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An Examination of Green Innovations in the Information Technology Sector

Md Sadaf Aqubal

Symbiosis Center for Information Technology, Symbiosis International (Deemed University), India

Abstract: ***Over the last decade an increasing number of firms are taking actions to cut their environmental impact. As information technology (IT) and information system have permeated most business activities they offer an important opportunity to solve the ecological problems. The IT industry is responsible for 2% of the world's total carbon dioxide emission and it is fast growing. Since this industry and the effects to environment are connected in many ways the industry has to learn how to change this negative relation into positive one. Though it is not possible to eliminate hundred percent impacts on environment, Green innovation can be a positive step in this direction. This paper is an effort to document the activities of major IT companies in India towards sustainability. For this research a document survey and analysis of the sustainability reports of 30 IT companies in India were analyzed to understand and find a pattern of activities. The study identified that a few initiatives such as green buildings, reduction of usage of paper, water management, reduce employee travel time, green data centers, tree plantation drives and the use of AI are among a few of the common activities the IT companies are engaged in.***

Keywords: Green Innovation, Information Technology

1. Introduction

Green innovation comprises of all type of innovations that contribute to the creation of key products, services, or processes to reduce the harm, impact, and deterioration of the environment and at the same time that optimizes the use of natural resources (Leal-Rodriguez 2018). Such type of innovation develops a critical role in the current times because it channelizes an appropriate use of the natural resources to improve the human well-being. Moreover, the creation and incorporation of changes in products and production processes could contribute to sustainable development

2. Literature Review

The topic 'An examination of green innovations in the information technology sector' provided me an opportunity to study in between the lines of multiple works done relating to green innovation. Our environment is deteriorating at a fast rate. There are many reasons behind this. Excessive waste disposal, toxic emissions, resource depletion energy dependency are causing severe damage to environment and survival of mankind. In this work I have listed down the views of authors of the papers which I have reviewed.

The focus of modern business is directed in transferring their business methods towards green operation (Hoffman 2018). There are several motivations which inspire organizations to go for green innovation. Some of the firms consider that they have responsibility towards environment. For such organizations' it is their personal preference to adopt eco friendly procedures (Weng Et.al. 2015). The other reason may be the organizations response to customers rising demand for sustainable goods and services. Sometimes organizations have to abide by government and foreign market regulations (Hoffman 2018).

Some authors have studied how sustainable developments play in influencing firms' performance (Chang and Kuo 2008). They have focused on economic, social and environmental performance (Heroux and Fortin 2013). They have failed to reach a consensus regarding the link of sustainable practice with firm's performance. There are two ways in which firm can contribute to green innovation. Firms can generate products and services through energy conservation. The other way is by utilizing technical and knowledge expertise to bring in eco friendly practices (Katsikeas et.al. 2016) Green innovation improves firm's efficiency, responsiveness, skill development and skill development towards customer, society and government.

According to an author, organizations have divided green innovation into two parts. They are green product innovation and green process innovation (Xie et.al 2019). Green product innovation is the development of a new product or service that has no negative effect on the environment or less than that of the current product or service. Green process innovation is the improvement of existing production process and use of environmentally friendly technologies to produce goods and services which have no or less impact on the environment (Xie et.al 2019). They also noted that green innovation firms did not experience increased financial performance as compared to non green innovative firms. They also found that green innovation leads to increase in cost of the firms (Xie et.al 2019). A research also confirms that there is a positive relation between reduction of carbon dioxide emission and financial performance among Japanese firms (Ganda & Milondzo 2018) . They also found a positive correlation between green product and process innovation and competitive advantage.

Another research work states that green innovation is in its infancy, development is slow and the overall efficiency is not high. It also states that the inherent defect of environment cannot be overcome by market means (Li et.al 2018). According to the research innovation economics regulatory factors are needed for correction as market and technology factors cannot explain the motivation of green innovation. Therefore it is the responsibility of government to strengthen environmental supervision. Government should promote environmental regulations so that industries

can take up green innovation. The condition and path of environmental regulation needs to be further explored.

The review of literature shows that there are some in depth study on the relationship between environmental regulation and green innovation. Scholars have not yet formed a unified understanding of relationship between environmental regulations and green innovation. Some scholars believe that environmental regulations can promote corporate research and development activities (Guo et.al 2018). Others are of the view that there is a negative relationship between environmental regulation and green innovation (Fang et.al 2019). They believe that environmental regulation will have an inverse effect on R&D resources, thereby reducing efficiency and inhibiting green innovation. Some scholars believe that environmental regulations have threshold effect on green innovation (Li & Li 2019). Some scholars neglect the regional spatial heterogeneity caused by institution, location environment and resource endowment (Ladenburg & Knapp 2015), while others neglect the heterogeneity of different dimensions of environmental regulation, which will lead to some errors in the research conclusion. Scholars have relatively few studies on environmental regulation, and their researches on industrial green innovation had focused on the impact of technique, technology and input.

Scholars believe that a sustainable and low carbon economy needs development of low carbon energy technologies (Fankhauser & Jotzo 2018). Information Technology will help in sustaining economic growth and cutting carbon emissions. In the developing countries the energy demand is increasing and they don't have competence as compared to developed countries. Public investment is one of the oldest way by which counties have supported renewable energy technologies (Ahuja & Tatsutani 2009).They have cited the example of oil crises in which USA have invested a significant amount of public resource in research and development of wind and solar technologies. Governments rely on two different types of environmental policy instrument; they are command and control and market policies (Helm (2019).

Low carbon innovation refers to renewable technologies which eliminate carbon emissions from production processes. Fossil based technologies also decrease the content of carbon per unit production (Gielen et.al 2019).. According to some scholars a combination of research and environmental policy instruments are more effective in promoting green innovation (Bergek et.al 2014).There is no one size fits all solution when one has to choose a combination of market based and command and control environmental policies as policies need to be tailored to meet the needs of each country.

As per a study green digital finance can lead to sustainable development (Zadek 2018). It refers to Internet investment and financing activities that generate environmental benefits to support sustainable development. Environmental benefits include the mitigation of gases, water and soil pollution, and the reduction of greenhouse gas (CO2) emissions, so as to improve the utilization of resources, mitigate and adapt to climate change.

A case study analyzes the efforts of one city to tackle traffic congestion at peak times by pioneering a number of green innovations including the introduction of a light rail system employing trams known as Nottingham Express Transit as well as electric and gas-powered buses (Disney et al 2018). The nature of these innovations is explored together with a detailed examination of how they came to be implemented and the impact they have had. The main focus of the case study is on public transport, it also covers important issues such as the preservation of historical and cultural aspects of cities, the economic development of cities, place leadership and economic opportunities for different social groups.

Another paper examines whether using eco-innovation is an opportunity to increase the competitiveness of agriculture, manufacturing, environmental industries and construction. It concludes that eco innovation is a powerful instrument which reduces negative impact on the environment and has a positive impact on the economy and society (Sarkar 2013).

Through the study of multiple papers the researcher understood the methodology to conduct this research. Most papers reviewed were one sided and focused on quantitative study of organizations and employees. There was no meta-research that catalogue he various activities that are being performed by these companies. Hence the topic was selected for research.

3. Research Method

While keeping research topic in mind a secondary data analysis was decided upon as the means to collect the data. As a result a starting point was to collect data on the different technologies used by the IT companies in India. The data was sourced from the annual sustainability reports of the companies which they religiously bring out every year. Companies were identified and the annual report as well as the sustainability report was used to make the final set of sources. This contributed to a large amount of data in the form of the reports. A few research papers helped in identifying how to go about and record and report the data.

4. Research Analysis

An initial survey of the reports produced a list of 24 activities the IT companies generally undertake in their effort to become environment friendly (Table 1). A word cloud of these activities are provided in figure 1. The pie chart shows the percentage of organizations undertaking the activities.

Table 1: Green Initiatives by the IT firms in India

High efficiency work place	Water management	Events to create awareness
Tie up with research institutes	Invest in solar energy	Install PV plant
Consume green electricity	Convert organic waste into biogas	Single use and non recyclable plastic
Green building	Plantation drive	Reduce travel time for employees
Waste management	Reduce use of paper	Using star rated equipments
Use of LED lights	Electric vehicles charging system	Working with suppliers and vendors
Volunteering	Use of AI	Green datacenters/cloud based service
Investment in green solution	Promote refurbishment and redeployment of equipment	Initiatives aimed at making sustainability personal included

Figure 1: Word cloud of the initiatives taken by IT organization

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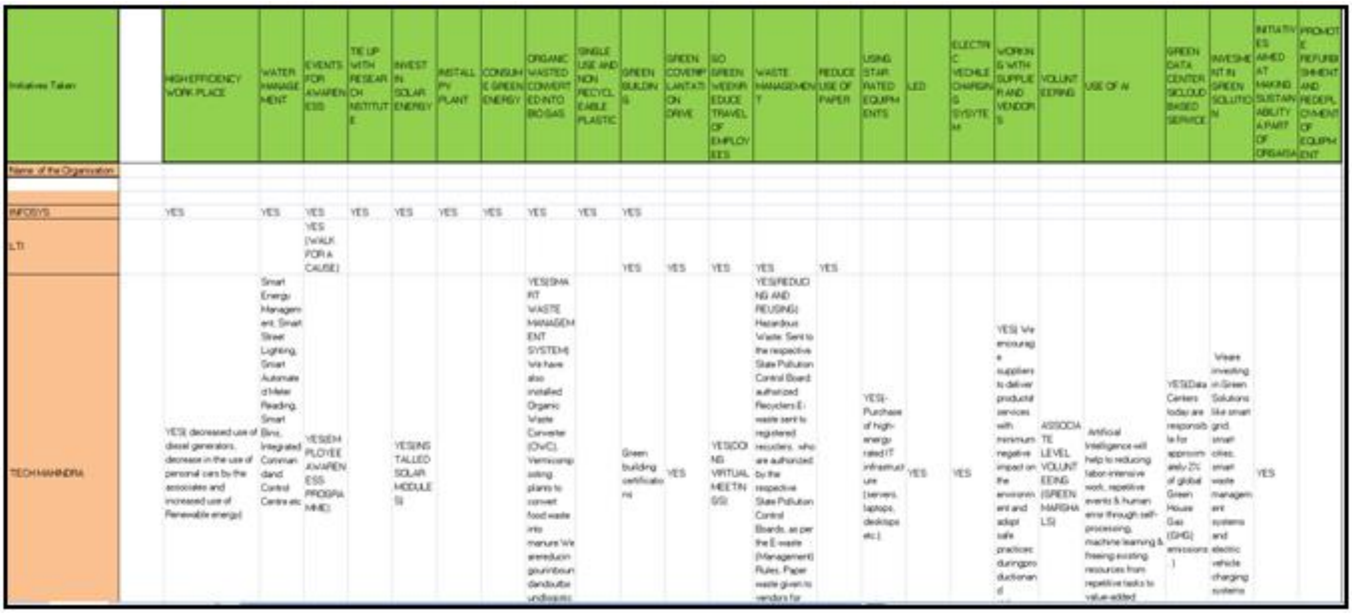

Initiatives Taken		HIGH EFFICIENCY WORK PLACE	WATER MANAGEMENT	EVENTS FOR AWARENESS	TIE UP WITH RESEARCH INSTITUTE	INVEST IN SOLAR ENERGY	INSTALL PV PLANT	CONSUME GREEN ENERGY	ORGANIC WASTED CONVERTED INTO BIOGAS	SINGLE USE AND NON RECYCLEABLE PLASTIC	GREEN BUILDINGS	GREEN COVER/PLANTATION DRIVE	GO GREEN WEEK/REDUCE TRAVEL OF EMPLOYEES	WASTE MANAGEMENT	REDUCE USE OF PAPER	USING STAR RATED EQUIPMENTS	LED	ELECTRIC VEHICLE CHARGING SYSTEM	WORKING WITH SUPPLIER AND VENDORS	VOLUNTEERING	USE OF AI	GREEN DATA CENTER S/CLOUD BASED SERVICE	INVESMENT IN GREEN SOLUTION	INITIATIVES AIMED AT MAKING SUSTAINABILITY A PART OF ORGANISATION	PROMOTE REFURBISHMENT AND REDEPLOYMENT OF EQUIPMENT
Name of the Organization																									
INFOSYS		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES														
LTI				YES YES (WALK FOR A CAUSE)							YES	YES	YES	YES	YES										
TECHMAHINDRA		YES(decreased use of diesel generators, decrease in the use of personal cars by the associates and increased use of Renewable energy)	Smart Energy Management, Smart Street Lighting, Smart Automated Meter Reading, Smart Bins, Integrated Command and Control Centre etc.	YES(EMPLOYEE AWARENESS PROGRAMME)		YES(INSTALLED SOLAR MODULES)			YES(SMART WASTE MANAGEMENT SYSTEM) We have also installed Organic Waste Converter (OWC), Vermicomposting plants to convert food waste into manure We are reducing [illegible]		Green building certifications	YES	YES(DOING VIRTUAL MEETINGS)	YES(REDUCING AND REUSING) Hazardous Waste: Sent to the respective State Pollution Control Board authorized Recyclers E-waste sent to registered recyclers, who are authorized by the respective State Pollution Control Boards, as per the E-waste (Management) Rules. Paper waste given to vendors for [illegible]		YES(- Purchase of high-energy rated IT infrastructure (servers, laptops, desktops etc.)	YES	YES	YES(We encourage suppliers to deliver products/services with minimum negative impact on the environment and adopt safe practices during production and [illegible]	ASSOCIATE LEVEL VOLUNTEERING (GREEN MARSHALS)	Artificial Intelligence will help to reducing labor-intensive work, repetitive events & human error through self-processing, machine learning & freeing existing resources from repetitive tasks to value-added [illegible]	YES(Data Centers today are responsible for approximately 2% of global Green House Gas (GHG) emissions)	We are investing in Green Solutions like smart grid, smart cities, smart waste management systems and electric vehicle charging systems	YES	

Figure: Snapshot of data collection

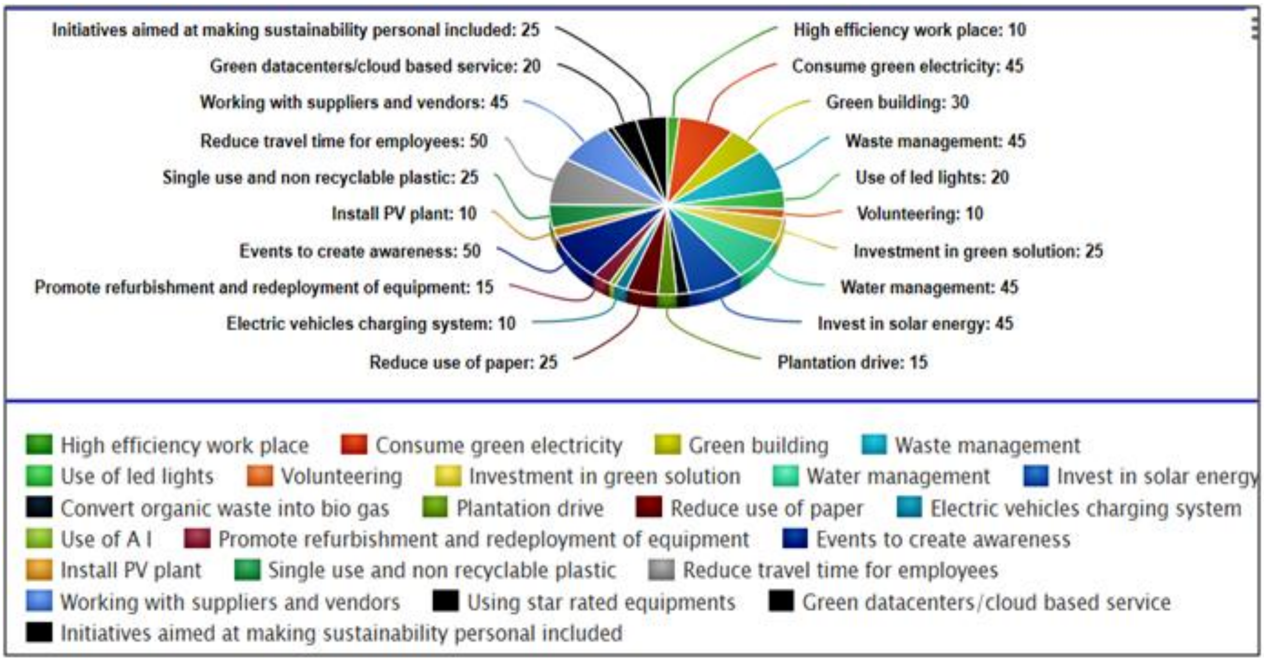

Fig (below): Pie Chart of percentage of organization undertaking the initiatives

5. Research Analysis

From the pie chart above it can be concluded that 25% of the organizations had initiatives aimed at making sustainability personal included in their organization. It should be followed by other IT organizations too. Every small step taken by these organizations can add up and can bring a great positive change.

Of the companies studied, it was found that most of the companies gave importance to reduction in travel time of their employees and spread awareness among their employees. Other things where companies paid attention were to consume green electricity, invest in solar energy, and pay emphasis on waste management and water management. Almost 50% of the companies studied collaborated with their vendors and suppliers.30% of the companies have green buildings. It means the company makes uses of the natural light and ventilations to avoid excess use of electricity. 20% of the companies use energy efficient equipments which consume less energy.15% of organization took plantation drive. They either conduct this activity of their own or in partnership with some local NGOs.

As data is the most precious thing for the IT industry. 20% of the companies whose report was studied had green or energy efficient data center or used cloud based services. 25% of organization has reduced the use of paper. 15% of industries promote use of refurbished and redeployment of equipment. 10% of the organizations had had electric vehicles charging system in their premises. 10% of organizations have installed photo voltaic plants to reduce the consumption of non renewable sources of energy or the energy produced from fossil fuel. A large number of organizations still do not have

efficient work place and has low participation in volunteering activities.

Data centers are an integral part of an IT organization. Data centers consume a lot of energy .Having green data centers or migrating to cloud based model can save a lot of energy. It will reduce the consumption of non renewable sources of energy.

Suppliers and vendors can play a major role in contributing towards sustainability. Most of the organizations outsource their noncore activities. If suppliers and vendors try to take some step towards green and clean environment. It will have a positive effect on our environment.

Many organizations have tried to reduce the travel time of their employees. As lesser the amount of travel, less will be the consumption of fuels used in vehicles. So IT organizations give their employees opportunity to work from home. To save travelling cost and time they do video conferencing. This saves a lot of fuel which indirectly have a positive effect on environment.

Plastics are non degradable. They are a pollutant and have devastating effect on environment. Most of the IT organizations have made their campus plastic free.

Most of the IT companies have installed Photo Voltaic (PV) plant on their rooftop. This helps them tap the natural sunlight and reduce the consumption of energy produced from thermal power plant. This helps them financially as they have to pay less for the electricity bills as they consume less energy which comes from power plants.

IT companies have started creating awareness among their employees. For this they periodically conduct certain activities which help people come together and share their views on sustainability and environment. These activities include events like debate, eco tour, and seminars etc .When people are aware they take steps which are good for the environment. They know what not to do in order to save our environment.

IT organizations promote reuse of their equipments. Few of the IT organizations have BYOD (bring your own device) policy. According to this policy employees can bring their own devices to the office. This help them in cutting cost as they don't need to buy those device which needs regular maintenance .Apart from that they have to comply by various laws when they wish to dispose them.

Many companies have electric vehicles charging points in their premises .This encourage employees to use E vehicles .As number of employees using E vehicles will increase it will directly have an effect on reduction in pollution .This will lead to decrease in pollutant in the long run.

IT organizations have started using soft copies of documents instead of hardcopies .This has reduced the use of paper. They try to make minimum use of paper. This is an environment friendly step and can be promoted in other organizations and industries.

IT organizations have their offices in those buildings where natural light can be optimally used. These types of buildings are known as green buildings .This reduces the consumption of electricity. Green building has proper ventilation. Green building does not require extensive air conditioning. Reduction in use of AC reduces the consumption of electricity.

Every organization whether IT or non IT produces waste. IT organizations have less waste generation as compared to organizations working in other industries. Many IT organizations follow a proper waste management process. This reduces the after effects of these wastes which it can have on environment.

It can be seen from the pie chart above that many IT organizations have started using LED lights in place of conventional lighting devices. LED devices consume less power and have long life. LED lights are costlier than the normal lighting devices. But there long life and reduced consumption of electricity makes them more efficient than other lighting devices.

It can also be seen from the pie chart that very few organizations volunteer for the cause of environment and sustainability. There might be various reasons behind this. An IT organization employee does have a compact schedule and many not get enough free time to volunteer.

Almost half of the IT organization which was covered during this research invests in green solution. This may include tie up with various research originations and educational institutions. They either fund them or send their employees to theses institution to undergo research.

Water is another resource which IT organizations manage efficiently. They recycle and reuse the water. Some of the IT organization also does rain water harvesting on small scale.

IT organizations have started generating their own power by installing solar panels on their rooftop. Solar panel provides service for a long time. When dust gets accumulated on the surface of solar panel their efficiency decreases. They just need regular cleaning and maintenance.

IT organizations have also started plantation drive. Thus they are trying to increase the green cover. It has great effect on our environment. As in the recent years we have seen massive deforestation to create living space for the rising population. Deforestation causes soil erosion and degradation of fertility of the soil. Cutting of trees also affects the water cycle and adds to increase in atmospheric temperature. Plantation drives taken by IT organizations are reversing the ill effects caused due to deforestation.

6. Conclusion

The areas in which the IT organizations directly focus on are reduction in use of electricity generated from thermal power plants, waste management, and water management and employees awareness. Apart from these there are other areas where they have also ventured into. These all have a positive effect on our environment. Apart from that IT organization

benefits from it financially. Though various IT organizations have focused on diverse areas they need to learn from others and try to copy those best practices which are being undertaken by other organizations in the direction of environment protection.

If IT sector can take up these initiatives, it can be easily taken up by other sectors too. We all share a common environment irrespective of the boundaries which we have created for ourselves. Every small step taken in direction of environment protection can have a positive cascading effect .It is not the duty of organizations alone but it does require a contribution from each one of us. Only by doing this we can create a better world for us and for the coming future generations.

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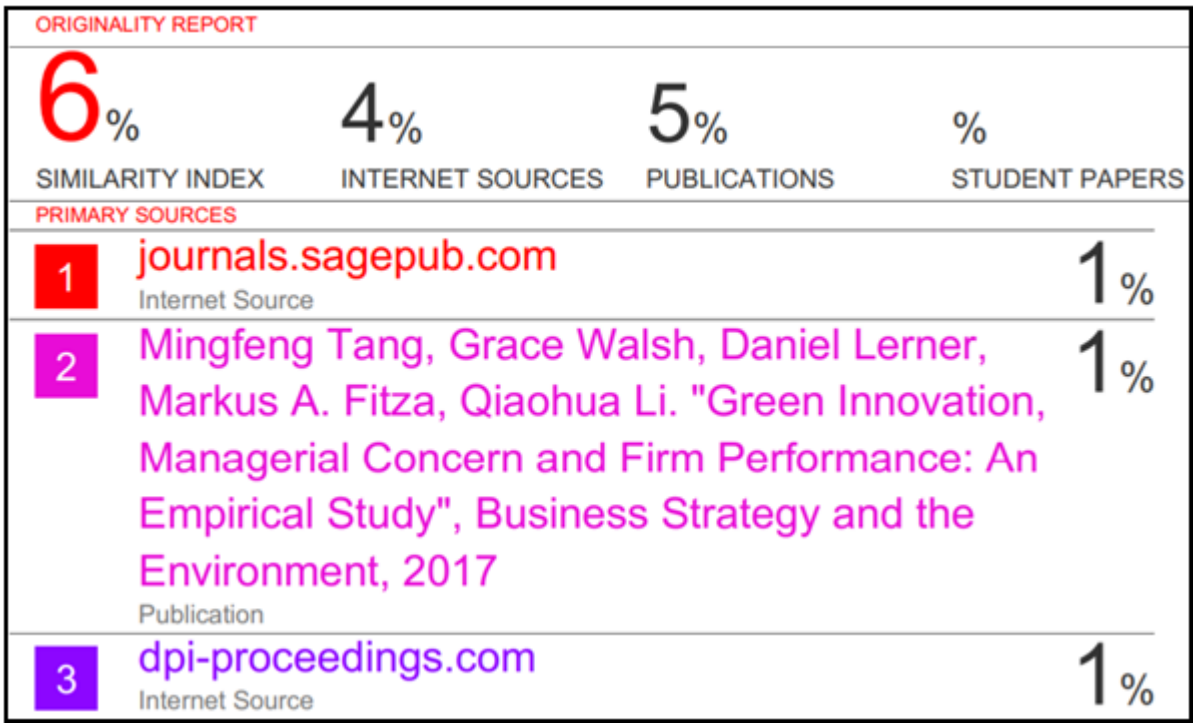

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