

## INFORMATION SYSTEMS: AS A FACILITATOR FOR GREEN SUPPLY CHAINS

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**Abstract** - Today, profit-oriented traditional management paradigm is the dominant management paradigm in our world and environmental management paradigm is not strong enough to suppress it. So, the adoption of green initiatives by supply chain members, which mostly exposed by traditional management paradigm, is possible if these initiatives are not contrary with traditional management paradigm. Moreover, these initiatives should be parallel with this dominant paradigm and should provide profit-oriented benefits. At this point, information systems have a potential of providing profit-oriented and environmental benefits at the same time to the firms and the supply chain members simultaneously, and information systems can be used as a facilitator for adopting green initiatives. The adoption of green initiatives by supply chain members is not possible if these initiatives are contrary with traditional management paradigm, although these initiatives may save the planet from possible disasters. And supply chain partners will resist this kind of changes if they result with cost increase. Thus, we need applications which meet the requirements of both traditional management paradigm (provide profit-oriented benefits) and environmental management paradigm (protection of nature). Also these applications should weaken the resistance from the supply chain members. In this study, we will discuss what role that information systems can play in greening of supply chains and we will state information systems as a facilitator for green initiatives. To achieve this, we consider some applications of information systems as case studies.

**Keywords** - Environmental management paradigm, green, information systems, supply chain, traditional management paradigm

### INTRODUCTION

In this study, we state information systems as a facilitator for companies which need to be green, but cannot be green voluntarily because of high costs. We assume that, normally supply chain members will be exposed by traditional management paradigm and they are profit oriented and environment is not their priority because they are exposed to traditional management paradigm. And information systems can be used to satisfy both two paradigms. In this research, we compare two paradigms frequently. Thus, before starting the main part we should clarify the characteristics and what we mean by traditional and environmental management paradigms briefly.

*Traditional management paradigm*, offers a profit oriented view. Environmental issues are not important, nature is a free source for production, and decreasing costs are vital for a company. This paradigm assumes that humankind is superior to nature.

*In environmental management paradigm*, profit and cost concerns are still important but environmental issues must be integrated into business processes. Firms' operations must be compliant with environment. Contrary to traditional management paradigm, this one sees humankind as a part of nature.

Also we use term "resistance" to mention the obstinacy of firms to be not green. In the following sections, we will discuss about factors which strengthen or weaken the resistance of supply chain members to go green and the role of information systems in this process.

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## FACTORS THAT STRENGTHEN THE RESISTANCE

The supply chain members which exposed to profit oriented traditional management paradigm tend to resist all of changes which are contrary with this paradigm. To this end, they can use all instruments to support their resistance. The instruments which strengthen supply chain members' resistance against green initiatives can be listed as;

- The power of multinational companies and lobbyists
- Lack of information
- Globalization
- Free market economy

**The Power of Multinational Companies and Lobbyists:** The majority of the 100 financial giants of the world consist of private companies. Environmental problems increase because of international finance system and firms which are stronger than governments. Those powerful firms can manipulate the legal system and may prevent government initiatives to implement green rules and laws. In some cases governments accept to regulate and reduce the pollution but they are not strong enough to force economic systems through this decision [1]. Governments do not wish to lose support of these lobbies. So, lobbies can easily oppose against sanctions which are contrary to their benefits.

**Lack of Information:** The literature has mix results for green SCM. Some of it suggest that going green increase cost for companies and reduce their competitiveness, while some others suggest that although there is initial cost increase, in the long run going green will positively affect company in financial forms [2]. As a result, going green has seemed as an uncertain journey.

As the results of Global Supply Chain Survey, in 2008, the most important problem for GSCM is not investment cost but the lack of information about legal regulations and limited knowledge of firms about what they should do to be green [3]. Also, another survey, "*How mature is the green supply chain*" in 2008, supports the idea of lack of information is the most important obstacle of green supply chain management [4].

**Globalization:** During the globalization process, international operating firms' supply sources have diversified and have spread to many countries. In terms of firms, diversification of supply sources makes it difficult to track the environmental impacts of suppliers. According to Cognizant White Paper (2008), proliferation of supply sources to many countries makes it difficult to monitor carbon footprints of finished products. However, new initiatives increasingly focus on suppliers' carbon footprints. Thus, firms aim to control environmental impacts of their supply chains.

**Free Market Economy:** Free market economy, which is the precondition of capitalism, has seen as the most important reason of environmental damages and disasters. According the most of researchers, free market economy increase the competitive and cost pressure on firms. It forces companies to ignore their environmental impacts and just focus on their costs and profits. Thus, short term profit expectations gaining more and more importance for companies and they don't care about negative environmental impacts of their business operations.

Modern industrial society is a system based heavily on the notion of profits. The bottom line for industrial companies is financial issues. To be successful they must increase revenues, reduce costs, and thereby achieve a healthy profit margin [5]. Objectives like employment, exports and protecting industries of strategic importance have traditionally enjoyed a higher political priority than safeguarding the environment [6]. So, tolerating expenditures to minimize the environmental impacts of business operations will not fit the notion of profitability.

Roarty [6] mentioned that, free market economics dictates that companies seek to minimize costs in order to maximize profits regardless of any environmental damage that might cause, in order to survive in highly competitive market.

Researchers often tend to state firms as a victim in the face of economic system. For example, according to [8]; given the close relation between minimizing costs and maximizing profits, it is natural to assume that an organization which seeks profits and has significant political power will feel some motivation to use that power to externalize costs, where possible. Also according to [6], to tendency to blame business for environmental problems overlooks the root causes which lie in the nature of the economic system and policy decisions made by government. However, by a more environmentalist perspective, [7] indicated that the expectation of solving environmental problems just by governments or industries, is a widespread incorrect idea. According to him, this manner and thought is a very dangerous delusion. This delusion shadowing the personal responsibility awareness and immobilize people against environmental destruction.

### **FACTORS THAT WEAKEN THE RESISTANCE**

In the previous section we cited about factors which strengthen the resistance of firms, which are against environmental initiatives. In this section, we will try to reveal factors which weaken this resistance. The past twenty decades has seen momentous industrial development that has helped our world to realize immeasurable wealth and prosperity [9]. On the contrary, such a rapid development has lead to unintended ecological deterioration, including global warming, ozone depletion, industrial accidents, etc [9]. However, public opinion has interested on environmental issues for last twenty years and has started to forced companies and industries to be green.

Customer pressure is one of the most important factors that weaken the resistance of firms, which are not voluntary to perform green initiatives. In addition to customer pressure, different factors such as economic reasons and legal regulations [10]; market share (negotiations with suppliers and customer loyalty), need of risk management (risk of pollution, risk of bylaw and risk of losing competitive advantage) [11]; legal regulations, brand image, innovation and cost decrease [4]; pressure from supply chain members, rivals, environmental organizations [2] added by different researchers and consulting firms. We have to mention that, increasing energy costs are also an important factor that weaken the resistance of firms and industries.

All of these factors have different weights to weaken the resistance and all of them play a complementary role in this process. It is possible to generate these factors as follows;

- Increasing level of customer awareness
- Competitors gains'
- The need for differentiation from rivals
- Increasing energy costs
- Legal regulations

**Increasing Level of Customer Awareness:** Since the negative effects of the global environmental problems begin to affect the daily life and even jeopardize the future of mankind, consumers tend to show interest in what they consume and the impact of their consumption to the environment. Most of studies reveal that, today, people are more sensitive to environment [2] . [12] indicates that there has been increasing public attention placed on the overall condition of the natural environment.

Today, most of consumers and managers feel themselves responsible about environmental issues [13]. [14] mentioned that traditionally companies were judged by customers according to quality of their products, quickness of solving customer problems and degree of fairness. But today companies are

measured according to (environmental) ethics. This trend affects firms, thereby supply chains and motivate them to be green.

**Competitors Gains’:** Some of today’s most successful organizations have made the decision to reshape themselves from the bottom up, improving their environmental profile and their public image, making financial savings and safeguarding against future environmental hazards [15]. By these improvements, a company is able to cost saving and increase their brand value. By this way, green initiatives become attractive for rivals.

3M company proceed a pollution control program called 3P (Pollution Prevention Pays). Between 1975 and 1990, 3M reduced their total pollution by over 530,000 tons (a %50 reduction in total emissions) and, according to company sources, saved over \$500million through lower raw material, compliance, disposal and liability costs [16]. Another example is about Toyota, the automobile manufacturer, produced environmental car: Prius. Survey results show that Toyota’s brand value increase about 47% [17]. We have to mention that, green initiatives are not profitable always. But it is available for differentiation and having competitive advantage. So, these type of advantages motivate rivals to be green.

**The Need For Differentiation From Rivals:** Companies operating in the same industry lost their diversity so there is no way for consumers to look civilization level of competing companies when making choices. Today, there is no significant differences between quality and prices so consumers prefer to buy from environment friendly companies [14], [2]. Also [18] cited that the most important reason for companies to be green is, not to lose their competitive positions. And this is why lots of companies are trying to put forward their environmental features and show up how green they are.

**Increasing Energy Costs:** Increasing of energy costs day by day, pushing companies to find a solution to this problem. Increasing number of green buildings that decrease energy consumption is one of these solutions. Another solution is APUs (Auxiliary Power Unit). The auxiliary power unit (APU) offers long-haul truck drivers amenities like air conditioning during driving breaks while eliminating the need to idle the engine. This technology could help eliminate 11 million tons of carbon dioxide emissions from truck idling in the United States each year [19].

Wal Mart, the retailer company which has the second largest private fleet in USA, purchase and install 7,000 APUs in its long-haul trucks. The company has estimated APUs save \$25 million in annual fuel costs, a figure that has likely increased with higher global oil prices in 2007 and 2008 [20].

**Legal Regulations:** Government, as a regulatory agency, may force companies and ultimate consumers to be compliant with different environmental regulations. Unlike the other factors, government doesn’t leave freedom of choice to companies and consumers [2]. Governments warn companies to be more sensitive against environment and force them to comply with environmental regulations. So, governments and legal regulations can be evaluated as one of the most important factor for weaken the resistance of companies, which are not volunteering to be green.

## COMPARISON OF STRENGTHENING AND WEAKENING FACTORS

Recently, the impacts of resistance weakening factors which force supply chain members to be green is rising. It has lots of reasons. Today, global environmental problems affect the daily life of people. Since people face with environmental problems, they are more sensitive to environment. Governments burden more strict environmental regulations to companies, firms burden more strict environmental rules to their suppliers and public opinion pushes consumers to be “green consumers”.

These improvements are the evidence of how environmental management paradigm get strong. Figure 1 shows the increasing impacts of environmental factors.

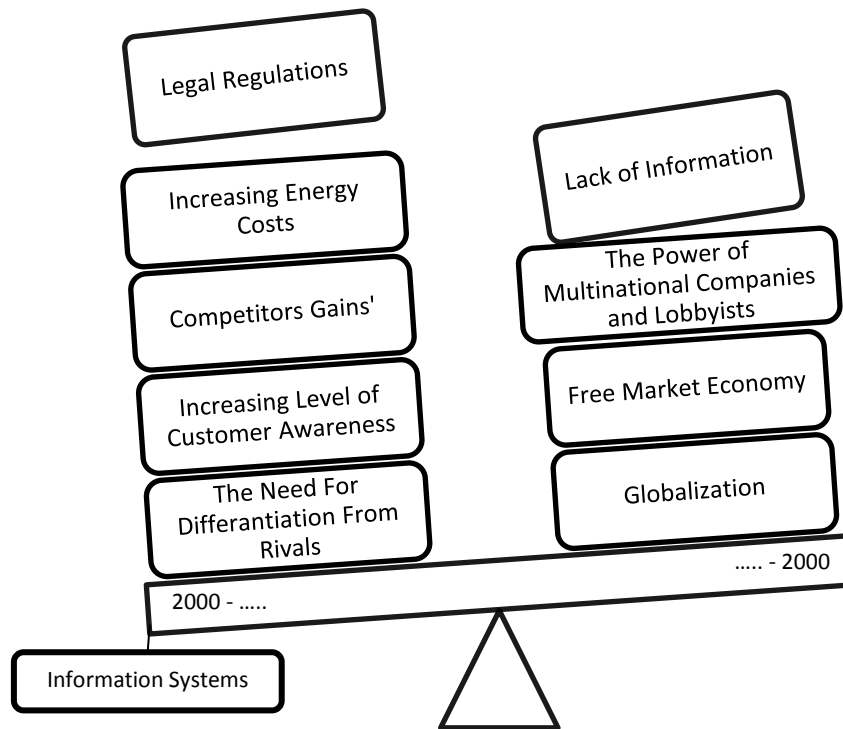


FIGURE. 1  
Strengthening and Weakening Factors

Although environmental management paradigm has getting strong, traditional management paradigm is still affecting the supply chains powerfully. The majority of the world has dominated by free market economy and this economic system feeds traditional management paradigm. So, despite on the increasing number of pushing factors, acceleration of green initiatives are still not enough. Acceleration of green initiatives and applications mostly depend on voluntarism of firms. If companies internalize green initiatives voluntarily, then greening of supply chains become easier.

In this point we have to ask this question: How it is possible to increase voluntarism level for green initiatives? The answer is hidden in the foundations of traditional management paradigm. If green initiatives provide some advantages like cost reduction, increasing brand value, operation efficiency...etc, it will be easier to green supply chains.

Then, is it possible to find solutions which save the planet and satisfy companies simultaneously? Now, we will discuss how a role that information systems can play at this point.

### THE ROLE OF INFORMATION SYSTEMS IN GREEN INITIATIVES

As we mentioned before, under normal conditions, supply chain members won't go green voluntarily. Some of pressure groups and factors force them to be green, but they are not enough to suppress the impacts of traditional management paradigm. In this section, we suggest that; acceleration of green supply chains can be achieved if supply chain members are voluntarily accept to be green. And information systems can be used for this purpose.

When we have a look at the resistance-breaking factors, like government regulations, customer preference, energy costs etc, they all have a potential to push companies to be green. Firms are performing green applications both for to be compliant with market and avoiding financial sanctions.

But, as we can see in business world, greening process is too slow and these factors are not enough. Actually there are lots of green opportunities for companies but unfortunately just a minority of companies can see and evaluate these opportunities.

The adoption of green initiatives by supply chain members is not possible if these initiatives are contrary with traditional management paradigm, which offers profit orientation and cost reduction. For adaptation of green applications, they should be parallel with traditional management paradigm because firms operating in free market economies are exposed by this dominant management paradigm. It means, green initiatives should provide some advantages to the firms, like profit increase and cost reduction.

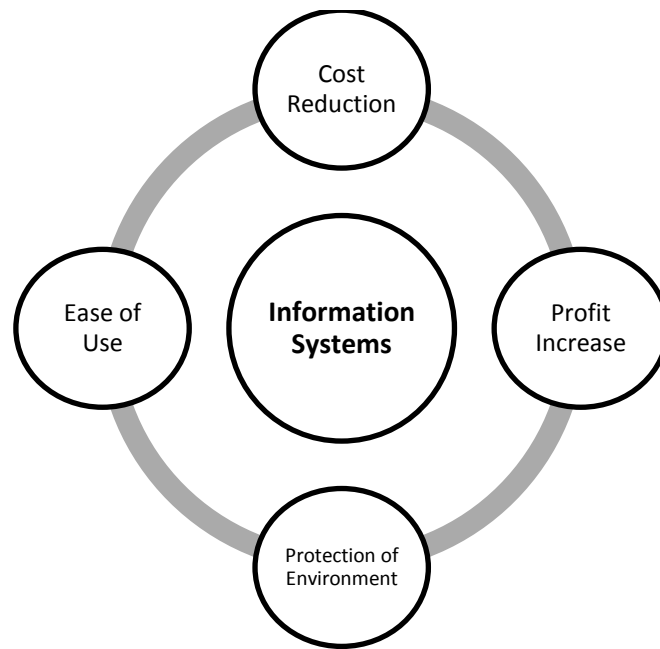


FIGURE. 2  
The Role Of Information Systems In Green Initiatives

This study suggests that; information systems are able to provide advantages that facilitate the adoption of green initiatives. If supply chain members are exposed by traditional management paradigm and if they are profit and benefit oriented, then they won't oppose information systems which provide them cost reduction and easy to use. And if these systems are green oriented at the same time, adoption process will be easier.

It is possible to talk about four roles of information systems in terms of green supply chain management;

- Cost reduction
- Profit increase
- Ease of use
- Protection of environment

In the following section, we present a case study which shows all these mentioned benefits of an information system.

#### **Case Study: E-Bill**

Today, lots of private and public firms tend to inform their customers about their payments by e-bill. In this study, we state e-bill as a green IS. E-bill is a good example, because it offers all of advantages of green IS; cost reduction, profit increase, ease of use and protection of environment. Now, we will focus on the advantages of e-bill, in terms of business and environment.

Traditional postal system requires lots of actors; like cargo firm, postman etc. And most importantly, it requires a more complicated physical distribution process. On the other side, an e-bill just requires a simple internet system. So, internet allows companies to reduce complexity. Another advantage of e-bill is clearing the errors away. In traditional system, there are lots of processes which made by humans; like material handling, posting, delivery, packaging etc. And these processes are error-prone. In the contrary, just a good working software is enough for an error free process for e-bill system because human hand factor is mostly eliminated. Also, if we compare these two systems with regard to their costs, of course e-bill is cheaper than traditional posting. Beyond these advantages, green image allows companies to increase their brand value. Today, lots of research results reveal that greening efforts have positive impacts on brand value.

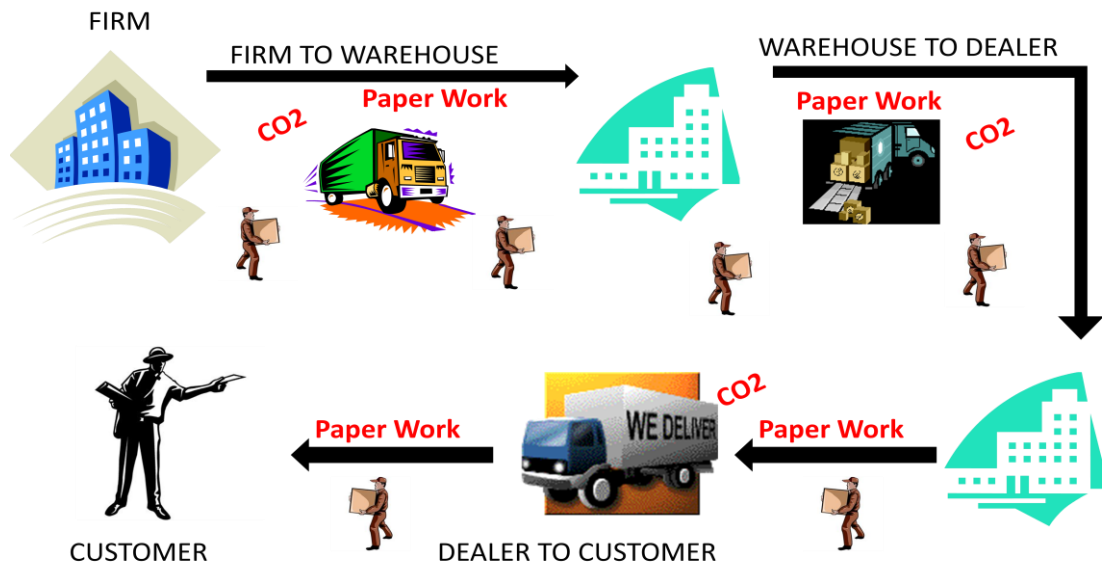


FIGURE. 3  
Supply Chain of Traditional Posting System

To benefit from the advantages of e-bill system, companies have to meet two main criteria; (i) technical infrastructure and (ii) convincing consumers. The initial investment cost will be high for technical infrastructure, but the total cost will decrease in the long run. On the other side, convincing consumers to use e-bill rather than traditional bill is more problematic than establishing technical infrastructure.

For convincing customers to use e-bill, putting environmental problems forward is a good strategy and most of companies tend to use this strategy. In different ads, companies indicate global environmental problems and its' consequences to the world and emphasize the importance of e-bill to stop this negative consequence. We caution that , putting environmental problems forward might be a good mask for companies. Are they really environment friendly or just profit oriented? This is uncertain at this point. Additionally, some of companies award their customers who prefer to use e-bill by different promotions. By these efforts, customers become voluntary to use e-bill.

From the perspective of consumers, e-bill allows them to get rid of some problems which they face in traditional postal system. Problems like delaying of bill, losing of bill, the necessity of saving the bill anywhere, the visibility of bill amounts by unwanted persons, can be solved by e-bill system. By this system, bills arrive on time, can be saved into e-mail address, and can be viewed just by the relevant person. Also small promotions make e-bills more attractive. Another advantage of e-bill is to get rid of the cost of traditional postal fee. Companies are generally tend to reflect the postal fee to the

customers' invoice and e-bills remove these costs. On the other hand, it allows customers to feel happy to save trees (and planet) and satisfies their consciousness.

From the perspective of nature, e-bill has lots of advantages for planet. First of all, it saves trees by reducing paper usage. So, companies need less paper and less trees need to be cut down. Also, because of decreasing package cycle, in the physical distribution process firms need to consume less gas or petrol. It means they consume less energy, less natural resource, and reveal less carbon emissions to the atmosphere.

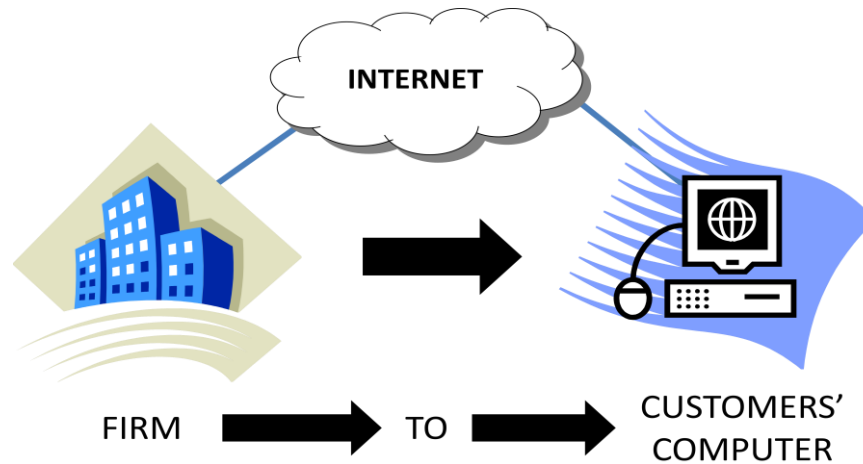


FIGURE. 4  
Supply Chain of E-Bill System

E-bill system is a good example for how information systems play a facilitator role in green initiatives. It provides logical and conscientious confidence to the firms and consumers. Of course e-bill system is just a sample of advantage of information systems. There are lots of opportunities that provides advantages to firms, customers and environment, like EDI. EDI (electronic document interchange) allows firms and customers to go paperless and speed up the process. Also it reduces the paper usage and saves trees. These examples can be increased easily. Now we will try to determine the common characteristics of these examples;

- a) The priority of supply chain members (which are the sides of green information systems applications) is profit and benefit, not environmental concerns. So these information systems were not preferred because of their environmental friendly characteristics.
- b) Supply chain members were not forced to implement or participate in these applications. They implement / participate in these applications voluntarily, because of their own benefits.
- c) Information systems may offer cost advantages to the supply chain members.
- d) Information systems may offer ease of use to the participants and facilitate their daily life of business.
- e) Information systems reduce the negative impact of business, saves the natural resources, provides less energy consumption.



TABLE.1  
Comparison of Two Systems: TPS vs. E-Bill

	TPS	E-BILL
Complexity	High	Low
Possibility of Error	High	Low
JIT Delivery	Low	High
Automation	Low	High
Manpower	High	Low
Delivery Cost	High	Low
Initial Cost of system designing	Low	High
Difficulty of managing system	High	Low
Customer satisfaction	Low	High
Energy consumption	High	Low
Paper usage	High	Low
Carbon Dioxide Emissions	High	Low

Regarding to this consequences, we can suggest that the probability of adoption of green initiatives depends on traditional management paradigm. If new green practices and applications are not based on traditional management paradigm, the adoption of green initiatives by supply chain members will not be possible although these initiatives may save the planet from possible disasters. Information systems are providing some advantages which are based on these values (profit and benefit) and save the planet at the same time and make it possible to adoption of green initiatives. And so, we clarified the importance of information systems in greening of supply chains.

## RESULTS

Supply chain members are mostly aware of the global environmental problems and their negative roles in this process. However, because of their profit oriented natures, they are not voluntarily stop their negative impacts if these efforts result with cost increase. Furthermore, they tend to resist all factors which force them to be green. This resistance will be maintained as long as a new paradigmatic breaking occurs in traditional management paradigm, which puts environmental issues in the center of businesses. Although some of instruments began to mature that weakens the resistance of companies (and traditional management paradigm), a full transformation will take a long time.

In that case, the best way to be green is to make companies participate voluntarily. And information systems have this potential of *satisfying firms, customers and environmental issues simultaneously*.

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