International Journal of Management and Commerce Innovations ISSN 2348-7585 (Online)
Vol. 7, Issue 2, pp: (1067-1075), Month: October 2019 - March 2020, Available at: www.researchpublish.com

A STUDY ON THE REDUCTION OF CARBON FOOT PRINT IN END TO END SUPPLY CHAIN

[1]Milan Jose, [2]Rinu Anna Rajan

Abstract: **Green Supply Chain Management (GSCM) has become the driving force behind a sustainable strategy. Both the academy and industry have gained increasing attention to this issue to make the industry competitive. With the ever-increasing demand for the reduction of carbon footprints and greenhouse gas emissions, there is a need to study the various parameters and drivers of sustainable development, particularly in the area of supply chain management. The study proposes that the main drivers of GSCM include environmental policy and green human resource management by providing them with training on sustainability practices. Also, the sustainability criteria in the selection of suppliers, which have been found to enhance sustainability outcomes, are another key driver.**

Keywords: **Carbon emissions, Green Supply Chain Management, Sustainability, Supply chain.**

1. INTRODUCTION

Companies have used supply chain intervention successfully for decades to improve their financial bottom line. Successful firms expanded their field of vision to look at the processes and operations of the firms they buy from and the firms they sell to. This has enabled them to make better, more informed decisions regarding how to run their operations. There were many benefits: improved productivity, increased efficiency, reduced waste, reduced capital requirements, and increased product development are just a few. Recently, the Carbon Trust released a report called ' Carbon emissions generated in everything we consume'. This report turns the traditional view of corporate carbon emissions on its head by showing that all the economy-wide emissions are generated to meet end consumer needs. The report concludes that companies can use a supply chain approach to search for new ways to reduce carbon emissions, just as they have used supply chain analysis for decades to deliver financial benefits. Energy efficiency has succeeded in delivering valuable carbon and cost savings for business and will continue to succeed. However, mitigating climate change will require more fundamental changes in the way business delivers goods and services to end consumers. The magnitude of the challenge is expressed in the goal of reducing carbon emissions in the UK by 60 percent from 1990 rates by 2050, set by the government in the 2003 Energy White Paper.

The next step for companies to take in efforts to reduce carbon emissions and mitigate climate change is to control the carbon footprint of goods across the supply chain. There are several problems which drive businesses to take action, including:

- Increases in direct energy costs and supplier energy cost
- Existing and planned legislation punishing high energy consumption and reductions in emissions
- Changing consumer attitudes towards climate change, offering forward-thinking firms an opportunity to develop and market low-carbon products.

Managing a product's carbon footprint means minimizing the carbon emissions that are required to deliver that product to the end consumer. A product's carbon footprint is the carbon dioxide emitted for a single unit of that product over the supply chain.

2. LITERATURE REVIEW

Cheng, Jiang & Qu (2015) find optimizing the organizational choices of businesses in business practices is one of the most effective methods for reducing carbon emissions. This paper proposes a green vendor-managed inventory (a green VMI) model under a carbon emissions trading system, with a retailer and a manufacturer. The proposed model combines both environmental and economic targets under a carbon emission limit, and the best decisions of the representatives are then obtained. Comparing this model with the conventional VMI model, this paper found that in the green VMI model it is contingent on the carbon limit whether the manufacturer can sell or purchase carbon credit. **Bhardwaj (2015)** discusses on Green Supply Chain Management (GSCM) which became the driving force behind the sustainable strategy. Within both academia and industry, this topic has been gaining increasing attention to making the industry competitive. With the ever-increasing demand to reduce carbon footprints and greenhouse gas emissions, the different parameters and drivers of sustainable development need to be studied. **Huchzermeier, Spinler & Theiben (2014)** tell that CO2 reduction has emerged as a key challenge within the sustainability arena for manufacturers in the fast-moving consumer goods industry. This aim needs to be balanced against the cost and responsiveness of competing priorities. Emissions-reducing efforts are driven by the need to meet industry and end-customer expectations, as well as opportunities for saving energy and costs. Manufacturers are now looking beyond their corporate limits to find new ways along the supply chain to reduce emissions. Research is needed to tackle the selection of suppliers in the face of sustainability challenges and provide insights into the factors affecting the transition of sustainability skills between the producer and suppliers. **Choi (2013)** tells the impacts of a carbon footprint tax on fashion supply chain systems are analyzed. Firstly, we build the two-echelon manufacturer – retailer analytical fashion supply chain model based on various industrial practices in fashion apparel. Secondly, by exploring the fashion supply chain with a highly fashionable product, we are investigating how the carbon footprint tax can affect the retailer's optimal sourcing choice. **Kanakoudis & Papadopoulou (2014)** Nowadays greenhouse gas emissions are widely considered one of the major causes of global climate change. The supply chain for each product consists of several processes for energy use. There are three new approaches (end-user pays; production-based, and profit-based) to the allocation of the carbon footprint (CF)-related costs generated between producers and users. These approaches vary according to the' blame' attached to each involved stakeholder, during the various phases of the life cycle of the' product.' As the necessity for the product/service exists, CO2 emissions occur according to the first approach. The second approach allocates the costs associated with CF production in each step of the supply chain not only according to how much of this CF is produced in each step. **Xia , Zhao & Yuan (2013)** suggest that under low carbon economy, carbon emission permits have become a kind of resource; in the market economy environment, new business-to-business partnerships have arisen, these features shift the cost structure of company activity and the income pattern. The paper discusses the previous literature on carbon footprint, individual business output optimization theory, and supply chain operation. The paper then put forward four worthwhile further research directions: distribution of carbon emission costs and scientific measurement in the supply chain; supply chain operation based on consumer behavior in the Low Carbon Economy Era; optimization of the allocation of carbon emission permits in the supply chain; Dynamic multi-period operation optimization of the carbon-efficient supply chain. **Das & Shaw (2017)** tell that over the course of time sustainable development has become one of the world's leading concerns. Today, the implementation of sustainability in the supply chain has been at the center of attention because of the introduction of strict environmental pollution regulations by various governments and the growing concern of stakeholders about social injustice. This study proposes an uncertain SCND model that minimizes total supply chain-oriented costs and determines the opening of plants, warehouses, and flow of materials across the supply chain network by taking into account different carbon emissions and social factors. **Kong, Wang & Zhang (2017)** study on prevailing carbon emission. China, as the world's largest CO2 emitter, faces great pressure to reduce its emissions. The secondary industry is the dominant contributor to China's total emissions, accounting in 2012 for about 88.34 percent. Hence an input-output subsystem model is applied in this paper to explore the carbon footprints of secondary industry in China. The production and supply of electricity, steam, and water, as well as the manufacture and processing of metals, are identified as the sectors with the highest carbon emissions from the perspective of the direct emissions generated by secondary industries. **Tao (2013)** researches and finds carbon emission management research is becoming a very important part of the green supply chain landscape as more businesses continue to make it part of their business strategy, amid customer, competitor, and regulatory agency pressures. To contribute to the body of knowledge in this emerging research stream, a series of lot size models are developed for the carbon-conscious retailer, manufacturer and a combined model of retailer and manufacturer that considers both economic and environmental performance. **InTech (2007)** discusses on carbon footprint on supply chain. It tells that environmental

impact is becoming more important to the bottom line of the company performance and specifies its importance in supply chain. Cost savings, gain in productivity, regulation concerns and consumer interests are major factors of consideration.

Objectives:

- To analyze the aspects considered by the carbon credit organizations in the manufacturing sector.
- To study the impact of the current speculation status of carbon credits on the manufacturing sector.
- To analyze the use by organizations of different provisions for carbon credits that are purchased.
- To identify the benefits that organizations have gained from implementing trading practices in carbon credits.

Research Hypotheses:

H0: Trading carbon credits do not vary in terms of geographical location

H1: Trading carbon credits varies in terms of geographical location

H0: Trading in carbon credits is not affected by the level of pollution

H2: Trading in carbon credits is affected by the level of pollution

H0: The kind of activities carried out by the company do not influence the amount of trade in carbon credits.

H3: The kind of activities carried out by the company influences the amount of trade in carbon credits.

3. RESEARCH METHODOLOGY

Research Approach:

¬ Exploratory Research

Research Model Development:

¬ Questionnaire

PrimaryStudy:
¬ Data Collection

¬ Data Analysis and Interpretation

Defining the Population in this Research

The research has found around 12 organizations are involved in the trading of carbon credits, but this research covers 9 organizations.

Sampling technique

Convenient sampling

4. SURVEY FINDINGS AND TESTING OF HYPOTHESES

1. How long has the company been active in investing in carbon credits

Duration	**Frequency**
Less than a year	1
Between 1-2 years	2
Between3-4 years	3
Between 5-6 years	2
More than 5 years	2

It has been noted that 50 percent of the participation of companies is less than two years old so that investing in carbon credits is a younger phenomenon. The table above also indicates that the average is two to three years; three to four years and more than four years are 17.5 percent, 20 percent, and 12.5 percent respectively.

2. Trading carbon credits does vary in terms of geographical location

HYPOTHESIS AND TEST RESULTS					
Null Hypothesis	**N**	**Mean**	**Standard Deviation**	**df**	**Sig. (2- N Mean df Deviation tailed)**
Trading carbon credits do not vary in terms of geographical location	11	2.75	1.299	10	0.066

Null Hypothesis: Accepted

Interpretation: The survey found that most of the respondents denied that the trading of carbon credits was influenced by the geographical location. It is noted that 54 percent disagreed with the assertion. The mean (2.75) and standard deviation (1.299) both support the view of the respondents. For the evaluation of the hypothesis, the Z-test was performed and the results of the test are shown in the table above, which means that the measured significance value (0.066) is greater than the p-value (0.05). It is therefore interpreted that the null hypothesis is accepted. Thereby, the trading of carbon credits does not vary with respect to the geographical location of the industry.

3. Trading in carbon credits is affected by the level of pollution

HYPOTHESIS AND TEST RESULTS					
Null Hypothesis	**N**	**Mean**	**Standard Deviation**	**df**	**Sig. (2- N Mean df Deviation tailed)**
Trading carbon credits do not vary in terms of geographical location	11	3.388	1.129	10	0.005

Null Hypothesis: Rejected

Interpretation: The frequency table above shows that more than 50% of the respondents agree with the above statement. The mean (3.388) and standard deviation (1.129) also indicate that respondents believe that trading in carbon credits is affected by the level of pollution. The calculated significance value (0.005) for the test of the hypothesis is less than the p-value (0.05). It is therefore interpreted that the null hypothesis is rejected. The amount of emissions is therefore influenced by trading in carbon credits.

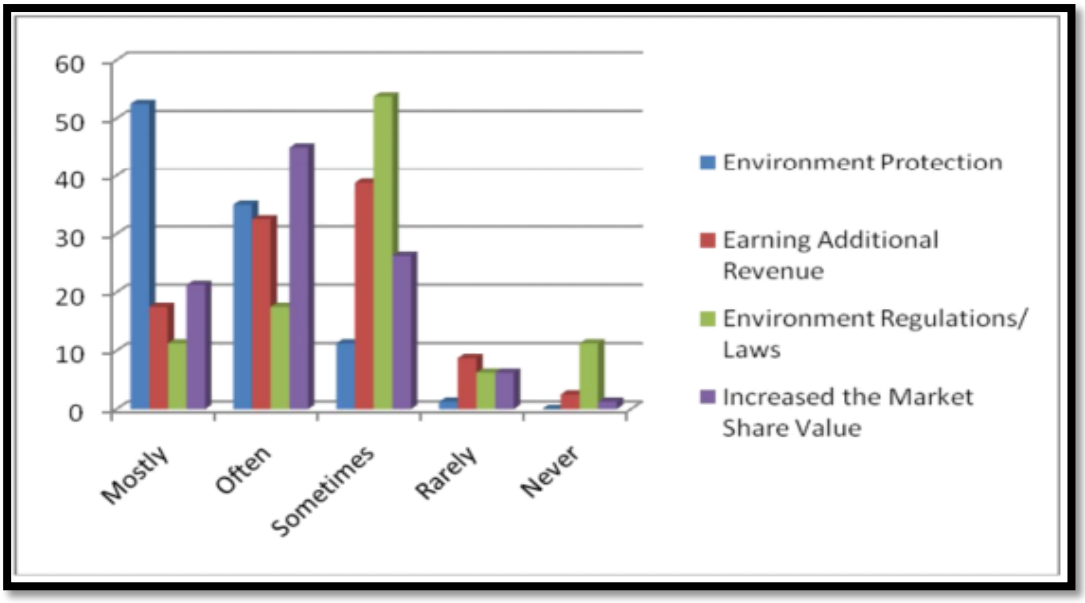
4. The kind of activities carried out by the company influences the amount of trade in carbon credits.

HYPOTHESIS AND TEST RESULTS					
Null Hypothesis	**N**	**Mean**	**Standard Deviation**	**df**	**Sig. (2- N Mean df Deviation tailed)**
The kind of activities carried out by the company influences the amount of trade in carbon credits.	11	3.8	1.123	10	0.009

Null Hypothesis: Rejected

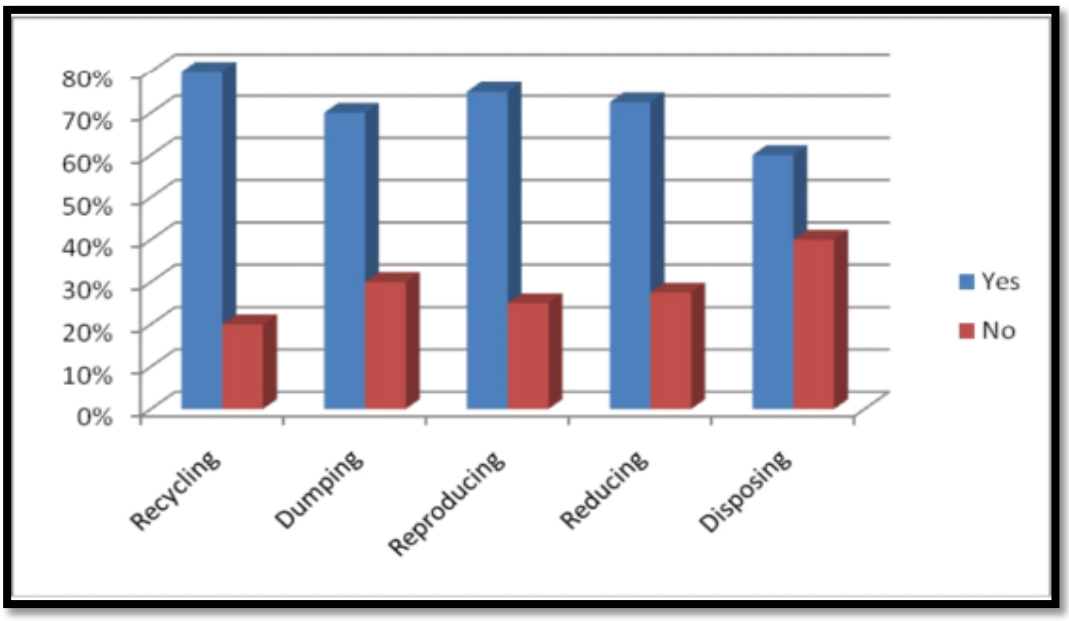
Interpretation: It is evident from the Frequency Table that 70% of the respondents agree and 15% of the respondents are found to be neutral with the above argument. The mean value (3.8) and the standard deviation (1.123) suggest that the form of operations carried out by a company influences the amount of trading of carbon credits. The Z-test was performed to test the hypothesis and the estimated significance value (0.009) is lower than the p-value (0.05). It is therefore interpreted that the null hypothesis is rejected. The form of operations carried out by the organization, therefore, influences the amount of carbon credit trading by the organization.

5. Reasons for the involvement of organizations in the trading of carbon credits



Interpretation: The factors involved by companies in the trading of carbon credits. The above table shows that 52.5 percent of respondents said that they were mainly interested in carbon credit trading for environmental protection, and 38.75 percent suggested that they were often involved in receiving additional revenue. The survey found that 53.75 percent of respondents suggested that they were often involved in trading carbon credits for environmental regulations/laws, and 45 percent of respondents said that they were mostly involved in trading carbon credits to raise market share value.

6. Organizations shall take reasonable steps to reduce the amount of carbon emissions.



Interpretation: It describes the appropriate measures taken by organizations to reduce the amount of carbon emissions. It shows that 80 percent of respondents said they recycled the waste and 70 percent said they dump the waste material. The results of the survey indicate that 75% of the organizations are reproducing the goods and 72.5% of the organizations have answered that they minimize the quantity of those materials that are responsible for carbon emissions during development. Also said that they had taken steps to reduce carbon emissions.

7. Organizations ensure that products are produced in environmentally friendly.

	Frequency Table		
Response	**Frequency**	**Percentage**	**Cumulative Percentage**
Strongly Disagree	0	0	0
Disagree	1	7.5	43
Neutral	3	14.5	60
Agree	5	70.5	80
Strongly Agree	1	7.5	100

TEST RESULTS					
Null Hypothesis	**N**	**Mean**	**Standard Deviation**	**df**	**Sig. (2- N Mean df Deviation tailed)**
Organizations are involved in the trading of project-based carbon credits as an exclusive separate business activity.	11	3.5	1.304	10	0.077

Interpretation: It has been noted from the frequency table that 80% of the respondents agree with the above argument, and this is further explained by the mean (4,075) and the standard deviation (0,009). The estimated significance value of the Z-test for evaluating this hypothesis is 0.007, which is less than the p-value (0.05). Organizations also ensure that products are produced as environmentally friendly.

8. Organizations regularly audit their energy consumption and management processes.

	Frequency Table		
Response	**Frequency**	**Percentage**	**Cumulative Percentage**
Strongly Disagree	1	15	17
Disagree	2	15	16.5
Neutral	0	0	0
Agree	4	57.5	62.5
Strongly Agree	3	12.5	100

Statement	**N**	**Mean**	**Standard Deviation**	**df**	**Sig (2-tailed)**
Organizations regularly audit their energy consumption and management processes.	11	3.175	1.394	10	0.000

Interpretation: 42.5 percent of respondents agree and 22.5 percent of respondents are found to be neutral with the above argument. The mean (3.175) and standard deviation (1.394) values suggest that companies routinely audit their energy consumption process. The Z-test was performed to test the hypothesis and the measured significance value (0.000) is smaller than the p-value (0.05). Organizations are therefore constantly auditing their energy consumption and management processes.

9. Organizations are involved in the trading of project-based carbon credits as an exclusive separate business activity.

	Frequency Table		
Response	**Frequency**	**Percentage**	**Cumulative Percentage**
Strongly Disagree	1	8	17
Disagree	2	13.5	23
Neutral	1	0	0
Agree	2	13.5	23
Strongly Agree	4	65	100

TEST RESULTS					
Null Hypothesis	**N**	**Mean**	**Standard Deviation**	**df**	**Sig. (2- N Mean df Deviation tailed)**
Organizations are involved in the trading of project-based carbon credits as an exclusive separate business activity.	11	3.5	1.304	10	0.077

Interpretation: It is noted that 40% of the respondents disagreed with the assertion and the mean and standard deviations were 3.5 and 1.304, respectively. Z-test was conducted to test this hypothesis and the measured significance value (0.077) was found to be greater than the p-value (0.05). It is therefore understood that the null hypothesis is accepted. Organizations do not, therefore, have a well-defined plan to reduce pollution.

10. The carbon credit trading practices contribute to sustainable development.

Response	**Frequency**	**Percentage**	**Cumulative Percentage**
Strongly Disagree	0	0	0
Disagree	2	20	40
Neutral	1	7.5	32.5
Agree	3	30.5	65
Strongly Agree	4	42	100

Statement	**N**	**Mean**	**Standard Deviation**	**df**	**Sig (2-tailed)**
The carbon credit trading practices contribute to sustainable development.	11	3.465	1.129	10	0.009

Interpretation: It has been observed that 60 percent of respondents agree with the statement. The mean value of 3.625 and the standard deviation (1.129) both suggest that they agree that this type of practice contributes significantly to sustainable development. The estimated significance value of the Z-test is 0.009 for evaluating this theory, which is less than the p-value (0.05). The trading practices of carbon credits, therefore, contribute to sustainable development.

Limitations of the research

The research area of the study is the country as a whole, but it is very difficult to cover every state of the nation. The research focuses on a broad aspect of carbon credit trading. The study is focused mainly on the manufacturing sector, so that this analysis can be extended to cover other industries, such as the service industry, etc. Furthermore, the time factor can be considered as one of the limitations. The results of this study that change due to demographic characteristics and time of the study. The present research focuses only on the views of those organizations which are interested in Carbon Credits Trading.

Suggestions:

The government should launch workshops, conferences and publicity campaigns to raise awareness about trading in carbon credits. Environmental rules and regulations in India are quite difficult to understand; thus, the relevant authorities need to draw up some easy rules and regulations so that manufacturing organizations can easily understand and abide by them. The Government of India will lay down some laws relating to the reduction of carbon emissions. The research shows that the reason for implementing carbon credit trading practices in organizations is to produce a product in an environmentally friendly way and also to support business activities such as investing in a green growing process. Therefore, the researcher suggests that this type of organization could take some interest in project-based carbon credits since this form of trading would provide some extra revenue. Organizations have become more sensitive to diminishing levels of air pollution. Therefore, the State should provide some additional benefits for those types of organizations interested in reducing pollution levels.

5. CONCLUSION

Carbon Credits Trade helps dramatically reduce carbon emissions. The best contribution of this idea, therefore, is that society has a pollution-free environment. This concept is creating new trade in the system, and many organizations are planning to invest huge funds in various carbon-reduction projects in the future. A lot of jobs will, therefore, be created in the market and unemployment will be minimized. Also, global warming is now a significant threat to society, and this phenomenon is directly linked to the reduction of carbon emissions. The business must, therefore, maintain an ecological balance in the environment. Carbon Credits Trading offers a lot of options for global investors to invest their funds. As a result, foreign investors are investing a significant amount of their funds in different projects in India; this investment will provide some indirect support to society in the form of other business developments. The idea will also enable people to participate in environmental activities such as planting trees, which would help reduce soil salinity, increase water and air quality and promote/raise biodiversity, reduce the usage of carbon emission equipment as much as possible in daily life.

REFERENCES

[1] Broto, R. B. (2016). Role of green policy on sustainable supply chain management. *Benchmarking, 23*(2), 456-468. doi:http://dx.doi.org/10.1108/BIJ-08-2013-0077

[2] Carbon footprint steps on supply chain. (2007). *Intech, 54*(10), 14. Retrieved from https://search.proquest.com/docview/208817111?accountid=38885

[3] Das, R., & Shaw, K. (2017). Uncertain supply chain network design considering carbon footprint and social factors using two-stage approach. *Clean Technologies and Environmental Policy, 19*(10), 2491-2519. doi:http://dx.doi.org/10.1007/s10098-017-1446-6

[4] Jiang, Y., Li, B., Qu, X., & Cheng, Y. (2016). A green vendor-managed inventory analysis in supply chains under carbon emissions trading mechanism. *Clean Technologies and Environmental Policy, 18*(5), 1369-1380. doi:http://dx.doi.org/10.1007/s10098-015-1048-0

[5] Jing-Li, F., Wang, J., Ling-Si, K., & Zhang, X. (2018). The carbon footprints of secondary industry in china: An input–output subsystem analysis. *Natural Hazards, 91*(2), 635-657. doi:http://dx.doi.org/10.1007/s11069-017-3147-1

[6] Kanakoudis, V., & Papadopoulou, A. (2014). Allocating the cost of the carbon footprint produced along a supply chain, among the stakeholders involved. *Journal of Water and Climate Change, 5*(4), 556-568. doi:http://dx.doi.org/10.2166/wcc.2014.101

[7] Tao, Z. (2013). *Carbon emission modeling in green supply chain management* (Order No. 3618949). Available from ProQuest Central; ProQuest Dissertations & Theses Global. (1531329443). Retrieved from https://search.proquest.com/docview/1531329443?accountid=38885

[8] Theißen, S., Spinler, S., & Huchzermeier, A. (2014). REDUCING THE CARBON FOOTPRINT WITHIN FAST-MOVING CONSUMER GOODS SUPPLY CHAINS THROUGH COLLABORATION: THE MANUFACTURERS' PERSPECTIVE. *Journal of Supply Chain Management*, *50*(4), 44-61. Retrieved from https://search.proquest.com/docview/1615787715?accountid=38885

[9] Tsan-Ming Choi. (2013). Carbon footprint tax on fashion supply chain systems. *The International Journal of Advanced Manufacturing Technology*, *68*(1-4), 835-847. doi:http://dx.doi.org/10.1007/s00170-013-4947-4

[10] Xia, L. J., Zhao, D. Z., & Yuan, B. Y. (2013). Carbon efficient supply chain management: Literature review with extensions. *Applied Mechanics and Materials*, *291-294*, 1407. doi:http://dx.doi.org/10.4028/www.scientific.net/AMM.291-294.1407