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Statistical Analysis of Utility Unplanned Power Outages & its Influence on Hosiery Industry of Punjab, India- A Case Study

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ABSTRACT:One of the most common obstacles confronted by the industry in developing countries are inadequate power supply. As the power demand increases with time the unwavering quality of power supply from feeder's turns into an essential issue. In this paper, feeder reliability study has been carried out focusing on unplanned outages. This study would help to find the trend of outage over past few years from 2012 to 2015 and includes formulation of hypothesis studying power outage effect year wise, season wise and reason based supporting the results with single factor ANOVA analysis. Cost aspect is also included by considering the important parameters that are affected in industry due to these outages connected with same feeder and their conversion is calculated time wise range considering various debts.

KEYWORDS: Power, Outages, Feeder, Rupee (Rs.), PSPCL, Heat map, ANOVA.

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I. INTRODUCTION

Electric Power distribution plays a very important role between the utility and customers, so utmost care should be taken for an uninterrupted power supply with minimum losses and good quality. This problem is faced by both developed and developing countries. But in later case, it leads to serious impact like social inequality, unemployment, and delay in supply order [1]. Researchers elaborated in study related to Tajikistan's electricity system crisis that was approximately 70% of the Tajik people suffered from extensive shortages of electricity during the winter so citizens were using wood and coal for heat which leads to many health hazards [4].So it is identified from the study that power outages affect all the five M's that are the man, machine, material, money and their management. As without power, there is a loss of labor, machines are idle, material wastage (raw, semi-finished and finished), money the most important resource of business is either wasted or stuck in different forms, finally, are all management related decisions suffers like production, administration and transportation.The demand-supply system is affected in all the sectors of the country whether the agriculture, manufacturing, and domestic sectors. In India, Punjab is such a region which consists of all the different categories mentioned above. Power outage loss to a particular sector has a great impact on others sectors in Punjab. Focusing on industry sector, it can lead to migration of industry to another state and from industry point of view leads to many types of losses related to productivity. The objective of the paper is to test the relationship between state power distribution and industry performance. Researcher concluded from the World Bank Enterprise Surveys, in a cross sectional sample of 80 economies that power outages are negatively associated with firm productivity [3]. It not only affects enterprise present but also their future decisions like the expansion of industry, the introduction of new projects. Author discovered that to cope up outage problem the most commonly used strategies, is using a generator, that have the negative productivity impact by diverting firm capital from direct productive uses to the generation of electricity [2].There are several types of power outages planned, unplanned, load shedding and peak load but out of these maximum in number are unplanned outages and their duration can vary from a few minutes to several hours. The reason of occurrence can be equipment failure, vehicle accidents, wind, and rain etc. Researcher estimated the outage cost of industries in Thailand by using the information of planned outage costs and unplanned outage costs are obtained from the surveyed sample of 800 industries in the Provincial Electricity Authority (PEA) service area. It has been claimed by the author that the average planned outage costs are lower than the unplanned outage cost about 60-90 % [6].

II. MATERIAL AND METHODS

The current study includes various phases such as data collection, conditioning, and digitization of data, developing a hypothesis from data, analyzing the hypothesis, reporting the results and discussion of findings. Ludhiana the industrial hub of Punjab is considered for this case study. The data used in the study is of two types: Industrial and State Electricity Department. So the data collection process was twofold. First, the data used in the study is collected from PSPCL (Punjab State Power Corporation Limited), India. The data is collected from the feeder in the district over the past four years from (2012-2015). The data contain outage, start date, end date, time, duration and reason. The data was in handwritten and then converted into digital format. The process includes many nontrivial activities as removing incomplete, redundant and not useful information. The researcher then visited the industry that was connected with the associated feeder. Survey method act as an important way of gathering information. A research design should be well designed, in a way to facilitate the collection of relevant evidence and information for the research, efficiently [5]. In this study, a questionnaire is used as a tool to collect the required data related to cost and other required information for Hosiery industry manufacturing T-shirt.

III. RESULTS AND DISCUSSION

The Current section deals with the analysis and interpretation of the data collected. The main aim of the present work is to study the various aspects of power outages. The analysis presents three statistics such as descriptive characteristics of a sample with heat maps, inferential comprises of an analysis of three hypothesis and cost analysis. Heat map is used to show the impact of outage value day, month and year wise. Different Heat map help us to compare values within as well as with other years. Thus providing easy analysis with different color shades to find which is the worst day of the week and which are the worst months for the outages. The heat map figure 1 for OSWAL feeder helps to understand the value of different outages in a different month for the year 2012. As it is clear that in seasons such as winter (January-February) and Monsoon (June-Aug) have the maximally outages value as highlighted in Colored Bars. For the worst week of the day, Sunday is the most affected one. Similarly, for heat map figure 1 for the year 2013 season Monsoon (June-Aug) is maximally affected. For worst day Saturday. Similarly, for heat map figure 2 for the year 2014 season Monsoon (June-Sept) and winter (December) is maximally affected. For worst day Friday. Similarly, for heat map figure 2 for the year 2015 season Monsoon (July-Sept) is maximally affected. For worst day Friday. Hypothesis were developed to find the relationship and impact of different parameters on one another. For interpretation of the result, ANOVA is used.

Null Hypothesis 1: The number of power outages events is same over time.

To test this hypothesis, the four years from 2012 to 2015 taken into consideration where a number of outages for each year are calculated. The results are summarized in Table 1: The table shows F (0.005436) and F-critical (4.81448) at significant level 5%. Hence it is concluded that there is no significant difference between power outages throughout the time. The alternate hypothesis related to different power outages over time is not true.

Table 1: ANOVA Analysis for Number of Outages Year 2012-15

SUMMARY						
Groups	Count	Sum	Average	Variance		
2012	4	335	83.75	2378.25		
2013	4	328	82	2540		
2014	4	323	80.75	2611.58		
2015	4	340	85	2833.33		
ANOVA						
Variation	SS	Df	MS	F	P-val	F crit
Between Groups	42.25	3	14.083	0.0054	0.999	4.814
Within Groups	31089.5	12	2590.792			
Total	31131.	15				

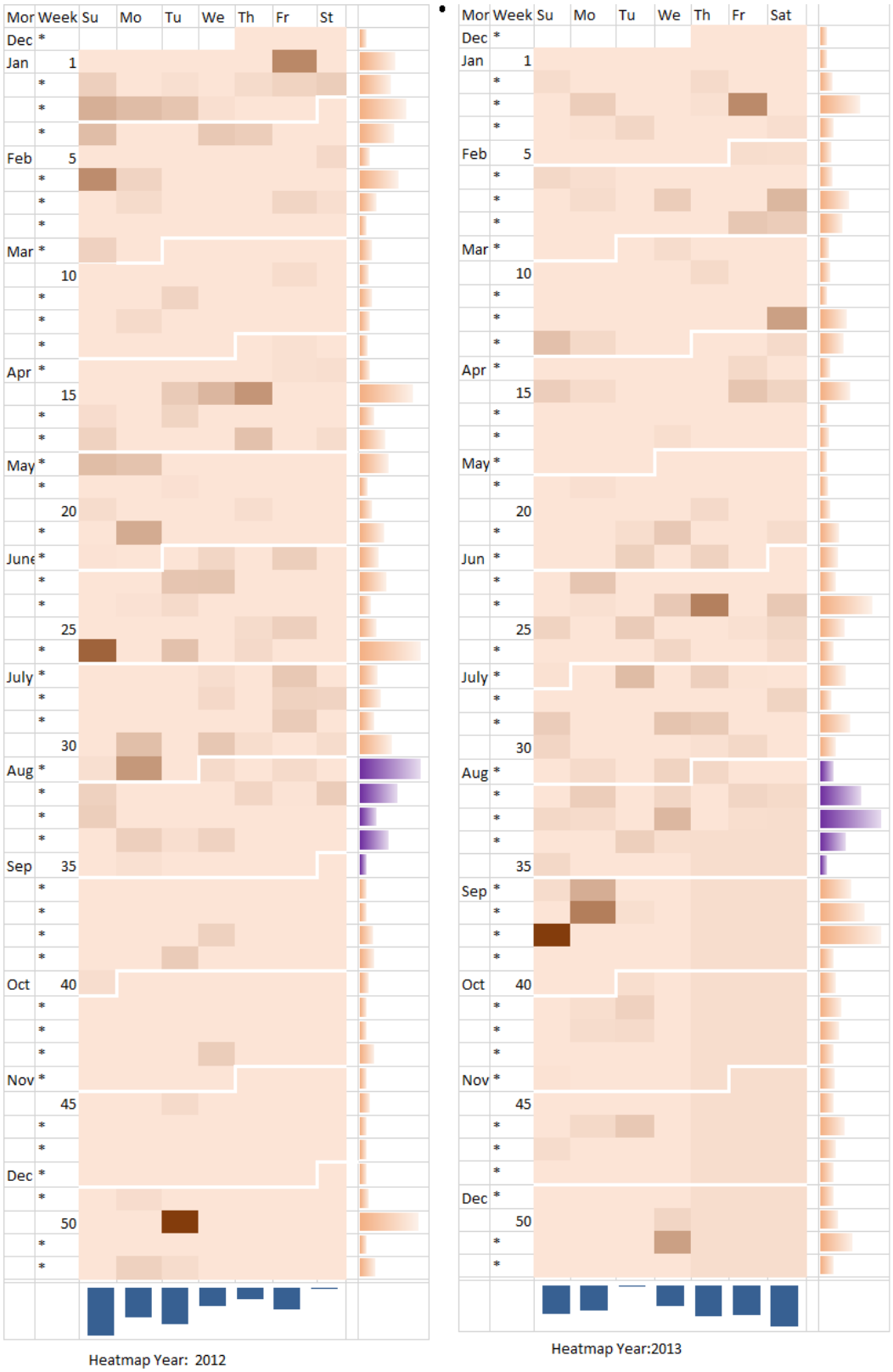

Figure 1: Heatmap for Oswal Feeder of Year 2012-13

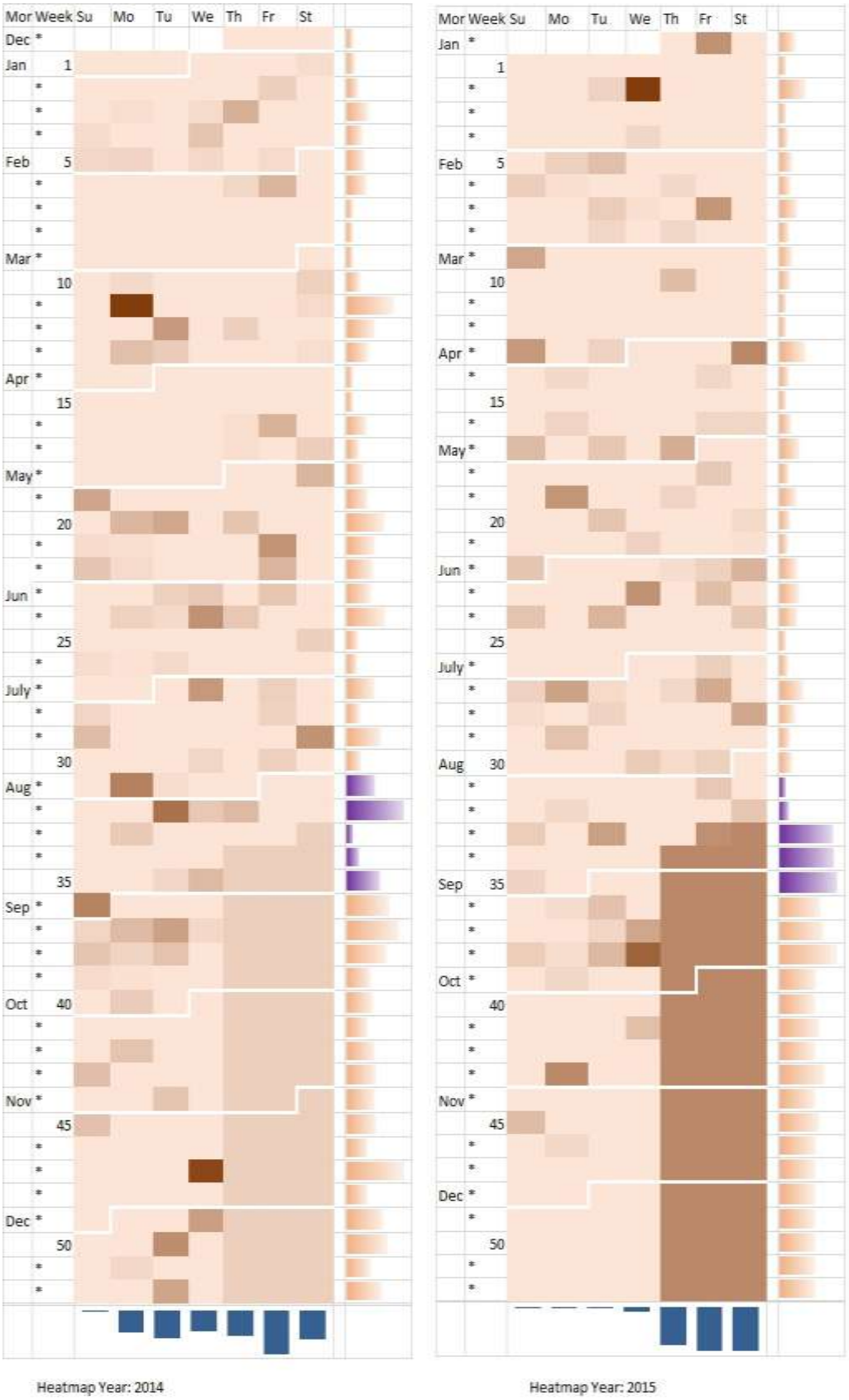

Figure 2: Heatmap for Oswal Feeder of Year 2014-15

Null Hypothesis 2: The season has no impact on power outages.

To test this hypothesis, the data from years 2012 to 2015 is divided into four seasons such as winter, summer, monsoon and post monsoon, where the number of outages for each season is calculated. The results are summarized in Table 2: The table shows F (3.86929.) and F-critical (2.7826) at significant level 5%. Hence it is concluded that there is the impact of seasons on between power outages throughout the time. Here Null hypothesis is rejected and alternate hypothesis accepted. Monson seasons has the maximum number of power outages about 194. The wind and rain are the main reason for power outages.

Table 2: ANOVA Analysis for Outages in Different Seasons of Years 2012-15

SUMMARY						
Groups	Count	Sum	Average	Variance		
Winter	14	99	7.071	45.60		
Summer	14	90	6.428	64.41		
Monsoon	14	194	13.85	242.43		
Post Monsoon	14	25	1.785	5.565		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1039	3	346.333	3.86929	0.0142	2.782
Within Groups	4654.42	52	89.508			
Total	5693.42	55				

Null Hypothesis 3: The number of outages do not get affected by the specific reason.

The power outage has various different reasons as Tree, Nothing Found (N F), Birdcage, Wires Joined Together (WJT), Jumper Changed (J C), Disc Problem (D P), Transformer Fault (T/F), Kite Struck in Line(KS), Wind and Rain(W&R), G. O. Switch(GOS), Fuse Problem(FP), Accident, Break Down, Try and Hold(T&H). To test this hypothesis, the data from years 2012 to 2015 is categorized according to power outage reason, where number of outages for each reason is calculated. The results are summarized in Table 3: The table shows F (4.409585) and F-critical (1.961218) at significant level 5%. Hence it is concluded that there is the impact of reasons on power outages throughout the time. Here Null hypothesis is rejected and alternate hypothesis accepted. The reasons like T/F and N/F are more significant.

Table 3: ANOVA Analysis for Outages due to Specific Reason of Years 2012-15

SUMMARY						
Groups	Count	Sum	Average	Variance		
Tree	4	17	4.25	10.9		
N F	4	95	23.75	304.91		
Birdcage	4	3	0.75	0.25		
W J T	4	30	7.5	51		
J C	4	37	9.25	54.25		
D P	4	2	0.5	1		
T/F	4	99	24.75	232.9		
KS	4	0	0	0		
W & R	4	42	10.5	57.666		
G O S	4	10	2.5	1		
F P	4	11	2.75	8.25		
Accident	4	16	4	18		
Break Down	4	10	2.5	13.666		
T & H	4	36	9	48.666		
ANOVA						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	3285.9	13	252.7	4.4095	0.0001	1.9612
Within Groups	2407.5	42	57.32			
Total	5693.4	55				

Cost analysis for unplanned outages on different parameters of associated industry (Years 2012-2015): The cost analysis includes average 26 working days of month, 12 working hour per day, Rs. 10,000 average salary of worker (Total number of workers in firm 20). Average electricity cost per unit considered is Rs. 6/-.For 20 minutes unplanned outage: a) Debts that incur are 20 minutes' production loss, 20 minutes' salaries paid to the idle workers, values of sale lost due to no production. In addition, restarting time (that includes after outage occurrence workers reinstate, analyzing the condition of machine and material) 10 minutes that is now outage is (20+10) 30 minutes. So net Loss increases considering restarting time (800.8+400.4=Rs 1201.2) b) Savings that incurs are 20 minutes' raw material not used and 20 minutes' electricity not used. Similarly, Debts and Savings for 60 minutes and 120 minutes are given as in Table 4.

Table 4: Values of debts and savings that occurs during Outage

Debts	Unplanned Outages Duration			
	1 Mins (Rs.)	20 Mins (Rs.)	60 Mins (Rs.)	120 Mins (Rs.)
Production Debt@ 6 Kg. /hr.	43.2	864	2592	5184
Salaries of Idle Workers@ Rs.277.7/hr.	10.6	212	636	1272
Sale Value Lost@ Rs. 518.4/hr.	8.64	172.8	518.4	1036.8
Savings				
Unused Raw Material @ 6.4 Kg./hr.	21.8	436	1308	2616
Electricity Saved @Rs. 36/hr.	0.6	12	36	72
Net Loss	40.04	800.8	2402.4	4804.8

IV. CONCLUSION

The detail study of heat maps and in depth analysis of Hypothesis reveals that period of Monsoon is much affected among the various seasons of Punjab. In this period due to cultivation of Paddy crop, the demand for electricity is elevated. Also wind and rain leads to maximum unplanned outages. Electricity services provided by PSPCL may be improved by training their manpower, improving new and replacing its old infrastructure this can be seen from Hypothesis analysis.

REFERENCES

[1]. R.Siddiqqi and N. Jalil, The Cost of Unserved Energy: Evidence from Selected Industrial Cities of Pakistan. ISLAMABAD: PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS, (2011).
[2]. A.Abeberese, C. Achak, and P. Asuming, Productivity losses and Firm Response to Electricity Shortage: Evidence from Ghana. (2017)
[3]. J. Arlet, Electricity Tariffs, Power Outages and Firm Performance: A Comparative Analysis. Global Indicators Group, Development Economics. The World Bank. (2017)
[4]. D.Fields, A.Kochnakyan and G. Stuggins. Tajikistan's Winter Energy Crisis: Tajikistan's Winter Energy Crisis. Washington DC: The International Bank for Reconstruction and Development / the World Bank; (2012).
[5]. S.Achchuthan, N. Sivathaasan, and D.Jayasundran, JMRS. Service Quality Dimensions of Electricity Services: Evidence from Electricity Board in Sri Lanka. Asian Social Sciences. (2014).
[6]. S.Panya, and W.Pattaraprakorn. Economic impact of power outage in Thailand: Industry perspectives. In. Proceedings of the International Conference on Energy and Sustainable Development: Issues and Strategies; (2010).

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