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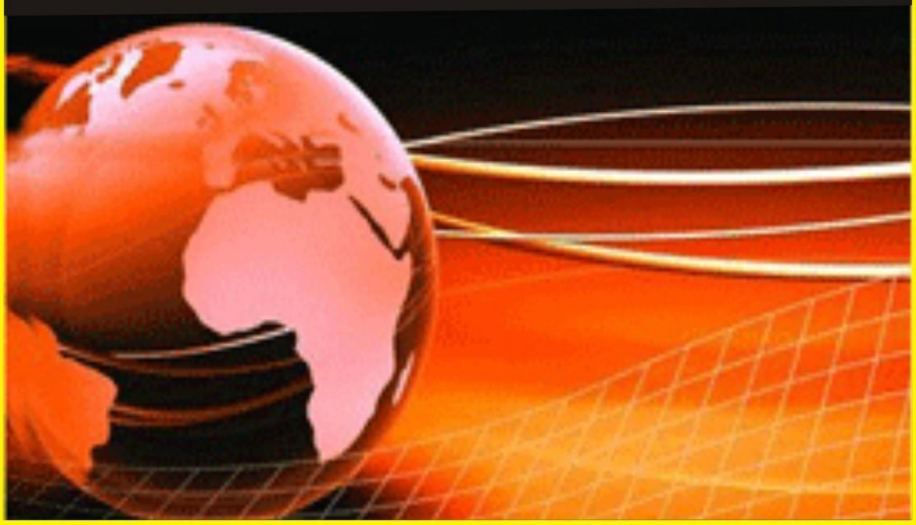

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COMPARING COX PROPORTIONAL HAZARDS MODEL AND PARAMETRIC MODELS FOR ANALYZING THE SURVIVAL OF PATIENTS WITH HEART FAILURE

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ABSTRACT

Heart failure is still a major global cause of morbidity and death, so assessing patient survival requires strong statistical tools. To investigate how long patients with heart failure live, this study compares the Cox Proportional Hazards (PH) model with common parametric survival models, including Exponential, Weibull, Log-logistic, Log-normal, Gamma, Gompertz, and Rayleigh. We start by checking the proportional hazards assumption of the Cox model using clinical data that covers patient demographics, comorbidities, and survival outcomes. Then, we explore how flexible and efficient the parametric models are for calculating hazard rates and survival functions. We compare the models based on fit metrics such as the Akaike Information Criterion (AIC). While the Cox PH model assumes less about the baseline hazard, our findings show that some parametric models offer better interpretability and predictive accuracy when their assumptions hold true. This comparison highlights the importance of picking the right model for survival studies. Using parametric methods can result in more precise risk assessment for heart failure prognosis.

KEYWORDS: *Akaike Information Criterion (AIC), Cox Proportional Hazard Model, Heart Failure, Parametric Models.*

1. INTRODUCTION

The last stage of many heart diseases is heart failure, a complex condition. Significant mortality, poorer quality of life, and high hospitalization rates are the results. Making clinical decisions, evaluating risk, and creating focused treatments all depend on knowing and forecasting how long heart failure patients will live. Survival analysis requires statistical models. They offer information about the likelihood of significant events, such as hospital readmissions or deaths.

One of the most popular techniques in survival analysis is the Cox Proportional Hazards model, which was first presented by Sir David Cox in 1972. Without requiring the baseline hazard function to be specified, it provides estimates of hazard ratios associated with various factors. The Cox model is flexible and simple to understand because of its semi-parametric methodology. It is predicated on the idea that the risk ratios between groups don't change over time, though. Results could be skewed or deceptive if this presumption is broken.

On the other hand, parametric survival models assume specific distributions for survival times, such as the Exponential, Weibull, Log-logistic, Log-normal, Gamma, Gompertz, and Rayleigh

models are parametric models. When the assumed distribution fits the data well these parametric models can produce more accurate estimates and also allow direct estimation of hazard rates and survival functions. Parametric models can also manage developing hazards and forecast outcomes outside of the observed follow-up periods, both of which are frequently beneficial in clinical practice.

Given the advantages and disadvantages of each modeling technique, it is vital to understand how they work in various clinical situations. In this study, we use a dataset of heart failure patients to evaluate the Cox Proportional Hazards model with parametric survival models. We assess the models' fit, predictive power, and interpretability, and consider the implications for clinical research and practice.

2. LITERATURE REVIEW

Survival analysis is highly applied in clinical research to analyze time-to-event data, particularly for long-term diseases such as heart failure. Over the years, different modeling techniques have been developed and employed to further develop the knowledge of the factors influencing patient survival and facilitate improved clinical decision-making.

Cox Proportional Hazards (PH) model, introduced by Cox (1972), is used extensively due to its semi-parametric nature, without necessitating the specification of the baseline hazard function. The Cox model has been employed by several studies, including those by Levy et al. (2002), to identify clinical predictors of death in heart failure populations. While the model is powerful and interpretable, it will have a limitation in relying on the proportional hazards assumption, especially when covariate effects vary over time.

In contrast, parametric models assume a specific distribution for survival times and are especially useful when the data exhibit time-dependent hazard structures. The Weibull model, for example, allows for increasing or decreasing hazards over time and has been effectively used in several heart failure studies (e.g., D'Agostino et al., 2008). Similarly, Log-normal and Log-logistic models have been used to model more complex hazard shapes, especially when survival curves show non-monotonic behavior. Research by Klein and Moeschberger (2003) and Bradburn et al. (2003) emphasizes the advantages of parametric models in providing smooth and extrapolatable survival estimates.

Recent studies have explored model comparison frameworks to assess the relative performance of Cox and parametric models. A study by Royston and Parmar (2011) compared flexible parametric models with Cox models in clinical trials and found that parametric models often performed better in terms of predictive accuracy when their assumptions were met. Additionally, statistical tools such as the Akaike Information Criterion (AIC) and graphical methods have been used to guide model selection (Collett, 2015).Ravangard et al., (2011) compare the results of Cox proportional hazards model and parametric models in the study of length of stay in a Tertiary Teaching Hospital in Tehran, Iran. Pourhoseingholi et al., (2007) compare the Cox regression and parametric models for survival of patients with gastric carcinoma. Pourhoseingholi et al., (2009) used log-normal censored regression model to find out the prognostic factors in gastric cancer.

For heart failure, precise survival modeling is essential because of heterogeneity in the patient population. Research such as that presented by Pocock et al. (2006) has shown that considering time-dependent effects and flexible modeling strategies can very much improve prognostic

models. Yet few studies have directly compared parametric and semi-parametric survival models for heart failure cohorts systematically, and hence more research in this context is required. Ahmad et al. (2017) employed Cox regression model, Kaplan Meier plot and Martingale residuals to analysis of heart failure patients' survival. Chicco and Jurman (2020) utilized machine learning classifiers to analysis heart failure patients' survival. Ashine et al. (2021) utilized Cox proportional hazard model and Bayesian parametric survival models to analysis survival time of patients with heart failure.

3. DATASETS AND STATISTICAL TECHNIQUES

Dataset

We analyzed a dataset that included 299 heart failure patients' medical records that were gathered between April and December 2015 at the Allied Hospital and the Faisalabad Institute of Cardiology in Faisalabad, Punjab, Pakistan [Ahmad et al. (2017)]. The patients were in age from 40 to 95 years old, with 105 women and 194 males among them. Each of the 299 patients had a history of heart failure and left ventricular systolic dysfunction that classified them in heart failure stages III or IV according to the New York Heart Association's (NYHA) classification [Bredy et al. (2017)]. The dataset contains total 13 potential features which were described in Table 1. The features Age, CPK (Creatinine phosphokinase), Ejection Fraction (EF), Platelets, Serum creatinine, Serum sodium, Time (Follow-up period) are taken as continuous where the features Sex, Anemia, Blood pressure, Diabetes, Smoking, Event are taken as binary.The quantitative features of the dataset are presented in Table 2 and Table 3. Other additional details about this dataset can be found in [Ahmad et al. (2017)].

TABLE 1: DESCRIPTION OF EACH FEATURE OF THE DATASET

Categorical Variables		**Continuous Variables**	
Variables	**Description (Numbers)**	**Variables**	**Description[Range]**
Sex	0-Female (105); 1-Male (194)	Age	Age of the patient [40-95]
Anemia	0-Absence (170); 1-Presence (129)	CPK	Level of CPK enzyme in the blood[23-7861]
High Blood pressure (BP)	0-No (194); 1-Yes (105)	Ejection fraction (EF)	Percentage of blood leaving the heart at each contraction [14-80]
Diabetes	0-Absence (174); 1-Presence (125)	Platelets	Platelets in the blood in kiloplatelets/mL[25.01-850.00]
Smoking	0-No (203); 1-Yes (96)	Serum creatinine	Level of creatinine in the blood in mg/dL[0.50-9.40]
Event	0-Survived (203); 1-Deceased (96)	Serum sodium	Level of sodium in the blood in mEq/L[114-148]
		Time	Follow-up period in days [4-285]

TABLE 2: STATISTICAL QUANTITATIVE DESCRIPTION OF CATEGORY FEATURE OF THE DATASET

Variables	Full Sample (299)		Dead Patients (96)		Survived Patients (203)	
	Number	Percentage	Number	Percentage	Number	Percentage
Sex (0-Female)	105	35.12	34	35.42	71	34.98
Sex (1-Male)	194	64.88	62	64.58	132	65.02
Anemia (0-Absence)	170	56.86	50	52.08	120	59.11
Anemia (1-Presence)	129	43.14	46	47.92	83	40.89
High Blood pressure (0-No)	194	64.88	57	59.38	137	67.49
High Blood pressure (1-Yes)	105	35.12	39	40.62	66	32.51
Diabetes (0-Absence)	174	58.19	56	58.33	118	58.13
Diabetes (1-Presence)	125	41.81	40	41.67	85	41.87
Smoking (0-No)	203	67.89	66	68.75	137	67.49
Smoking (1-Yes)	96	32.11	30	31.25	66	32.51

TABLE 3: STATISTICAL QUANTITATIVE DESCRIPTION OF NUMERIC FEATURE OF THE DATASET

Variables	Full Sample (299)			Dead Patients (96)			Survived Patients (203)		
	Median	Mean	s.d.	Median	Mean	s.d.	Median	Mean	s.d.
Age	60.00	60.83	11.89	65.00	65.22	13.21	60.00	58.76	10.64
Ejection fraction	38.00	38.08	11.83	30.00	33.47	12.53	38.00	40.27	10.86
CPK	250.00	581.80	970.29	259.00	670.20	1316.58	245.00	540.10	753.80
Platelets	262.00	263.36	97.80	258.50	256.38	98.53	263.00	266.66	97.53
Serum sodium	137.00	136.60	4.41	135.50	135.40	5.00	137.00	137.20	3.98
Serum creatinine	1.10	1.39	1.03	1.30	1.84	1.47	1.00	1.19	0.65
Time	115.00	130.30	77.61	44.50	70.89	62.38	172.00	158.30	67.74

s.d.: standard deviation

Statistical Techniques

The Cox Proportional Hazards Model is a most widely used generalized and a powerful semi-parametric model used in survival analysis to investigate how different variables influence the probability of a certain event—like failure, relapse, or death—happening. The model displays the following hazard function

$$h(t|X) = h_0(t).\exp\left(\beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p\right)$$

where$h(t|X)$ is the hazard function for the covariate X at time t, $h_0(t)$is the baseline hazard function which does not need to be specified, $X_1, X_2, \ldots, X_p$ are covariates and $\beta_1, \beta_2, \ldots, \beta_p$ are the regression coefficients.

The model assumes that two single risk ratio is stable over a period of time:

$$\frac{h(t|X_1)}{h(t|X_2)} = \exp[\beta^T(X_1 - X_2)]$$

which is referred to as proportional hazard assumption. The regression coefficient β, positive indicates the hazard increases and thereby the probability of survive is reduced; negative indicates the hazard is reduced and thereby the probability of survive is improved. The hazard

ratio (HR) exp(β) shows by how much the risk increases or decreases if the covariate shifts by one unit.

An alternative to the Cox Proportional Hazards Model in survival analysis when proportional hazard assumption violated is the Aalen's Additive Hazard Model. Aalen's model implies that covariates have an additive effect on the hazard function, whereas Cox assumes that covariates have a multiplicative effect on the hazard.Also the Aalen's Additive Hazard Model is a non-parametric model which allows the effects of the covariates to change over time. The model is given by the following hazard function

$$h(t|X(t)) = \beta_0(t) + \beta_1(t)X_1(t) + \beta_2(t)X_2(t) + \cdots + \beta_p(t)X_p(t)$$

where$h(t|X(t))$ is the hazard function for the covariate $X(t)$ at time t, $\beta_j(t)$ is the time-varying regression coefficient.

In addition, in case the proportional hazard assumption is bound to be in violation, the use of parametric survival models can prove better. Parametric models most commonly used are Exponential, Weibull, Log-logistic, Log-normal, Gamma, Gompertz and Rayleigh distributions.

Proportional hazards assumption was checked in this research by employing Schoenfeld residuals, Cox regression model and parametric models such as Exponential, Weibull, Log-logistic, Log-normal and Rayleigh.The p-value less than 0.05 are taken as statistical significant. Akaike Information Criterion (AIC) was used to compare the different model performance.

4. RESULTS AND DISCUSSION

The results for proportional hazards assumptions testing are shown in **Table 4** and a plot of Schoenfeld residuals for all the covariates is shown in **Figure 1**. From Table 4, the correlation between the Schoenfeld residuals for the variable 'Ejection.Fraction' and ranked survival time is -0.0277 with a p-value of 0.03. This significant p-values proof that the proportional hazards assumption is not satisfied for the variable 'Ejection.Fraction'. The p-values for the other variables are not significant suggest that there is not enough evidence to reject the proportional hazards assumptions for these variables. The global test for the entire model is not significant with $p = 0.39$. This global test offers evidence that the proportional hazards assumption is satisfied for that model.

TABLE 4: TEST FOR PROPORTIONAL HAZARD ASSUMPTIONS

Covariates	**rho**	**chisq**	**p**
Gender	-0.1054	0.0763	0.78
Smoking	0.0134	0.4790	0.49
Diabetes	0.0983	0.1920	0.66
BP	0.0074	0.0082	0.93
Anaemia	0.0840	0.0169	0.93
Age	0.2090	0.1030	0.75
Ejection.Fraction	-0.0277	4.6900	**0.03***
Sodium	0.0728	0.1100	0.74
Creatinine	-0.0455	1.5200	0.22
Pletelets	0.1127	0.00006	1.00
CPK	-0.1140	1.02	0.31
GLOBAL		0.1170	0.39

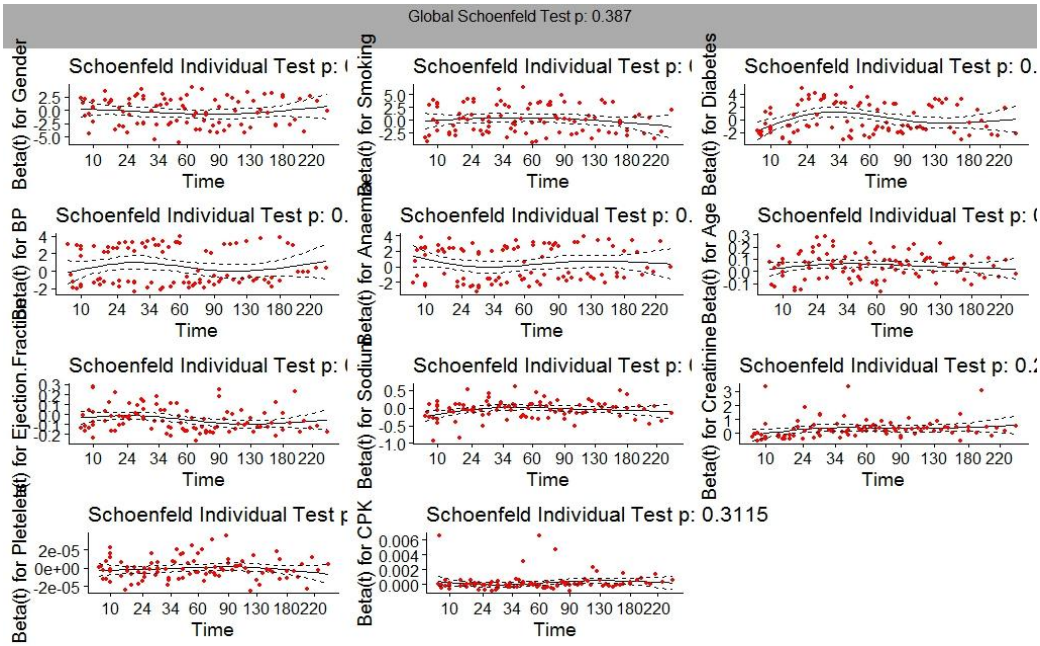

Figure 1. Schoenfeld residuals

The Cox proportional hazard model and the parametric models like, Exponential, Weibull, Log-logistic, Log-normal and Rayleigh was used separately to investigate the influence of several factors on the survival times.

The results of Cox regression model and the parametric models are presented in Table 5 – Table 10. The prognostic factors like Blood pressure (BP), Anaemia, Age, Ejection.Fraction, Creatinine and Creatinine phosphokinase (CPK) are the significant factors for survival of the heart failure patients as per all six models. Sodium is significant covariates as per log-normal and Rayleigh models. The performances of the models are compared through AIC values which are shown in Table 11. We see that Cox regression model has the lower AIC among all models and the parametric model exponential has the lowest AIC among all parametric models. Also comparisons of the results of the covariates between Cox and Exponential models are present in Table 12. Both models perform same to identify the effective risk factor for survival of the patient with heart failure.

TABLE 5: SIGNIFICANCE OF VARIABLES UNDER COX REGRESSION MODEL

Covariates	Coefficient	HR	Z-value	p-value
Gender	-0.2375	0.7886	-0.944	0.3452
Smoking	0.1289	1.1376	0.513	0.6078
Diabetes	0.1399	1.1501	0.627	0.5307
BP	0.4757	1.6092	2.201	0.0278*
Anaemia	0.4601	1.5843	2.122	0.0338*
Age	0.0464	1.0475	4.977	6.45e-07*
Ejection.Fraction	-0.0489	0.9522	-4.672	2.98e-06*
Sodium	-0.0442	0.9568	-1.899	0.0575
Creatinine	0.3210	1.3786	4.575	4.76e-06*
Pletelets	-4.635e-07	1.0000	-0.412	0.6806
CPK	2.207e-04	1.0002	2.225	0.0260*

TABLE 6: SIGNIFICANCE OF VARIABLES UNDER EXPONENTIAL MODEL

Covariates	Coefficient	SE	Z-value	p-value
Gender	0.234	0.252	0.93	0.352
Smoking	-0.118	0.251	-0.47	0.639
Diabetes	-0.142	0.223	-0.64	0.524
BP	-0.507	0.214	-2.38	0.017*
Anaemia	-0.492	0.214	-2.29	0.022*
Age	-0.0486	0.0093	-5.23	1.7e-07*
Ejection.Fraction	0.0509	0.0106	4.82	1.4e-06*
Sodium	0.0437	0.0231	1.90	0.058
Creatinine	-0.325	0.0681	-4.77	1.8e-06*
Pletelets	5.16e-07	1.13e-06	0.45	0.649
CPK	-2.38e-04	9.95e-05	-2.39	0.017*

TABLE 7: SIGNIFICANCE OF VARIABLES UNDER WEIBULL MODEL

Covariates	Coefficient	SE	Z-value	p-value
Gender	0.246	0.263	0.93	0.350
Smoking	-0.119	0.261	-0.45	0.649
Diabetes	-0.147	0.232	-0.63	0.528
BP	-0.514	0.222	-2.31	0.021*
Anaemia	-0.5	0.224	-2.24	0.025*
Age	-0.0498	0.01	-4.96	7.2e-07*
Ejection.Fraction	0.0525	0.0116	4.53	5.9e-06*
Sodium	0.0450	0.0241	1.87	0.062
Creatinine	-0.333	0.0731	-4.56	5.1e-06*
Pletelets	5.51e-07	1.18e-06	0.47	0.641
CPK	-2.43e-04	1.04e-04	-2.34	0.019*

TABLE 8: SIGNIFICANCE OF VARIABLES UNDER LOG-LOGISTIC MODEL

Covariates	Coefficient	SE	Z-value	p-value
Gender	0.256	0.285	0.90	0.369
Smoking	-0.123	0.283	-0.44	0.663
Diabetes	-0.136	0.248	-0.55	0.585
BP	-0.522	0.247	-2.12	0.034*
Anaemia	-0.489	0.245	-1.99	0.046*
Age	-0.0508	0.0105	-4.85	1.2e-06*
Ejection.Fraction	0.0506	0.0122	4.14	3.5e-05*
Sodium	0.0516	0.0270	1.91	0.056
Creatinine	-0.360	0.0979	-3.67	0.0002*
Pletelets	6.77e-07	1.28e-06	0.53	0.597
CPK	-2.36e-04	1.16e-04	-2.03	0.042*

TABLE 9: SIGNIFICANCE OF VARIABLES UNDER LOG-NORMAL MODEL

Covariates	Coefficient	SE	Z-value	p-value
Gender	0.176	0.296	0.59	0.5520
Smoking	-0.0862	0.292	-0.30	0.7675
Diabetes	-0.0864	0.255	-0.34	0.7343
BP	-0.503	0.256	-1.97	0.0489*
Anaemia	-0.524	0.253	-2.07	0.0384*
Age	-0.0482	0.0107	-4.51	6.5e-06*
Ejection.Fraction	0.0443	0.0115	3.84	0.0001*
Sodium	0.0608	0.0269	2.26	0.0239*
Creatinine	-0.359	0.0104	-3.44	0.0006*
Pletelets	7.16e-07	1.32e-06	0.54	0.5880
CPK	-2.55e-04	1.17e-04	-2.18	0.0291*

TABLE 10: SIGNIFICANCE OF VARIABLES UNDER RAYLEIGH MODEL

Covariates	Coefficient	SE	Z-value	p-value
Gender	0.0727	0.128	0.57	0.5686
Smoking	-0.0837	0.127	-0.66	0.5107
Diabetes	-0.0767	0.114	-0.67	0.5002
BP	-0.401	0.107	-3.74	0.0002*
Anaemia	-0.376	0.108	-3.49	0.0005*
Age	-0.0321	0.0049	-6.47	9.5e-11*
Ejection.Fraction	0.0306	0.0054	5.61	2.1e-08*
Sodium	0.0272	0.0116	2.34	0.0191*
Creatinine	-0.213	0.0361	-5.90	3.7e-09*
Pletelets	7.85e-08	5.87e-07	0.13	0.8935
CPK	-1.72e-04	5.26e-05	-3.27	0.0011*

TABLE 11: MODEL COMPARISON AS PER AIC

Models	Cox	Exponential	Weibull	Log-logistic	Log-normal	Rayleigh
AIC	958.46	1280.42	1282.24	1285.46	1287.37	1374.36

TABLE 12: COMPARISON OF THE RESULTS OF THE COVARIATES BETWEEN COX AND EXPONENTIAL MODELS

Covariates	Cox model			Exponential model		
	Coefficient	SE	p-value	Coefficient	SE	p-value
Gender	-0.2375	0.2516	0.3452	0.234	0.252	0.352
Smoking	0.1289	0.2512	0.6078	-0.118	0.251	0.639
Diabetes	0.1399	0.2231	0.5307	-0.142	0.223	0.524
BP	0.4757	0.2162	0.0278*	-0.507	0.214	0.017*
Anaemia	0.4601	0.2168	0.0338*	-0.492	0.214	0.022*
Age	0.0464	0.0093	6.45e-07*	-0.0486	0.0093	1.7e-07*
Ejection.Fraction	-0.0489	0.0105	2.98e-06*	0.0509	0.0106	1.4e-06*
Sodium	-0.0442	0.0233	0.0575	0.0437	0.0231	0.058
Creatinine	0.3210	0.0702	4.76e-06*	-0.325	0.0681	1.8e-06*
Pletelets	-4.635e-07	1.13e-06	0.6806	5.16e-07	1.13e-06	0.649
CPK	2.207e-04	9.92e-05	0.0260*	-2.38e-04	9.95e-05	0.017*

5. CONCLUSION

This research offers a comparative assessment of the Cox Proportional Hazards model and widely applied parametric survival models in the analysis of patient survival with heart failure. The Cox model, due to its semi-parametric flexibility and interpretability, is still an influential model, particularly when the proportional hazards assumption can be made. Nevertheless, parametric models like the Weibull and Log-normal provide useful alternatives, especially when survival times are known to follow established distributions or when extrapolation beyond the observed region is needed.

Our results show that the prognostic variables such as Blood pressure (BP), Anaemia, Age, Ejection.Fraction, Creatinine and Creatinine phosphokinase (CPK) are the important factors for survival of the heart failure patients according to all six models. Sodium is important covariates according to log-normal and Rayleigh models. Parametric models are capable of outperforming the Cox model in model fit and predictive accuracy when their assumptions are met.

Finally, the selection between Cox and parametric models ought to be determined by the nature of the data, the clinical question being investigated, and diagnostic tests like residual analysis and goodness-of-fit tests. The implementation of both modeling methods may give a better insight into the survival of patients and the strength of clinical conclusions obtained from survival analysis.

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GREEN MARKETING: - CURRENT SCENARIO, NEED, STRATEGIES FOR AWARENESS AND CHALLENGES IN INDIAN MARKET

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ABSTRACT

In this age of modernisation, liberalization and globalisation, it has become an even more difficult task to make the customers as well as consumers happy, contained and not forgetting making our natural environment safe and pollution free that is the need of time. Pollution to the environment is a major issue in the contemporary business world. There are also the environmental problems known by the consumers such as global warming and effect of environmental pollution. Green marketing is an aspect that has become particularly significant in the contemporary marketplace and has become the significant concept in India as in any other part of the world regardless of being a developing or a developed one. In this research work, a lot of attention has been focused on the concept, need, and significance of green marketing. All these sources of evidence such as books, journals, websites, and newspapers are important since data must be gathered concerning the significance of green marketing. The Paper seeks to determine what exactly green marketing is all about and how a business firm can be more competitive by employing the strategies of green marketing so as to come up with a competitive advantage over others. It discusses the key challenges in adoption of green marketing practice. Describing the existing Scenario of Indian market and requirements, the paper has elaborated Strategies that may be used to create awareness, the challenges and opportunities available to businesses regarding green marketing. Why companies are adopting it and future of green marketing and gives conclusion that green marketing is something that will always keep on increasing woman sex tape with regard not just to the practice but even in the demand too.

KEYWORDS: *Green Marketing, Liberalization, Globalization, Adoption.*

INTRODUCTION

India is a nation that has over 121 Cr. and off the book over 17 percent of the world population. It ranks the seventh biggest nation in the earth in terms of sum total of land area of 3,287,263 sq kilometres. The length of India spans north south direction at 3214 km and east west direction at

2993km. Its land porous international limit is 15,200km; 7,517km is the coastline. India boasts of 28 states and 7 union territories. Green marketing is a key research subject in the academic world that has been defined in numerous ways and has been around at least three decades. Green Marketing or Environmental Marketing, 1 according to the AMA, is all the activities aimed at producing and mediating any exchanges to sustainably satisfy human needs and wants, such that satisfaction of human needs and wants will take place with minimal harmful effect on the natural environment. Accordingly we can state that Green Marketing deals with: - Producing and offering the consumers good quality of products that are also non-hazardous to them even in the long run. Utilize the developmental resources in a way that will make the development resource available to the future generation in a way that will be able to have access to the development resources to satisfy their needs thus resulting to Sustainable Development. To formulate and use policies that would no bad impact on the environment i.e. both in the present and the future time. So, with the increasing awareness of the consequences of global warming, non-biodegradable solid waste, harmful effects of the pollutants etc., the production, marketing consumption, and disposing of the products and services are occurring in a less way harmful to the environment leading to the development of a concept of such holistic marketing and this is also termed as Green Marketing. A keen realization that switch in to green products and services is necessary is on the rise among marketers, as well as, the consumers. Even though this transformation towards going green seems costly at first, it will most certainly be irreplaceable and beneficial, even in terms of costs, in the foreseeable future. There was the initial wave Known as the Green Marketing in the 1980s. The two physical checkpoints of the first wave of green marketing came in the form of published books the titles of which were (both) Green Marketing. In the United Kingdom they were by Ken Peattie (1992) and by Jacquelyn Ottoman in the United States.

Green marketing flourished in the late 80s and very early 90s; it was spoken about long before then also. The practice of green marketing is the in vogue term. Even the leaders of the companies are concentrating on the products that are eco-friendly. By default adoption of usage of organic product can create environment friendly products that have reduced or no mal-effects on the environment in the course of production.

Organic Goods:-The case of Asian country is unique, which cannot be replicated anywhere as here the farming methodologies are organic in most of the instances due to custom as well as several economic and societal determinants. The aim of green marketing is fulfilling two goals, which are enhanced quality of the environment and customer satisfaction. An inaccurate assessment of one of them or even sacrificing one in favor of the other can be called green marketing myopia. Subsequently, the concept of marketing myopia was popularized by a Harvard business professor called Theodore Levitt in an influential and popular article in The Harvard Business Review in 1960. There is the environmental marketing which was based on clean technology which entailed the designing of new ingenious products. The next and the current marketing phenomenon is the sustainable. Green marketing, therefore, is beneficial to firms in maintaining a steady long-term growth as well as profit and helps the firms to market products and services according to the environmental needs. The question is however, not that straight forward pinning down what green marketing is. In fact the terms in which this section has been utilised have been divergent and they comprise: Green Marketing, Environmental Marketing and Ecological Marketing. The American Marketing Association has defined green marketing as the activities of businesses and companies aimed at producing, marketing, releasing and reclaiming items in a way that is ecologically considerate or sensitive. Green marketing is a

way of selling a product and/or service on its merits in terms of the environment. Such a product or service can be globally friendly in bits or is created and/or packaged in environmentally friendly manner. Concisely, it is similar to marketing but driven by the environment and with an urge to seek favour of the environmental concerns of the consumers. It is also known as sustainability marketing or ecological marketing. The developed products can be of recycled type or of used merchandises that should be created on the basis of betting on the customer requirements.

The energy saving, the water saving and the money saving and moreover the minimization of the negative environmental impact are the keys by which efficient products are developed. Under product management, the marketers will offer market-driven trends and client needs to inexperienced product attributes to product designers. Some of these attributes include energy conservation, organic, untested chemicals and home grown supply among others. Some of the terms can be explained as follows:

Organic: In the present scenario the only products which can retain a legitimate claim of being organic are the products which can be termed as agricultural products. The United States Department of Agriculture (USDA) regulates this term and all organic products must meet the specifications in order to pursue the USDA Organic certification.

Ozone Friendly or Safe: This is one of the commonly used phrases depicting how a product or packaged item can affect the upper ozone layer in a negative, or in this case, positive manner, like an aerosol can that does not produce chlorofluorocarbons (CFCs).

Recyclable: The product or a package that can be recovered in or separately out of the solid waste stream by means of a comprehensive recycling program known as recyclable product.

Recycled: A product, or a package made with something that has been recycled in it. This recycled material is reclaimed or intercepted by the solid waste stream, which is either pre-consumer (duringmfg of product or post-consumer (after the consumer uses it).

Refillable: A product or package has a system established to allow collection and returns of the packaging to allow it to be refilled with the product by the consumers under what is called refillable.

Sustainable: What this means is that ways of farming, constructions, manufacturing and electricity generating are done in a way that cannot be used in delectable resources, such as coal or oil, also allowing them to be used repeatedly.

Carbon footprint: Refers to the impact that a process or act creates on the climate in relation to the greenhouse gases that it generates. Many people would tend to attribute global climate change directly to greenhouse gases i.e. methane, water vapour, nitrous oxide, carbon dioxide and fluorocarbons.

Carbon Neutral: This is lowering its energy consumption and compensating to make its energy consumption near the amount of carbon dioxide produced by it by acquiring energy using renewable source or by offsetting by planting trees or by investing in windmills.

Compostable: Any compostable product or packaging material being promoted must be able to decompose into usable compost in a secure and affordable way into a compost site as well as in a domestic compost heap or unit.

Degradable: A product or a package which fully decomposes and it goes back to nature, in a fairly short time, after the consumer disposes of the product also called as degradable product.

Natural: Probably the most vague of all the green terminologies, the term natural products does not have any definitive environment impact but is presumed to be produced of natural materials or ingredients as compared to manmade. Although a product that is touted as natural might sound good to the consumer, in most of the instances it is mere rhetoric. Consider it, poison ivy, anthrax and gasoline can be considered technically natural as well, that does not make it healthier or even friendlier to the environment. Words such as Phosphate Free, Recyclable, Refillable, Ozone Friendly, and Environment Friendly are some of the things that are most likely to be associated with green marketing by the consumer and these are words that would be described as green marketing claims.

Aims of the Study:-

To research on the significance of green marketing in the current situation.

To study application of green marketing to Indian corporate sector.

To analyze the necessity of the Green marketing in India in various points of view.

To investigate and comprehend the strategy that should be used in order to conduct an effective Green marketing.

To research into the current situation and possibilities of Green marketing in India.

Current Scenario-India:-

There is a lot of talk among many analysts that 2025 will be the year that will determine the fate of many of the green businesses because, with the growing competition in the green arena, some businesses will reach new heights in terms of innovation and services whereas others will start drifting behind. The trends can be here and there, and naturally, no green business can follow all of them, and there is no sense in trying. Nevertheless, monitoring the trends of green business is an excellent equivalent measure that guarantees that your business can be successful, versatile, and imaginative when new challenges and opportunities claim their way in, as there was no better way to have green business prosperity in 2025 and beyond.

Consumers:-

According to the research done, deforestation and air pollution have got the largest number of respondents as the most significant green issue in India. More consumers in India believe it should instead be developing countries that should work on green innovation compared to the developed countries than in any other nation. The findings of the just-released 2014 edition of the Global Image Power green Brands Survey reveal that the environment worry is being expressed by the consumers in terms of a willingness to pay a premium on going green products. 64 per cent of Indian consumers show that they would spend more on green products next year. Moreover in line with the rest of the emerging nations, Indians are ready to pay pricing on a green premium with 48 % of the Indians ready to lay additional 10 per cent of the product just because the product is green. Indians response to green advertising is relatively high considering that 86 percent of the consumers in India have indicated that they trust green advertising more in making choices unlike in other countries. There is a 28 percent extended period of consumer

purchase plan of auto in India in the recent one year as compared to purchase of 16 percent last year.

Producers:-

AMUL has been judged as the Top Indian Green Brand under Global Green Brands survey. AMUL Green movement has also been adjudged as the Best Environment Initiative in the Sustainability Category by the International Dairy federation in the year 2014. Srishtis good green Governance award has also been given to it four years in succession since 2014. The 2014,

Best 10 Green brands in India are:

1. AMUL
2. Dabur India ltd.
3. Infosys
4. Taj Hotels
5. Britannia Industries ltd.
6. Suzlon India
7. Hindustan Unilever Ltd.
8. Wipro technologies ltd.
9. MarutiUdyog ltd.
10. Godrej Consumer Products

The results indicate that going both green and consumer friendly is the only mantra of long term success today.

Government:-

One of the promoters of green marketing and eco friendliness by the Indian government has been to ban or stop using of plastic bags in their daily usage and has assisted its automotive industry to develop greener vehicles by helping using of hybrid and electric vehicles (EVs) by investing in greener vehicles. The government put itself on the forefront of environmental building construction, use of alternate sources of energy by the companies. The governmental Bodies are Making Firms more Responsible. In most instances, the government compels the company to resort to policy that safeguards the interests of the consumers by cutting down production of substandard products or by products, Change consumer and industry softer-and/or consumption of substandard goods; or, Enable all forms of consumers to consider the environmental makeup of goods.

Green Marketing Need:-

In the given context, the issue revolves around ensuring that the customers stay within the fold as well as ensuring that even our natural environment stays safe and this is the major requirement of the hour. Green management is essential to companies because they will lose a lot of their loyal and profiting customers and consumers. In the modern innovative business world of high technology caused by ever growing community and consumer interest in green and socially

responsible product, more community pressure on company to internalize externality like health concerns, neighbourhood amenity, global warming; environmental and governmental regulations and initiatives, innovative technologies and methods of dealing with pollution, use of resources and energy and to maintain old (loyal and profitable) customers and consumers, implementation of green marketing is very much in need.

Additional green management generates new eco-friendly customers and this results in rise of sales and profits of the organization thus growth and development of the business; it also results in favorable image of the organization among the people. The current times are a phase where the government policies around the globe are very rigid and everyone around the world is talking about global warming and climate change and protection of environment, the companies would not have the option but to go green in terms of marketing their products because otherwise it would be late and then no one knows whether they would be able to survive in the greener world or not. The world economy in general and India in particular is turning towards energy efficient products on the part of the consumer. One way or another, most of the companies are treading into green marketing due to the following reasons:

In India, 25 per cent of the consumers seek products that are environmentally friendly and about 28 per cent can be regarded as health conscious. Thus, green marketers can have a rather large number of segments to target. It has also started dawning on many companies that they need to conduct themselves in an environment friendly manner and believe in the fulfilment of environmental goals in pilot as well profit related goals. Green marketing was adopted as a form of compulsion rather than choice due to a number of regulations that have recently been adopted by the government to protect the consumers and the society in general. Such as the prohibition of plastic bags in most of the country, denying of smoking in the very places, etc. Green marketing is adopted by many companies so that they can remain competitive.

Successive Green Marketing Strategy:-

1. Knowing the Customer: Knowing the customer consists of the consumer being aware and concerned about the issues that your product is trying to help, without this knowledge it will be difficult to attain success in green marketing.

2. Educating the customer: This would mean educating the people as to why whatever they are doing is not only to conserve on the environment, but also informing them why it is important. Otherwise, a major part of your target market will be thinking, so what? Does it make any difference to me and you sales pitch on green is lost.

3. Authenticity, openness to the customer: This portrays that a) In practice, you are actually doing what you have been preaching on your green marketing and also the b) the policies that you have as a business are in good terms with whatever deeds that you might be doing which is environmentally positive. Both these criteria must be achieved so that you can make a business with this level of environmental credentials to enable your green marketing campaign to succeed.

4. Convincing thy Buyer: This implies that, the customers must be given knowledge that the product on offer shall serve the purpose or vision as to why it is bought i.e. no compromise in the quality of the goods in the name of the environment.

5. Charging thy customer: Which is offering a premium and ensuring that the consumer can afford it and that they perceive it to be worth it and charging them accordingly, because many of

the environmentally preferable products are more expensive as there are economies of scale involved and they are made of higher quality of materials.

6. Providing your customers with the chance to take part: Involves personalizing the value of your environmentally controlled behaviours which is usually achieved in letting the consumer participate in some positive environmental activity, nor to overlook the altered expectations on the side of the customers.

Four Ps of Green Marketing:-

Green Product:

The products will need to be developed on basis of the needs of the customers who like environment friendly products. The products manufactured can be of used goods or by recycling. Efficient products do not only save water, energy and money, but also minimize hazardous impact on the environment.

Impacts, on the environment. Green chemistry constitutes the increasingly popular dimension of product development. The marketer in the process of product management would have a role to play by providing the product designer with the market driven fashions and customer requests of green product properties like energy saving, organic, green chemicals, local sourcing, etc. That is the case in point of example Nike being the pioneer among the shoe companies to sell itself as green. It is branding its Air Jordan shoes as having environmental friendly aspect as it has vastly minimized usage of corrosive glue adhesives. All the pictures in this range of shoes have been chosen to underline the message that, they have decreased the wastage levels and utilize environmental friendly materials.

Green Price

Green pricing considers factors that are relevant to people, planet and profit, and factors that take care of the well-being while being productive to the employees as well as the communities. It can be made to have a Value added by altering its looks and functionality as well as being customized etc. Wal- Mart came out with a recyclable cloth shopping bag. At IKEA, customers started paying when using bags made of plastic, and people were also persuaded to penny shop using what was termed by IKEA as the big blue bag.

Green Place

Green place is all about management of logistics in order to minimize transportation emissions hence in effect attempting to minimize the carbon footprint. As an example, it can license a local producer of a mango juice manufactured in India rather than selling an imported mango juice. This prevents transportation of the product by long distance which is cost consuming when it comes to transportation costs and carbon emission as a result of ship and other means of travel.

Green promotion

Green promotion deals with the set-up of the instruments of promotion, which include advertising and marketing materials, signage, white papers, web sites and videos, and presentations without failing to consider people, planet and profits in mind. British petroleum (BP) has a gas station with their sunflower logo, and it prides itself in investing in solar energy. Indian Tobacco Company has made environment- friendly papers and boards that are elemental chlorine free. Toyota has been attempting to introduce gas/electric hybrid technology to most of

its products. It is also in the process of carrying out the largest research and development into the much-hyped hydrogen car, and in marketing itself as the global first of eco-friendly cars companies. International business machines Corporation (IBM) has unveiled a series of green retail store technologies and services that will enable retailers to drive better energy efficiency in retailing through their IT operations. The main attraction of this portfolio consists of the IBM SurePOS 700, a point-of-sale product that saves nearly 36 percent of power or more, according to IBM. We even find the name of retail outlets like Reliance Fresh, Fresh@Namdhari Fresh and Desi that though dealing with selling fresh vegetables and fruits, conveys a subliminal message of green marketing. Green Marketer will have ability to attract customers based on various concepts performance, money savings, health and convenience, or simply the environment friendly aspect so that green marketer can target a wide range of customers. Consciousness among the people can be achieved by sensitizing the consumers about the advantage of using products which are environmental friendly. Placing profiles that deal with green marketing on social networks informs other peer groups in the online world. It can also directly be marketed to the consumers and they can be marketed through the advertisement of a product like energy saving compact fluorescent lamps, the battery powered Reva car etc.

Green Marketing in Indian Corporate Sector:

The companies in India are slowly discovering that they belong to the greater community and hence will have to act in a responsible manner in terms of environment. This goes to mean that companies are faced with the view that they should meet environmental goals along with profit related goals. This makes the environment problems become part of the firm corporate culture.

A company should consider the adoption of green marketing basically because of five reasons.

i. The companies feel that they owe it a moral duty to be more socially responsible.

ii. Organizations see the environmental marketing as an opportunity that can be harnessed in order to accomplish the goals of the organization.

iii. Expenses linked to disposal of waste compel the companies to change their ways of actions.

iv. The environmental activities of the competitors compel the firms to transform their environmental marketing activities.

v. Responsible firms are being enacted by the government.

Best Companies who Green the India

The green business trend is a perfect manner to be sure that your business remains fresh, adaptable, and innovative to new confrontations and possibilities.

1. Suzlon Energy

One of the greenest and best Indian companies in India is the wind-turbine maker as the fourth largest in the world. Tulsi Tanti; founder of Suzlon, has made the whole world believe that the future of energy is wind and this is why he has constructed his factory in the city of Pondicherry to operate completely on wind energy. Corporate building of Suzlon is the most energy efficient building to be constructed in India

2. ITC Limited

ITC reinforced their green drive by launching the first time ever in India the ozone treated elemental chlorine free bleaching technology. The outcome is a complete new line of best green services and products: the multi-purpose paper is environmentally friendly, and much less polluting than the conventional one.

3. Tata Metaliks Limited (TML)

Environment Day at TML, one of the greatest green companies in India, occurs every day. One of the practical examples which made everyone take note is the fact that the company does not encourage working on Saturdays at the corporate office. The lights are also turned off in the day time and the whole office relies on sunlight.

4. (TNPL) Limited

TNPL was also adjudged the best performer in the 2010-2011 Green Business Survey and honored with a Green Business Leadership Award, which was presented to it in the Pulp and Paper Sector. The projects that have been done by this greenest company in India in Clean Development Mechanism projects and wind farm project enabled it obtain 2,30,323 Carbon Emission Reductions and produced earning of Rs. 17.40 Crore.

5. Wipro Technologies:

Wipro Technologies the global IT services division of Wipro Limited has become a member of The Green Grid, a global consortium aimed at promoting the improvement of energy efficiency in data centres and business computing ecosystems. Green IT efforts of Wipro comprise of energy efficient data centres along with eco friendly product engineering designs and PC ranges. Wipro will also expand its green IT programs by joining The Green Grid, as the organization aims to offer industry wide guidelines of recommended best practices, metrics and technologies that would serve the purposes of overall improvement in data centre and business computing energy efficiencies.

6. HCL Technologies:

The reason why this IT major can be regarded as the epitome of Indian green initiatives is the fact that the company took some steps to go green in resolving the toxics and e-waste issue in the electronics business. HCL has already pledged to eliminate the vinyl plastic, which is hazardous, and Brominates Flame Retardants in the products and has urged the law makers in India to come up with Restriction of Hazardous Substances (RoHS) regulation for India.

7. Oil and Natural Gas Company (ONGC):

On top of the list of other 10 green Indian companies is India largest oil producer ONGC that will front the top 10 green Indian companies as the move to install energy efficient, green crematoriums, which will substitute the traditional wooden pyre all over the country, first move. Mokshada Green Cremation will result in 60 to 70 per cent less use of wood and a quarter reductions in burning time precreation according to the NGO.

8. IndusInd Bank:

Green banking has been gaining pace as one of the leading Indian green initiatives since the concept was introduced by the first solar powered A TM by IndusInd launching a bank-changing

eco-friendly approach to the effort of Indian market. The bank has more of such initiatives to come in line so as to deal with the in clemencies of climate change.

9. IDEA Cellular:

IDEA, one of the best Indian Companies, makes India green with the 'Use Mobile, Save Paper, campaign. The company had adopted environment friendly initiative of Green Pledge campaigns in Indian cities whereby thousands had volunteered to be part of saving paper and trees. IDEA has also established bus shelters adorned with potted plants and climbing tendrils and so on to communicate the green message.

10. Hero Honda Motors:

Hero Honda is a large two-wheeler production company in India and a very responsible eco-friendly company in India as well. The philosophy of the company to constantly innovate the green products and solutions has contributed a lot in maintaining the right balance between business, man and nature.

Green Marketing Problems:-

Despite the fact that green marketing is being exercised by so many firms, green marketing has some issues that should be dealt with during the implementation of green marketing. The main obstacles to

Cost Factor:

Green marketing refers to the marketing of green-products/services, green technology, green power/energy whereby, a lot of funds have to be incurred towards R and D programs to develop such products and then subsequent programs of promotion and as a result, such may bring about increase in costs.

Convincing customers:

The customers might not agree with the green marketing strategy employed by the firm hence, the firm must make sure they take every action to persuade the consumer of their green commodity and the only way is by doing implementation.

Sustainability Initially:

This is because the profits are very small as green technologies and renewable and recyclable products cost a lot. Green marketing will only succeed in long term. Therefore the business should not think in short term strategy and should prepare the same but not to get into trap of unethical practice to gain profits within short time.

Non Cooperation:

The companies, which have engaged in Green marketing, must ensure that they put their best foot forward trying to convince the stakeholders and most of the times they will not be able to convince them about the merits of Green marketing in the long run vis a vis short term costs.

Free of green myopia:

There are two goals which have to be fulfilled by green marketing they are enhanced quality of environment and customer satisfaction. Underestimating one of them or focusing too much attention on one of them instead of another one may be called -green marketing myopia.

To break the challenges the green marketing statements by a firm should work as follows:

1. Speak of the benefits for the environment elegantly;

2. Give descriptions of the properties of the environment;

3. Exposition as to how benefits are attained;

4. Make sure that the differences in comparison make sense;

5. Make sure negative aspects are put into consideration; and

6. Do not use any meaningless terms or pictures.

CONCLUSION

Green marketing is not such a simple concept. It would require the company to conduct a plan and then conduct a research work to achieve this to determine how feasible it is going to be. Green marketing needs to be developed as it is very young. Green marketing may not be so simple to adopt in the short-run, yet there will be benefit effect in the long-run to the firm. In the Indian companies, the Green Marketing is still at the childhood stage. In Indian market, the lots of opportunities are available. Green products are also ready to pay premium price by customers. This shift in consumer behaviour is forcing corporate to consider effects of its actions on the natural environment of the world which proved to be quite disastrous. The sky rocketing growth of the environment concern over the past two decades is pushing the companies to show the transition so to guarantee the sustainable development of the society. It is always not an additional form of marketing, but should be acted upon with more force since it possesses societal as well as environmental aspect. It is also the role of the marketers to create awareness to the stakeholders on the necessity and the benefits of the green products. It is a fact that the organizations have realized that they cannot stay in the current competitive world without embracing green as a part of their introspective strategy. The Indian FMCG companies are not left behind since they are opting green to maintain their image on the market. The companies are engaged in a number of actions in order to demonstrate their care about the environment and the society, however, on the other hand, the companies need to realize that the Green marketing cannot neglect the economic side of marketing.

Green marketing is useful in effective results such as cost saving, employee satisfaction, minimization of wastes by comp to society as well as the companies which use it. All it takes is the desire and dedication of all the stakeholders of the companies. Marketers also need to ensure that the consumers are aware as to why and how they would require use of green products over the non-green ones and the advantages they would get subsequently. The green marketers will get all the support of the Government and even consumers will not complain at paying extra price to have cleaner and greener environment. Lastly, the consumers, the industrial buyers and suppliers should spread the good message about the impacts of Green marketing on the environment. Green marketing is even more significant and applicable in the developing nations of the world such as India who must set the pace and be trend setters in this area.

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