

Impact of Nanotechnology on Cost Leadership and Competitive Advantage Strategies in Energy Sector

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Abstract: The discussion of scarce energies and emerging global warming phenomena are regarded as serious problems pertinent to threats of the world through the natural suffering. To date, a huge part of academic literature from different aspects has been allocated to these two problems. Creating nanotechnology products is a helpful way to pass these difficulties in the future. The core idea of this study is to investigate the related literature by taking advantage from qualitative research as desk study of published issues about nanotechnology and management strategies. In depth, reviewing the literature of nanotechnology presented that almost all scholars are consensus about existing solutions which influence the use of nanotechnology and its products. However, using nano products would not be as a sufficient solution. It has been noticed that the important point is the correct management and planning for the future. It is interesting that management would have been allocated to manage time and place in the right time and place so that the different ideas lead to competition among firms in the energy sector to get more profit economically and environmentally from innovation situations as opportunities in the future markets. Consequently, competitive advantage as an important strategy is intervened for conducting energy companies to achieve their goals in the successful ways. Additionally, the lack of efficiency energy system causes to find and introduce the best consumption patterns of managing fuels through cost leadership. The current study only focuses on nanotechnology applications as well as strategies namely competitive advantage and cost leadership.

Key words: Nanotechnology, Competitive advantage, Cost leadership, Desk study, Generic strategies

INTRODUCTION

Nanotechnology is valuable subject for developed or developing countries for providing benefits through the renewable energies instead of traditional energies. Although there are various sources of energies in the world for supplying demands, the next generation would be encountered the lack of energies in the next few centuries. Moreover, emerging global warming phenomena causes new challenging and geographical problems. Against the mentioned problem, management of resources is not avoidable for optimization of energies and resources. Hence, this study attempts to explain and explore the findings from the qualitative research through the secondary data which are provided by scholars in this area. Especially, the desk study would be carried out to understand the situations of the economical views from energy sectors in the past, now and the future. As increasing demands of fossil fuels from the countries like China and India as well as the global warming problem, nanotechnology and its products would be as a solution for decreasing these problems. This research also focused on the cost leadership and competitive advantages in impact of nanotechnology, especially in the European Union (EU) countries.

Literature Review:

Generally, the important scientific findings can affect the strategies of work for managing organization. Hence, revolution which is due to nanotechnology can change the old protocols in converting the impact of new features. Luther *et al.* (2008) presented that improving new technology causes to create new products and services. The firms should contemplate about changing strategies on the basis of changing needs and wants. However, other parts have to obey from new approaches which are developed from nano scholars for the future. Nanotechnology is derived from the word "nanometer" and nano equals one out of a billion in meters. Therefore, nanotechnology has worked with materials which are on the basis of molecular and atoms. Also, it can produce smaller and more efficient products which have fewer side effects from drugs, expenditure-affectation, as well as being the sources of energy. In addition, there are new features which can contribute to making products. Nanotechnology for production from bottom-up approach converts atomic or molecular forms

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to configure unique materials. For instance, research about nano-crystal led to finding new information through destroying and absorbing of chemical processing as competition of molecule and atoms.

McGowan and Sauter (2005) suggested that storing energies can be contemplated to save energy as well as delivery of them through the strong networks. Another aspect is environmentally consistency through the technology. For example, wing turbines can produce more energy with less costs and good distributions. The studies of Porter (1985), Kleiman (2000), and Shurchuluu (2002) have presented that the markets of energies are encountered with the challenge through the new technologies. A company would be successful, if it has employed flexible strategies and capabilities. As mentioned earlier, cost leadership and competitive advantage are helpful features for company to achieve more profits. Luther *et al* (2008) noticed that the existing problems through global warming and increasing demands of energies cause to find solutions as renewable energies and supportable features. So saving energies as well as efficiency of performances would be as consciousness activities for sustained life in the future. As a result, decreasing consumption of fuels by using light products in a car as well as optimizing fuel system can be contemplated as remedies for saving energy.

The term of competition refers to the capability and ability of a company or industry to bring products or services to markets based upon nanotechnology. Revenues, trade, and market share are some indices of competitive assessments (Sargent, 2008). Today, the world is moving with the high and continues speed of change. It is also a considerable demand in the existing market for the various goods and services that end up to the extensive competition between different industries and companies. Mostly the competitiveness of each company relies on the competition between the companies through the industry. Although the competitiveness of economy depends on the average and collective of competitiveness between the firms, it also relates to other critical issues as well. Competitiveness is a relative concept and it will be more important when it is used for the international market. Therefore, it indicates the capabilities of a firm to create more profit, more wealth, more value, more revenue through its ability in comparison with its competitors in the market (Shurchuluu, 2002). The interaction between product market and capabilities of firm would be contemplated as abilities of firm like physical infrastructure, technology, financial ability, and work forces. They can also assist transferring the asset to the products and services. At the framework, the quality indicates that product and services come out to the market due to the global standardization; meanwhile, innovation can bring new ideas to the market. The competitiveness framework should be supported by another suitable collection of resources named economic structure (Shurchuluu, 2002).

Competition is the name of the game so that organizations try to find a supportable improvement of competitive advantage. According to Kinicki and Williams (2006), competitive advantage is the ability of an organization to produce goods or services more effectively than competitors, thereby outperforming them. Thus, competitive advantage is not talking about differences. This kind of competitive advantage is reached when the organization enhances real value to the customers. So the expanse of organization resources is required meaning that resources of the companies must be used more efficiently. Meanwhile, the innovation and cost saving also must be accrued in companies. Through using two strategies of differentiation and cost leadership, sustainable competitive advantage can be developed (Porter, 1985). Based upon cost leadership, according to Kleiman (2000), in competition environment, the production and services of firms must be in a lower cost of their competitors. Also, in a differentiation strategy, when a firm produces a product or service, that is preferred by buyers. This can happen by improving the quality of the product or services better than its rivals, or providing innovative products or services that are not offered by its competitors (Al-Rfou and Trawneh, 2009).

The majority of categories of competitive advantage strategies are cost saving, concentration and differentiation (Porter, 1985). In general, the firms can be classified according to Porter's (1985) generic strategies. Porter (1985) offered a model which is viewed in three different strategic groups namely differentiation, cost leadership, and focus strategies. It can be considered as a framework strategy within different industries and companies. Also, Porter's (1985) generic strategies and competitive facets can be determined by variety of clusters among the competitors in a specific industry or market. In addition, different strategies would be considered in different areas for the research issues. Consequently, selecting strategy would depend on the firm's competitors. If the firm is capable to deliver lower cost services and products in comparison with other competitors, it has a competitive advantage. On the other hand, if the firm's product quality is satisfactory, firms will change to higher boundaries and returns. Differentiation is another advantage for firms to obtain. In other words, differentiation leads them to proposing desired and unique things, and translates into a best price. In fact, this will cause higher boundaries and performance.

Kessler and Charles (2007) also stated that the laws of nanotechnology knowledge are less changed for improving products in these days. In addition, the strategies of suppliers can be conducted to depict the behaviors as the employing nanotechnology in the production from informing positive or negative aspects on the basis of capabilities. So, increasing nanotechnology in the markets causes to create some opportunities or threats for the firms to find right strategies as competitions aspects in the future. Hence, finding out the right strategy causes to improve the positions of companies in the market in the early time. The sustainable life cycle of firms is considered in the different levels from the advantages or disadvantages of their business strategies e.g. generic

features or patent aspects. Moreover, growing nanotechnology features are not avoidable especially in competition of industries to find more profits. As mentioned earlier, consistency of environment as green product or producing safe energy as well as saving in different ways of energy cause to develop products by industries in employing nanotechnology sciences. This study specifically aims to answer the following propounded questions:

- 1) What factors have played the main roles in using new technology to supply the demands of energies in the future?
- 2) How can cost leadership strategy provide more reliable strategy in saving energies in the future?
- 3) Is competitive advantage strategy a necessary factor for R&D system?
- 4) How nanotechnology can be intervened in order to decrease cost and increase efficiency in performance of a firm?

Methodology:

This study employs a qualitative research design for finding out the phenomena which are related to links of energies, cost leadership and competitive advantage from the management views. The uniqueness of the work takes advantages from the case studies in the literature to conduct the desk study. The aim of this qualitative research here is to describe the role of management in competitive advantages and cost leadership by concerning nanotechnology which affect in improving firms or organizations. This approach can describe in-depth of traits and performances from the managers and efficiency views. Besides, this method is strong in exploring, intensifying, and explaining the phenomena. The current researchers would use grounded theory for recognizing the items which were discovered from the qualitative data.

The paradigm of this research would be viewed as the interpretivist epistemological situation which confirms finding out of the firms' strategies. Hence, interpretivist perspective would be used in the desk study to explore the cause-effect relationship within implementing of the firms, innovation, cost leadership, and competitive advantage. Additionally, interpretivist view focuses on the perceptions, explanations, and thoughts of scholars or authors around the mentioned constructs. Hence, this study uses qualitative technique to find the best approach for the firms as the strategy.

Illustrating of global warming to the residents of the world can cause to create awareness to environmental phenomena for the future. Also, giving attentions to consumption patterns of the energies is producing new challenge of the global common sense to apply solution for confronting serious problems in the future. Unfortunately, the great areas of academic literature are allocated to the valuable subjects of solutions and remedies for these difficulties in the future. Hence, this study intends to find out the concepts of nanotechnology from the secondary data as desk study in the different cases which are investigated from scholars in different situations i.e. different strategies through cost leadership and differentiation among the firms, specifically in using nanotechnology as supporting saving energy and consistency of environment against global warming problem.

Investigation in previous studies can cause to find the linkages among the constructs and creating new models of causal relationships. Also, desk study is an approach which is useful to find the material issues from the secondary data. It is focused on past studies to ascertain management risk. The accuracy of research is due to pursuing the literature for finding out innovations in nanotechnology. So, qualitative research on the basis of case studies helps this research to explain better findings in the management risk as desk study.

Data Analysis:

Since the firms which employ nanotechnology in the world can be accounted in the different countries, this research zooms on the performance of companies in Germany. Hence, the present researchers propound the existing qualitative data from the relevant literature as case studies which are investigated. Also, qualitative research is developed based on the beliefs and attitudes of the respondents, so this investigation uses non-probability methods for sampling. The sample size in qualitative research is not considered more. Hence, case-oriented qualitative is inquiry of beliefs or attitudes from the subjects. Besides, the core idea of the study is related to desk study from scholars in nanotechnology and management. Consequently, the kind of sample is included in judgment as key information sample because of employing academic professionals' articles. To sum up, the goal is to understand the experiences and existing knowledge of management in nanotechnology through the other scholars in the field. Generally, the raw data should be read in several times with different glances in the first step. By considering grounded theory, they should be read again line-by-line to discover common sense inside the text as deductive approach. Then, the researchers would reduce the data to display and formulate the data. Automatically, the data would be conducted to descriptive analysis. Consequently, the researchers can judge and interpret the quantitative data as well as introduce new information (Huberman and Miles, 2002).

Case 1: Global warming and reducing sources of fossil fuels in the world simultaneously created the difficult situation. Hence, these phenomena should be contemplated as main subjects in the world. The best

strategy for this situation would be found remedies like using nanotechnology. It causes revolution of energy markets and achieving the needs to invest in long term through R&D in the route of nanotechnology. Replacing renewable fuels takes time for the energy markets. Therefore, integrating and optimizing renewable energy systems would be serious in the future studies.

Case 2: Germany is considered as a geographical point to develop nanotechnology. It is ranked as third country in the world from different aspects of nanotechnology. It is also known as nano-material, -optics, -analytics, and – biotechnology. Although, there are about 100 enterprises in Germany, the government recognizes to improve the energy sector by considering nanotechnology. Hence, it causes to influence in different ways of economical situations like building engineering, fabric industry, and car manufacturing. Additionally, nanotechnology has capabilities in the efficiency of energy system from different aspects because of enabling technology.

Case 3: According to constant theory in energy sector, the natural sources of energies can respond 80 percent of demand by 2030, but they would not be sufficient for the future demands. Hence, the renewable energies are coming out for replacing traditional energies by employing nanotechnology. The provision of EU is to decrease 20 percent greenhouse gases and 20 percent efficiency of energy system by 2020. Germany provides 9 percent of supplying renewable energies in the world especially producing 5 percent electric power as well as sharing 0.5 percent in distributing photovoltaic. Additionally, the accomplishment of R&D will be carried out until 2050. This way need to create new features and innovative techniques. Moreover, fossil fuels include 30 percent natural gas, 60 percent coal and 10 percent crude oil. Those are sufficient just for few centuries. Although, replacing renewable energy would be as a remedy for saving energy, cost leadership would be an effective way to decline costs and increase quality of energies. Moreover, competing advantage can cause to improve organizational and environmental performances. For instance, providing energies such as solar energy and solar thermal power plants would be very useful. The methods can provide 50 percent of demand services by 2100.

Case 4: The level of solar market is changing from 16 billion \$ (U.S.) in 2007 to 30 billion \$ (U.S.) in 2010. Specifically, Germany has improved in photovoltaic market. The R&D section of German shell and EU depicted that solar technology can provide 20 percent to 30 percent demand of the world by 2030. Additionally, the solar technology is included 50000 jobs, 150 firms and 4 billion Euro incomes in Germany.

Case 5: It is accounted that the existing level of traditional energies e.g. fossil fuels as 5500 MTOE (Million Tones Oil Equivalents) which divided to 60 percent coals, 30 percent natural gases, and 10 percent crude oil. The mentioned sources would be enough just for few centuries. They can provide approximately 80 percent of demands and constant theory considers this situation by 2030. Hence, investment in renewable energies and employing new approaches help to sustain life in the future. EU has a provision as decreasing 20 percent greenhouse gases and 20 percent efficiency of energies by 2020. Also, 15 percent of saving energy in renewable energy belongs to biomass-technology. Water power and earth heat as geothermal energy, wind power and solar power are renewable energies.

Case 6: Employing nanotechnology provides useful potentials for energy sector. It is not only replacing fossil fuels but also changing energy systems i.e. optimizing materials and components. Additionally, it influences the commercial, economical and profitable views. Moreover, added value chain from nanotechnology is involved to convert, store, transport, and use of energies. Nanotechnology has become as a good solution to save energies, cost leadership and competitive advantages.

Case 7: There is a problem in using energy for current system. It should be revised by using right and more efficient features from industries and householders. For example, utilizing nanotechnology in vehicle manufacturing with a light-wear-resistant engine parts and nanotechnology cause saving energies. Nano-porous thermal insulation is another example for providing energy of buildings. Next example can be light and heat flux glasses for reducing consumption of energies.

Case 8: Nano materials are disposing to other materials by regarding their properties. The electrons as tiny parcels should be quant-sized by nano cluster for interacting atoms. It is related to the size as fluorescence traits. Additionally, solar cells can help the converting efficiency using chemical factors. Moreover, nano materials have key role in the biology processing like nucleic acid and proteins according to chemical interactions.

Case 9: The demand of energy in the world is continuously rising. For instance, energy agency has presented that the world demand is around 12000 MTOE beyond 18000 MTOE by 2030. Also, China and India are consuming more energy because of economical situations in the world. Another problem is pertained to transportation and traffic jam which leads to consumption of more energy. Germany as an industrial country has exhibited more saving energy in comparing other countries at the same economical levels. The best way to control this situation is to change the source of energies. Renewable energies and added value chain are predicted for replacing resources. Consequently, employing nanotechnology is not avoidable for the future energy sectors.

Case 10: Nanotechnology causes to change and improve materials in the industries and households. Also, this is used in conducting energies from one point to other points as well as storing them as mobile energies in

the specific time. Conducting electric powers, converting earth heat to electricity or other kinds of energies, transmission of energies and producing nano particle materials are examples of nanotechnology which shows the impact of saving energy and innovation. Therefore, optimizing cost leadership and competitive advantage are factors for efficiency of employing nanotechnology.

Discussion and Conclusion:

The selected cases from different sources of the literature were implicated to the mentioned problems. The problem in each case has been stated with a solution about renewable energies and saving energies. Global warming and energy problems are contemplated from different scholars. Hence, they would like to propound different strategies for removing problems through the management glances. Moreover, they have consensus to employ nanotechnology in order to supply the demands in the future. In fact, nanotechnology and its products have important role to provide energies directly or indirectly for the future.

However, existing deficiency in energy sector from distribution, consumption and supplying energies as well as global warming problems causes to find the major remedies for natural sufferings. Therefore, without management strategies, the companies could not have good completion in the future. Moreover, without innovation many firms might be removed from the global markets because of intensive competitions.

In response to the first research question, it is stated that the renewable energies can be used as replacing fossil fuels for challenging with green houses gases and other problems which are due to global warming. Changing technology rapidly influences the changing energy sectors by utilizing nano products as more efficient and saving energies in the world. Nanotechnology not only is considered as science but also is intervened to determine economically macro or micro benefits. Hence, innovation in the nanotechnology can influence as a main construct on the other parts of energy system such as consumption patterns, efficiencies, performances, and even ordinary life of the residents of the world. Although innovation is considered as a major remedy for the solution of supplying energy, it is not sufficient. Therefore, there are variety of strategies which can affect the energy sectors and geographical problems like delivery systems, expenditures, and other side effects from different performances. For example, developing of nanotechnology needs the R&D section, while this sector can provide new strategies in products and services.

To answer the second research question, the study of Ellis and Calantone (2011) confirmed that cost leadership strategy is deduced competitive advantage strategy for taking advantage from flexible strategies. Normally, there are different tactics for removing economical difficulties. Most of them are accounted as stimulate markets instead of designed strategy towards achieving goals. Undoubtedly, converge of tactics causes to create new strategies. From methodological view, the formation of strategy depends on different tactics and performances in the same direction to reach the specific goal. In that case, there are two strategic group analyses. Strategic groups are related to firm behavior in the market so that they follow similar strategy as key decision role (Porter, 1985).

Generally, cost leadership is one of the important strategies which is considered to deliver value to customers for competition. If the company has capability to provide values for the customers, then it would have good position in a market. Therefore, cost leadership is pertained to decreasing the costs with high quality and pricing policy. In fact, the costs for a firm can be accounted in two groups namely cost of selling and cost of process. Cost leadership from energy system is saving energy from different ways like efficiency of fuels, storing energies, or decreasing costs from processing and features.

With regard to answering the third question, competitive advantage, in fact, is a strategy which can produce a relationship between management and the environment of company. In this case, this study confirmed the study of Barney (1995). However, SWOT analysis can be considered as competitive advantage. It is strength of internal potential of an organization in direct exploiting from environmental opportunities and against threats from external environment for coving internal weaknesses. Hence, competitive advantage is a source of SWOT analysis. The strong companies are always predicting the future economical situation from provision. The forecasting power and risk management knowledge can influence their future strategies. Therefore, their competitive advantage strategies are due to their good performance for sustaining competition. In fact, this strategy causes to find and hold their good position in the international markets. Consequently, knowing, estimating, and initializing performance are major factors from competitive advantage in the R&D sections. Hence, R&D can help entrepreneurs in the future process for getting good strategies.

In response to the last research question, the results of this study confirm the findings of McGowan and Sauter (2005). This study presented that renewable energy is not clearly understood from the residents of the world because populations have less awareness from the renewable energy system. Most of the residents discussed renewable energy as solar, hydro and wind power. They ignored biomass as a renewable energy source. They prefer renewable energy for the following notices:

- 1- Consistent with environment
- 2- Not finished in a few centuries
- 3- Clean and no pollutions

4- More reliable

The scholars prefer renewable energy systems as alternative energy sources instead of traditional fuels like fossil fuels. Hence, investment in the renewable energies would be as more profitable and benefits for the next generations because there are more advantages than disadvantage in this investment. This investment should be employed in R&D system for innovation and competitive advantage strategies in the future. In this case, nanotechnology can be helpful as a science and knowledge. It is very popular from different aspects, even as producing in small size and molecular views. Competitive advantage is influenced by innovations through nanotechnology in order to create renewable energy sources. Besides, nanotechnology products can be used in productions of industries. Moreover, cost leadership strategy can be affected by innovation and competitive advantage strategies. It would be useful from reducing costs and prices to added value. Consequently, innovation, performances, competitive advantage and cost leadership strategies are as major variables which are contemplated from the desk study as deducing through cases.

Recommended Model:

Innovation, implementing new technology, competitive advantage, differentiation and cost leadership strategies are considered variables from the case study as qualitative research. Also, the interpretation can be carried out as main goals from outcomes of the data. The current researchers believed that the most important factor to overcome the problems i.e. climate changing and lack of energy sources in the future is innovation from R&D system of nanotechnology for producing renewable energy sources. This factor can affect other parts of the energy system. Implementing new technology is due to innovation which can be considered as antecedents of competitive advantage and cost leadership strategies. In fact, the following integrated model is deduced as a model from data of qualitative research on the basis of causal relationships through the interpretation of the findings.

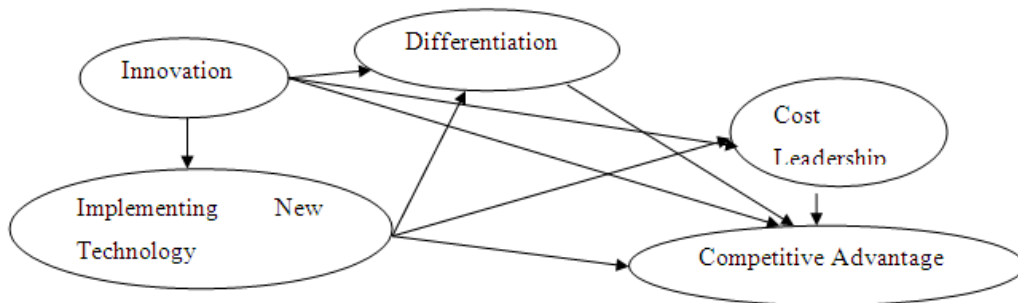


Fig. 1: Recommended Model

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