NT. The 28 items of NT are reliable because the ACC is 0.893. The 4 items of NT culture are reliable because ACC is 0.838. The strategic plan, which consists of 4 items, is reliable because ACC is 0.830. The 4 items related to technology selection and evaluation, are reliable because ACC is 0.827 while the 4 items of the nature of raw materials are reliable because ACC is 0.853. The 4 items related to the nature of machines and production processes are reliable because ACC is 0.829 while the 4 items of the products quality are reliable because ACC is 0.834. The 4 items related to talented management are reliable because ACC is 0.913. Thus, the internal consistency of NT can be acceptable.

The 25 items of ES are reliable because the ACC is 0.792. The reducing environmental pollution, which consists of 4 items, is reliable because ACC is 0.890. The 4 items related to rationalizing the consumption of available resources are reliable because ACC is 0.871 while the 4 items of preserving human health are reliable because ACC is 0.886. The 4 items related to using renewable natural resources are reliable because ACC is 0.863. Thus, the internal consistency of ES can be acceptable.

9.5. The Means, St. Deviations and Correlation among Variables

Table (8) Means, Standard Deviations and Intercorrelations among Variables

Variables	Mean	Std. Deviation	NT	ES
Nanotechnology	2.55	0.544	1	
Environmental Sustainability	3.18	0.457	0.477**	1

Table (8) shows correlation coefficients between NT and ES. NT is (Mean=2.55; ES=0.544), while ES is (Mean=3.18; ES= 0.457). Also, the correlation between NT and ES is (R=0.477; P <0.01).

9.6. The Correlation between NT and ES

Table (9) Correlation Matrix between NT and ES

Research Variables	1	2	3	4	5	6	7	8
NT Culture	1							
Strategic Plan	0.856**	1						
Technology selection	0.845**	0.847**	1					
Raw Materials	0.837**	0.864**	0.871**	1				
Nature of Machines	0.074**	0.026**	0.053**	0.041**	1			
Product Quality	0.036**	0.067**	0.046**	0.044**	0.134**	1		
Talented Management	0.118**	0.089**	0.102**	0.085**	0.809**	0.197**	1	
Environmental Sustainability	0.468**	0.477**	0.473**	0.495**	0.082**	0.038**	0.028**	1

Note: ** Correlation is significant at 0.01 level.

Based on Table (9), correlation between NT (NT Culture) and ES is 0.468 whereas NT (strategic plan) and ES shows correlation value of 0.477. Also, NT (technology selection and evaluation) and ES is 0.473 whereas NT (the nature of raw materials) and ES shows correlation value of 0.495. The correlation between NT (the nature of machines and production processes) and ES is 0.082 whereas NT (product quality) and ES shows correlation value of 0.038. Also, NT (talented management) and ES is 0.028. The overall correlation between NT and ES is 0.477.

9.6.1. Nanotechnology (NT Culture) and ES

Table (10) MRA Results for NT (NT Culture) and ES

Nanotechnology (NT Culture)	Beta	R	R^2
1. The company is keen to follow scientific articles on nanotechnology.	0.231**	0.444	0.197
2. The company is keen to attend the conferences related to nanotechnology.	0.194*	0.432	0.186
3. The company holds seminars and workshops on nanotechnology.	0.067	0.372	0.138
4. The company is keen to spread nanotechnology culture.	0.064	0.275	0.075
▪ MCC ▪ DC ▪ Calculated F ▪ Degree of Freedom ▪ Indexed F ▪ Level of Significance	0.478 0.229 21.849 4, 295 3.31 0.000		
** P < .01			

As Table (10) proves, the MRA resulted in the R of 0.478 demonstrating that the 4 independent variables of NT (NT Culture) construe ES significantly. Furthermore, the value of R^2, 4 independent variables of NT (NT Culture) can explain 0.23% of the total factors in ES level. Hence, 77% are explained by the other factors. Therefore, there is enough empirical evidence to reject the null hypothesis that it said there is no relationship between NT (NT Culture) and ES.

9.6.2. Nanotechnology (Strategic Plan) and ES

Table (11) MRA Results for NT (Strategic Plan) and ES

Nanotechnology (Strategic Plan)	Beta	R	R^2
1. There is a strategic plan for the company on nanotechnology.	0.115	0.415	0.172
2. There is integration between the various departments that work in the field of NT.	0.134*	0.419	0.175
3. There are sufficient financial resources to cover the strategic plan in the field of nanotechnology.	0.303**	0.471	0.221
4. The goals of each company's management are in line with the strategic goals of nanotechnology.	0.001	0.241	0.058

▪ MCC	0.497
▪ DC	0.247
▪ Calculated F	24.152
▪ Degree of Freedom	4, 295
▪ Indexed F	3.31
▪ Level of Significance	0.000
** P < .01	

As Table (11) proves, the MRA resulted in the R of 0. 0.497. This means that ES has been significantly explained by 4 variables of NT (Strategic Plan). As a result of the value of R^2, the four independent variables of NT (Strategic Plan) justified 25% of the total factors in ES. Hence, there is enough empirical evidence to reject the null hypothesis that it said there is no relationship between NT (Strategic Plan) and ES.

9.6.3. Nanotechnology (Technology Selection) and ES

Table (12) MRA Results for NT (Technology Selection) and ES

Nanotechnology (Technology Selection)	Beta	R	R^2
1. There are specific criteria in the company on which to choose the new technology.	0.002	0.297	0.088
2. The company uses reviewers to assess how technology is managed, especially NT.	0.351*	0.478	0.228
3. The company assesses the risks of modern technology, including nanotechnology.	0.090	0.369	0.136
4. The company is keen to follow the latest developments in nanotechnology.	0.110	0.394	0.155
▪ MCC ▪ DC ▪ Calculated F ▪ Degree of Freedom ▪ Indexed F ▪ Level of Significance	0.494 0.245 23.869 4, 295 3.31 0.000		
** P < .01			

As Table (12) proves, the MRA resulted in the R of 0.494 demonstrating that the 4 independent variables of NT (Technology Selection) construe ES significantly. Furthermore, the value of R^2, 4 independent variables of NT (Technology Selection) can explain 0.25% of the total factors in ES. Hence, 75% are explained by the other factors. So, there is enough empirical evidence to reject the null hypothesis that it said there is no relationship between NT (Technology Selection) and ES.

9.6.4. Nanotechnology (Raw Material) and ES

Table (13) MRA Results for NT (Raw Material) and ES

Nanotechnology (Raw Material)	Beta	R	R^2
1. The company has logistical management systems for various materials in the field of NT.	0.326**	0.484	0.234
2. The company has patents in the field of raw materials, especially nanotechnology.	0.070	0.383	0.146
3. The company is following up on the international experiences of raw materials in the field of NT.	0.116*	0.383	0.146
4. The company is keen to recycle the waste products of its products in the field of nanotechnology.	0.081	0.397	0.157
▪ MCC ▪ DC ▪ Calculated F ▪ Degree of Freedom ▪ Indexed F ▪ Level of Significance	0.511 0.261 26.089 4, 295 3.31 0.000		
** P < .01			

As Table (13) proves, the MRA resulted in the R of 0. 0.511. This means that ES has been explained by the 4 independent variables of NT (Raw Material). As a result of the value of R^2, the four independent variables of NT (Raw Material) justified only 26% of the total factors in ES. So, there is enough empirical evidence to reject the null hypothesis that it said there is no relationship between NT (Raw Material) and ES.

9.6.5. Nanotechnology (Natural of Machine) and ES

Table (14) MRA Results for NT (Natural of Machine) and ES

Nanotechnology (Natural of Machine)	Beta	R	R^2
1. The company's production processes are easy to adapt to suit any changes in raw materials.	0.033	0.065	0.004
2. The available machines in the company are flexible to accommodate changes in raw materials.	0.020	0.039	0.001
3. Flexibility of different tools in the company to suit changes in raw materials.	0.077	0.083	0.006
4. There is flexibility in machinery, tools and production processes in the field of NT.	0.077	0.086	0.007
▪ MCC ▪ DC ▪ Calculated F ▪ Degree of Freedom ▪ Indexed F ▪ Level of Significance	0.102 0.010 0.774 4, 295 3.31 0.000		
** P < .01			

As Table (14) proves, the MRA resulted in the R of 0.102 demonstrating that the 4 independent variables of NT (Natural of Machine) construe ES significantly. As a result of R^2, the 4 variables of NT (Natural of Machine) explain 0.010% of the total factors in ES. Hence, 99% are explained by the other factors. Therefore, there is enough empirical evidence to accept the null hypothesis that it said there is no relationship between NT (Natural of Machine) and ES.

9.6.6. Nanotechnology (Quality of Product) and ES

Table (15) MRA Results for NT (Quality of Product) and ES

Nanotechnology (Quality of Product)	Beta	R	R^2
1. The company's products are leading in the local and international market.	0.003	0.032	0.001
2. The company's products are trusted by the end consumer.	0.025	0.009	0.008
3. The company takes into account in its products not to harm the environment and public health.	0.004	0.021	0.004
4. The company's products are reviewed to know their effects on the environment and public health.	0.071	0.058	0.003
▪ MCC ▪ DC ▪ Calculated F ▪ Degree of Freedom ▪ Indexed F ▪ Level of Significance	0.062 0.004 0.288 4, 295 3.31 0.000		
** P < .01			

As Table (15) proves, the MRA resulted in the R of 0.062 demonstrating that the 4 independent variables of NT (Quality of Product) construe ES significantly. Furthermore, the value of R^2, 4 independent variables of NT (Quality of Product) can explain 0.04% of the total factors in ES. Hence, 96% are explained by the other factors. Therefore, there is enough empirical evidence to accept the null hypothesis that it said there is no relationship between NT (Quality of Product) and ES.

9.6.7. Nanotechnology (Talented Management) and ES

Table (16) MRA Results for NT (Talented Management) and ES

Nanotechnology (Talented Management)	Beta	R	R^2
1. The company has a clear strategy for recruiting talented individuals in management.	0.095	0.053	0.002
2. The people working in the company are flexible in dealing with the changes in the raw materials.	0.003	0.021	0.004
3. Workers' adventure is available to learn about the new nanotechnology.	0.053	0.012	0.001
4. Training missions abroad on the latest pharmaceutical industry technology in the world.	0.002	0.13	0.001

▪ MCC	0.066
▪ DC	0.004
▪ Calculated F	0.320
▪ Degree of Freedom	4, 295
▪ Indexed F	3.31
▪ Level of Significance	0.000
** P < .01	

Source: The researcher based on the outputs of SPSS, V.23, 2015

As Table (16) proves, the MRA resulted in the R of 0. 0.066. This means that ES has been significantly explained by the 4 independent variables of NT (Talented Management). As a result of the value of R^2, the four independent variables of NT (Talented Management) justified only 0.04% of the total factors in ES. Hence, there is enough empirical evidence to accept the null hypothesis that it said there is no relationship between NT (Talented Management) and ES.

10. Research Results

10.1. Research Results Related to NT

1. The fields of NT application are numerous and varied in the fields of medicine, agriculture, chemistry, pharmaceutical industries, disease detection, food production, and environmental protection.
2. There are many opportunities and challenges related to NT, and these opportunities and challenges are in the technological, economic and social aspects. Therefore, we must work to take advantage of opportunities and take advantage of them, and reduce the risks that result from the application of NT at Pharmaceutical companies in Egypt.
3. In light of (Stobie, 2003) model, a number of results related to technology management were achieved (Khalawey, 2008):
   - Insufficient awareness of the importance and culture of NT and its various dimensions, although it is one of the vital elements in companies that work in the field of NT, including the Pharmaceutical companies in Egypt.
   - The lack of a strategic plan for NT, in addition to the weak financial resources to put the strategic plan into practice for Pharmaceutical companies in Egypt.
   - Poor standards upon which to choose, review and evaluate the new technology used, especially in the field of NT, in addition to not following the latest developments in NT, and assessing the opportunities and risks that result from its application in Pharmaceutical companies in Egypt.
   - There is no effective system sufficiently for the logistics management of the raw materials that are used in the field of NT, in addition to insufficient attention to follow-up global experiences of raw materials related to the field of NT and their appropriate use which leads to maximizing the benefits from them, and reducing the risks that arise from their use in Pharmaceutical companies in Egypt.
   - The nature of the production processes and the machines used are not commensurate with keeping pace with the changes related to the raw materials that are used in the field of NT, bearing in mind that the machines used are considered one of the most essential requirements for the success and effectiveness of the application of NT in the Pharmaceutical companies in Egypt.
   - Some of the products provided by Egyptian pharmaceutical companies have an impact on the environment, which requires legislative rules regulating work in such products.
   - The management and employment that is used and worked in the field of NT is not sufficiently skilled that can deal with the risks of NT and control it in Egyptian pharmaceutical companies, which requires the necessity of sending missions to train abroad on the latest technology in the pharmaceutical industry in the world.
4. The most prominent Arab weakness in the technology field and its reflection on NT is the best way to prepare a scenario for reforming nano scale knowledge, and this can be done through (Mazeed & Abas, 2011):
   - The scientific progress is only the result of continuous research in the areas of scientific research that is based on drawing knowledge, developing institutions and developing products through spending on areas of scientific research.

- Weak private financing of technology in general, and NT in particular, on the grounds that this is a long-term investment, in addition to the limited government allocations for spending on the scientific research and technology sector.
- The lack of clarity of technological policies, or in other words, the absence of a strategic vision related to technology transfer and exploitation, in addition to the lack of coordination with other policies.
- The increase in the sales and nano products, especially consumer products in the Arab markets, which leads to the depletion of Arab money and its waste on the consumer side, which results in the loss of the ability to establish legal capital on the one hand, and falling into the net of failure to keep pace with the NT on the other hand.
- The growing gap between the developed and Arab countries in the field of using technology in general, and in the field of NT in particular, despite the fact that technology is one of the main pillars in achieving economic development based on knowledge in general, and nano knowledge in particular.

5. One of the studies carried out in the Arab environment has reached a set of general conclusions that explain the Arab weakness in the technological field, the most important of which are the following (Mazeed & Abas, 2011):
   - The use of NT has brought about a new industrial revolution no less important than the first industrial wealth that occurred in the seventeenth century. The uses of NT in medicine, agriculture, libraries and other and varied.
   - The United States of America is the leading country in the field of NT due to several considerations, the most important of which is that it possesses the scientists who have the ability to deal with this science, in addition to that it is the largest country in terms of allocating financial resources for the development and use of NT in all areas in which it can be used.
   - One of the most important challenges facing Arab countries is the volume of spending on NT research, as there is a large gap between the developed countries and the Arab countries in terms of the size of the agreed upon research on NT development.

10.2. Research Results Related to ES

1. The components of the environmental sustainability of the Egyptian pharmaceutical companies showed the importance of making better use of the available resources, deepening the relationship with society, solving environmental problems, continuous improvement and development according to the needs of the environment, as the previous aspects play an important role in achieving environmental sustainability.
2. The Egyptian pharmaceutical companies lack the concept of environmental sustainability and its role in influencing the improvement of internal processes and activities in it. This requires the need to pay attention to documenting the relationship between environmental sustainability and the development and continuous improvement of the activities and operations.
3. The Egyptian pharmaceutical companies management does not have a specific strategy to prevent or reduce pollution as a result of the operations or activities that these companies carry out in the surrounding environment.
4. The Egyptian pharmaceutical companies management does not have an integrated set of programs that are concerned with how to use resources efficiently and effectively, in addition to the lack of policies and programs that seek to rationalize the use of the available resources.
5. Insufficient attention to the naturally renewable energy in Egyptian pharmaceutical companies according to their sources, and the consequences of using them in their own operational processes in a manner that improves their production and reduces costs related to their production operations.

11. Recommendations

11.1. Recommendations Related to NT

1. The necessity of developing a work environment that is able to practice advanced technology and make it a philosophy of senior management in order for industrial companies to proceed in their right practices in a manner that accompanies the changes resulting from the technological revolution, on the basis of

benefiting from modern technology. In addition to the ability of available human resources to realize the importance of modern technology in achieving ES.

2. The management of the industrial companies in Egypt must support and use advanced technology capable of keeping pace with changes in the global environment so that the skills and capabilities of workers to deal with technology in all its forms increase. This will leads to reducing the gap in the use of technology in terms of , Increase productivity and reduce costs, on the other hand.
3. Invite all specialists in universities and other ministries in order to present their expertise in the field of NT, and build an integrated model for industrial companies that takes into account the infrastructure, economy, social capital. This will leads in achieving ES.
4. Allocating a sufficient budget to support, develop and attract specialists from scientists and researchers in the field of NT for the purpose of working on localizing technology and developing it in industrial companies. In addition to the necessity of establishing a local scientific base that specifies the types of technology that can be transferred from developed countries to the industrial companies in Egypt.
5. Developing educational systems and working to achieve a qualitative transfer in the curricula and teaching methods in a manner that contributes to preparing new generations that can deal efficiently with developments in the field of technology in general, and in the field of NT in particular, This will leads in achieving economic sustainability, social sustainability, and sustainability environmental.
6. There are several requirements that must be considered when applying NT in the Pharmaceutical industry in Egypt (Khalawey, 2008):
   - The need to pay attention to the culture of NT by following scientific articles in the field of NT, and attending conferences and workshops related to NT in the Egyptian pharmaceutical industry.
   - Focusing on the importance of having a strategic plan in the Pharmaceutical companies in Egypt about NT, in addition to its importance to provide sufficient financial resources to cover the strategic plan.
   - The importance of good selection, review and evaluation of the new technology that is used in pharmaceutical companies in general, and in the field of NT in particular. This is in addition to the necessity of these companies being keen to follow the latest technology in the field of NT and trying to increase productivity and reduce costs in the pharmaceutical industry in Egypt.
   - Focusing on the existence of a logistic management system for various materials in the field of NT, and the need to follow up global experiences of raw materials in the field of NT. This is in addition to the need to recycle the waste products of Egyptian pharmaceutical companies.
   - The need to pay attention to providing machines and equipment with multiple characteristics that can deal with the changes that occur in the raw materials that are used in Egyptian pharmaceutical companies.
   - Focusing on the necessity of a unique quality of products to the local and global market, provided that these products can obtain the ultimate consumer confidence on the one hand, and not harm the environment and public health on the other hand. In addition to the need for Egyptian pharmaceutical companies to review and evaluate their products on an ongoing basis to know their effects on human health and environmental health from time to time.
   - Focusing on the importance of having a strategic plan related to the importance of having talented individuals in the field of management, in addition to the presence of skilled and distinguished labor in the field of NT to deal with the changes that occur in the raw materials that are used in the Egyptian pharmaceutical companies. This is in addition to the need to pay attention to sending workers to missions and attending conferences and workshops to train in the latest pharmaceutical industry technology in the world, which leads to achieving the goals of Egyptian pharmaceutical companies and increasing productivity and reducing costs in the field of medicines.
7. The necessity of keeping pace with technological developments in general, and NT in particular, through academic decisions in the various educational stages, workshops, seminars, and conferences in a manner that leads to increasing awareness of the importance of nanotechnology in all areas of life.
8. The need to enrich scientific research in the field of NT and work to develop and spread the culture of NT by sending researchers and scholars to developed countries in the field of NT. This is in addition to the training courses that contribute to increasing familiarity with and knowledge of NT in terms of its

importance, applications and risks, which ultimately leads to keeping pace with the developed countries in the field of NT.

9. The necessity for the Ministry of Higher Education, in cooperation with all universities, to reconsider the preparation of decisions and programs to enhance NT culture and to include them in curricula in order to keep pace with global developments in this field, as the application of NT includes many fields such as chemistry, biology, geology, and physics, which leads to make the current learning system in line with and compatible with developments in the field of NT.
10. Developing the laboratories of the faculties of science in the field of physics, chemistry, biology and geology, to keep the developments of courses in the field of NT. In addition to the advanced educational methods associated with this field. This requires that there be a comprehensive strategy between the Ministry of Higher Education, international universities, and research centers in various developed countries that are interested in the field of NT to benefit from different experiences and experiences, and exchange ideas, experiences and programs in the field of NT.
11. Technology transfer, and development are subject to ideological options that are far from the economic conditions for their implementation, and this requires: (Mazeed & Abas, 2011):
    - The necessity to compel the government to involve scientists in the field of technology in particular in decision-making in the national planning process. This is in addition to the periodic and systematic evaluation of the status of scientific systems and technology to advance the level of research structure in the scientific and technological fields.
    - Establishing world-class scientific and technological bodies and committees working to encourage scientific achievements on the one hand, and the introduction and application of technological policies on the other hand.
    - Encouraging technological interaction, spreading scientific awareness related to nanotechnology and simplifying it for members of society, and showing its role in achieving growth and progress for societies.
    - Benefiting from Arab experiences abroad by mobilizing the largest possible number of human scientific competencies in the field of technology in general, and NT in particular, and working to transfer technology in a manner that achieves benefit from the experiences of developed countries.
    - Working on using information technology in a way that helps decision-makers in setting the policy that achieves economic development based on technology in general, and nano knowledge in particular.
12. The necessity of accessing strategic industrial technology related to NT, the main axes of which are as follows (Mazeed & Abas, 2011):
    - Identify successful experiences in the field of NT in the world and try to define the mechanisms through which the technological base in the Arab countries can be developed, with a view to reducing the size of the technology gap between the developed and Arab countries.
    - Work to establish specialized centers in the field of technology in general, and NT in particular in the Arab countries, with a view to absorbing NT in the light of industrial development programs in the Arab countries.
    - The necessity of the interests of the various sectors to extract part of the financial resources that they obtain and allocate them to finance and develop their research centers in the field of technology in general, and NT in particular, in order to reduce the gap between the developed countries and the Arab countries on the one hand, and keep pace with technological developments in the field of NT on the one hand other.

11.2. Recommendations Related to ES

1. Dissemination of a sustainable environment culture to all industrial companies in general, and the Egyptian pharmaceutical companies in particular, through various media channels, courses, seminars and workshops for all individuals in society on the sustainable environment.
2. Setting a strategic plan that seeks to strengthen and develop the relationship between the Egyptian pharmaceutical companies and the continuous improvement and development of the surrounding environment, given that it plays an important role in influencing their internal activities and operations.

3. The necessity for Egyptian pharmaceutical companies to pay attention to research and studies that seek to address environmental problems, which leads to providing a safe environment free from the causes of pollution and environmental damage.
4. The necessity of taking care of the Egyptian pharmaceutical companies' administration in providing appropriate measures to identify levels of environmental pollution, given the practice of these companies of their various activities and operations, in addition to the necessary treatment and providing the appropriate capabilities through which to reduce environmental pollution.
5. The necessity of using resources and recyclable parts on the one hand, and paying attention to manufacturing processes that are based on the production of products related to the environment on the other hand.
6. Extending the knowledge and awareness of managers and workers in the Egyptian pharmaceutical companies towards environmental sustainability in order to keep pace with new developments in this field.
7. Focusing on the importance of the role that environmental sustainability plays in reducing environmental and community pressures on the organization in general, and its production systems in particular.
8. Enhancing the role of the integrated relationship between the manufacturing systems in the Egyptian pharmaceutical companies and social responsibility in promoting environmental sustainability and ensuring their long-term sustainability.
9. The necessity for Egyptian pharmaceutical companies to pay attention to developing a strategy whose primary goal is to reduce pollution and reduce its negative effects. In addition, adherence to the matters specified by the Ministry of Environment is not sufficient to prevent or reduce environmental pollution.
10. The necessity of designing a set of programs and policies that Egyptian pharmaceutical companies must adhere to, how to use available resources on the one hand, and rationalize consumption on the other hand. This leads to a reduction in the waste resulting from the activities carried out by companies, thus preserving human and environmental health.
11. The need to pay attention to raising awareness among all workers at the different administrative levels of Egyptian pharmaceutical companies about the importance of renewable energy and how to benefit from it. This can be done through courses, workshops and seminars on the nature of renewable energy, its sources, and the implications of its use.

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