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Application of Game Theory on financial benefits and employee satisfaction: Case study of a state bank of Sri Lanka

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***Abstract* - The principal agent problem revolves around the competing interest between shareholders and the employees. The organization focus is on maximizing shareholder wealth, while employees try to obtain the maximum benefits for themselves. As per the motivational theories, people have different types of needs. Therefore, management should focus on a wide range of factors to motivate the employees to work to their full potential in the interest of the organization. The study focuses on both employee and the management of a state bank. The organization is always eager to minimize the cost and maximize the profit. Game Theory was used to provide a mathematical framework for understanding the optimal outcome and what the tradeoffs are to achieve that outcome. The objective is to find the right balance between financial gains and employee satisfaction. To fulfill that objective, one needs to evaluate the benefits given to employees, the effectiveness of those benefits on employees and finally recommend an effective benefits allocation mix to the organization, which will address both employee and the top management of the bank.**

Keywords - employee satisfaction, Game Theory, optimization

I. INTRODUCTION

In any business organization, there are two parties. The main party is the stake holders or the management, the second party is the employees or the workers. Management always looks at the business by their perspective, which is to maximize their profit and be the market leader. The employees desire also same which is to be the leader of the market and elevate their workplace brand at the top. But their main target is to upgrade their financial stability.

Therefore, the employee's perspective their ambition is to elevate the earnings, if the management fulfill their targets, then the employees are eventually motivated to work effectively and efficiently. If the earnings are increased, it will be a cost to the organization and it will affect to the profit of the organization as well. Therefore, the organizations are always focusing on the variable earnings than the fixed income such as salaries of the employees, to elevate if the targets are achieved. Then the organization can survive in the market easily.

Many business entities as well as sate banks, the allowances provided are not effective and attractive to employees. From an employee perspective, it is not properly allocated. Therefore, most of the employees are working to get their salary and attend to other additional jobs to fulfill their financial requirements. If this scenario continues, it is difficult to cater to the customers to fulfill their satisfaction because employees are not focusing on customer expectations but intend to achieve their personal targets in financial benefits. But most of the private institutions and banks have recognized and resolved their employees' non-salary benefits and allowances by allocating the funds effectively. Therefore, the employees of private banks are willing to give the maximum output to the organization and get the maximum benefits from the employer. Eventually, compare to state banks the growth rate and the services are higher in these banks or institutions [1]. Because of the government security and the deposits of the government institutions are hold by the state banks. Therefore, the brand value and the profitability are high in these institutions [2]. To achieve the targets, state banks need to motivate the employees to fulfill the required expectations. In Maslow's hierarchy of needs, a theory of motivation, states that five categories of human needs dictate an individual's behavior. Those needs are physiological needs, safety needs, love and belonging needs, esteem needs, and self-actualization needs. The theory explains what is important to fulfill the needs in each level of a human being. According to the theory, each banker has already achieved the first need out of five. That is physiological needs. Therefore, the bankers are always focusing on the second stage which is safety needs**.** At this stage, Maslow clearly mentioned that emotional security, financial security (e.g. employment, social welfare), law and order, freedom from fear, social stability, property, health and wellbeing are to be satisfied [3]. Therefore, many employees in state banks are considering the safety needs or financial security in this stage.

Therefore, the financial benefits should be rescheduled according to the set goals and requirements of the bank while fulfilling the present requirements of the employees for their hard work as a reward system. Therefore, it is needed to observe that the allowances of the state banks, provided to elevate the effectiveness and the quality of the work. Hence, it is a suitable time for state banks to revise their allowances for employees and to introduce new allowances to satisfy the employees and get the maximum output of them to increase the profit of the bank while having a good balance between minimum cost and maximum benefit [4]. The requirements of the employer and the employee are contradictory to one another. Because if the employer allocates more money for the employee, the profitability

will be decreased and if the employees are not satisfied with the payments for their hard work, then they are not motivated to work more and that will have an adverse effect on bank performance.

Therefore, the authors assume that this could be a game between two players who try to maximize their profit or financial benefits while the opponent try to minimize the loss or cost to the bank. This problem can be defined as a game between the employer and the employee. If an employee tries to maximize its profits by limiting the allowances and financial benefits to its employees, the limiting amount would be the maximum gain to the employer as well as minimum loss to the employee [5].

Therefore, it can be defined as game between employer and employee. Application of Game Theory would be the appropriate technique to solve this issue and this game can be defined as Zero-sum game between those two. Here the authors carefully assume that the loss of one party is similar to the gain of the other party. The authors have recognized the critical allowances to upgrade the profitability and employee satisfaction in the organization and introduced the best model by using Game Theory to find the effectiveness of these benefits.

II. Literature Review

The article "Burnout and customer satisfaction" discussed about the service provider's dissatisfaction should be taken in to consideration for the success of the organization. This is because it connects to the most important outcome for the organization which is customer satisfaction. Considering the results of this research, shows there is a positive correlation between service provider's service and customer satisfaction [6]. There should also be empowerment in the employees who serve the customers.

The empowerment can be done in many steps. Providing a high salary is one method but there are many other ways than increasing salary. The organization can provide training programs. The empowerment of the employees can mitigate the problems coming in day-to-day activities. Also, by satisfying the employees, lead them to serve their customers pleasantly. Before implementing the empowerment programmes, the organization should look at how the employees are satisfied. This article explains that the over empowerment of employees also affects badly in treating customers because if more power comes to the employees that they may reject the customers and they treat some selected customers only [7].

The game theory was used to find the corruption survey. The theory is performed an ineffective manner to find the best solution and make the decision on which the corrupt people react. This is based on the bribery commission and the company. They tried to find the corrupted people by giving some questions and collecting the responses. It is a simple model which is presented that bribery might be the dominant strategy. This is the same approach as a prisoner's dilemma type of situation. In game theory, it is difficult to predict the winning party, but this has taken various parameters like legal remedies. This paper then reviews the principal general equilibrium effects and concludes that they are negatively effect on economic development [8].

The article described how the private and the public transportation systems mitigated their risk factor by using the game theory. This game also has the options for the private sector to make the decision. The public sector has introduced some strategies. By considering those strategies and the payoff values, it can be seen that the authors had made an assumption that the priority will be given to player 2 and as a result of that, the payoff values have been taken according to the consideration of the private sector. Therefore, in this game, it can be seen that the negotiation can be made, and the real values must be presented to another party [9].

The author has introduced a mathematical model to look at the teams and select players. The author used the game theory for those findings. He has taken every player's salary or allowance for each league as payoff values and found the most suitable player for each club. Also, it is mentioned that the authors have made some realistic assumptions to address the limitations in the practical world to incorporate them to the objective in the model [10].

III. Model Development

The model development of game theory in the proposed system is on the satisfaction of the employees for the allowances providing the employer get the maximum gain for the financial benefits given to employees for a minimum cost. To fulfill the objective, it is being prepared a set of questions for the employees, and evaluated their preference in Likert scale. The questions have been made referring to the non-salary benefit circulars and that would directly affect the reliability of the research. As player 1, the banks will introduce many allowances to satisfy the employees. But only the main benefits have been taken as player 1 strategies, because other benefits are claimed by some groups. Satisfaction is a mental process, but in this case, the employee should scientifically argue with themselves to find the best allowance mix that they should utilize.

It has been taken only the allowances which have been allocated to the officer grades and above employees. The minor staff has been omitted as they get only the OT allowances. The allowances allocated to officer grades are directly affected to the bank's profitability. They are medical allowance, difficult station, key holding, disturbance and cash loading are some of them considered in this research. Those allowances are considered as different strategies (Str) proposed by the player or management of the bank.

TABLE I: PAYOFF TABLE FOR PLAYER VS OPPONENT

		Opponent		
		Str 1	Str 2	Str 3
Player	Str 01	a_{11}	a_{12}	a_{13}
	Str 02	a_{21}	a_{22}	a_{23}
	Str 03	a_{31}	a_{32}	a_{33}
	Str 04	a_{41}	a_{42}	a_{43}

The summary of these can be incorporated into a cross-tabulation table as shown above. The main assumption in this methodology is that the game between the employees and employers is considered as a zero-sum game. The benefit that player 1 gets is equal to the loss of the opponent. In another way that the benefit that the management of the bank or the employer earn is equivalent to the loss of the employee. The value is measured in a Likert scale and weights are given according to that.

Assumed that there are no saddle points in this game. Therefore, in the long-run decision was mixed and used the mixed strategy to find the ultimate optimal value of the game.

Assume that the probability of the strategies are P_1 ,P_2, P_3….,P_n

Where Σ Pi= 1

Assume that the optimal value of the game is V

Therefore, the above problem could be developed as a linear programming problem as follows,

Obj Max V

a_{11} P1 + a_{21} P2 + a_{31} P3 + a_{41} P4 +a_{51} P5 $\geq$ V

a_{12} P1 + a_{22} P2 + a_{32} P3 + a_{42} P4 +a_{52}P5 $\geq$ V

a_{13} P1 + a_{23} P2 + a_{33} P3 + a_{43} P4 +a_{53} P5 $\geq$ V

a_{14} P1 + a_{24} P2 + a_{34} P3 + a_{44} P4 +a_{54} P5 $\geq$ V

a_{15} P1 + a_{25} P2 + a_{35} P3 + a_{45} P4 +a_{55} P5 $\geq$ V

$P_1 + P_2 + P_3 + P_4 + P_5 = 1$,

Pi $\geq$ 0

V value can be found in Linear Programming. Therefore, values for P_1 ,P_2, P_3 , P_4 & P_5 can be found values.

TABLE II: PAYOFF VALUE FOR DIFFERENT STRATEGIES

	Strongly disagree	Disagree	Neither agree nor	Agree	Strongly agree	**Min**
Medical Allowance (P1)	123	166	306	112	210	**112**
Difficult Station (P2)	102	214	156	368	125	102
Key Holding (P3)	24	60	309	632	315	24
Disturbance (P4)	91	176	189	296	310	91
Cash loading (P5)	37	118	186	568	390	37
Max	**123**	214	309	632	390	

IV. DATA ANALYSIS AND PRESENTATION

The proposed model was validated from the data collected from the employees and employers of a state bank. According to the output values obtained after running the model in MS Excel Solver using actual data as well as simulated data, it can be seen that, there is no pure solution for this game as expected. Therefore, it has been taken the "Minimax" and "Maximin" principles to fulfill the objectives.

Raw Min, Value = {112, 102, 24, 91, 37}

Max = 112

Column Max, Value = {123, 214, 309, 632, 90}

Out of that the Min = 123

Therefore,

Maximin Value $\neq$ *Minimax Value*

It indicates that there is no saddle point, and the value of the game lies between 112 and 123. To find the effective way to allocate funds among these benefits, it is needed to assign the probabilities for that. Therefore, Linear Programming technique has been used to solve the problem.

Expected Payoff for Player 01, When Player 02 or opponent choose, Strongly Disagree (SD), Disagree (D), neither agree nor disagree (AD), Agree (A), Strongly Agree (SA) under different strategies as shown in Table II.

Objective Functions: Max V

$123 P_1 + 102 P_2 + 24 P_3 + 91 P_4 + 37 P_5 \geq V$ (1)

$166P_1 + 214P_2 + 60P_3 + 176 P_4 + 118P_5 \geq V$ (2)

$306P_1 + 156P_2 + 309P_3 + 189 P_4 + 186P_5 \geq V$ (3)

$112P_1 + 368P_2 + 632P_3 + 296 P_4 + 568P_5 \geq V$ (4)

$210P_1 + 125P_2 + 315P_3 + 310 P_4 + 390P_5 \geq V$ (5)

Assume that the minimum value of game = V

And, V> 0

Subject to, $P_1 + P_2 + P_3 + P_4 + P_5 = 1$

Expected pay-off equations in the model,

1. Expected Payoff for Player 01, When Player 02 Choose, Strongly Disagree (SD)
2. Expected Payoff for Player 01, When Player 02 Choose, Disagree (D)
3. Expected Payoff for Player 01, When Player 02 Choose, neither agree nor disagree (AD)
4. Expected Payoff for Player 01, When Player 02 Choose, Agree (A),
5. Expected Payoff for Player 01, When Player 02 Choose, Strongly Agree (SA),

The above linear programming problem was solved using MS Excel Solver and obtained the following output table.

By considering the above MS Excel Solver output spread sheet, the value of the game is 122.166. Further, the probabilities of the decision 1 or the strategy 1 is 96.03% and decision 2 is 3.97% in the long run to achieve the maximum benefit of the game to player 1 or to the management of the bank.

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
B2	variables p1	0.960288809	0	0	42.1754386	21
C2	variables p2	0.039711191	0	0	21	20.03703704
D2	variables p3	0	-52.07220217	0	52.07220217	1E+30
E2	variables p4	0	-15.62454874	0	15.62454874	1E+30
F2	variables p5	0	-44.90974729	0	44.90974729	1E+30
G2	variables V	122.166065	0	1	1E+30	1

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
G12	V	1	122.166065	1	1E+30	1
G7	s.to V	122.166065	-0.924187726	0	11	60.91346154
G8	V	167.9061372	0	0	45.7400722	1E+30
G9	V	300.0433213	0	0	177.8772563	1E+30
G10	V	122.166065	-0.075812274	0	266	11
G11	V	206.6245487	0	0	84.45848375	1E+30

Fig. 1. MS excel solver output spread sheet

Ninety six percent of the total allowance should be spent on employee medical scheme and 3.97% to difficult station or for servicing in remote less privileged area. This would satisfy the employees while getting the best benefit to the organization. P_1=96.03% and P_2 is 3.97 % and all other values of P_i are equal to zero.

V. Conclusion and Recommendations

According to the P_1 value obtained, it is evident that the medical allowance is the most important allowance among the others. The value of P_1 is 96.03%. This is because most of the employees are utilizing this allowance. The effectiveness is very high. Medical allowances are given to the employees as well as to their families. Most of the employees are satisfied and happy to receive the medical allowances as it covers the medical expenses of the whole family. This will be a big benefit to the employees from their savings. Therefore, according to the management of the bank and employee's perspectives, this may fulfill both player's and the opponent expectations.

According to the output table, the value of P_2 is 3.97%. Therefore, it is a prudent decision to allocate 3.97% of the allowances to the difficult station or working for rural areas or outstations allowances. The obtained output result for P_2 reflects the actual scenario. Since this research was carried during the epidemic lockdown period, most of the employees are not willing to go to outstation areas and work, because of the uncertainty of the lockdowns of the country. Therefore, if the bank increases this allowance that would be useful for both employees and the banks, especially during the lockdown period. This will fulfil the requirements of the bank to give a similar service to the customers in out station while rewarding the few employees still wish to render their services in outstations.

It is evident that P_3 to P_5 values, are equal to 0% out of the total allowance which is not popular among the bank employees. Therefore, by referring to the value it can be justified as this type of allowance may disappoint some employees. For an example strategy 3, allowance could be utilized only one employee at once. Then the others cannot utilize this allowance as only one person is allocated. However, this is an additional allowance which every employee prefers to get. However only one or maximum two employees will be appointed, and the rest of the members cannot claim that allowance. Therefore, majorities of employees were not satisfied with the P_3 or 3rd strategy that the bank offers. Therefore, by introducing this strategy the satisfaction of the majorities of the employees will be very less

The strategy 4 allowance, P_4 value is also 0%, as there is not much benefit to the majorities of employees. This disturbance allowances rewards the employees who report to work by 6: 30am. Most of the male employees in the bank are between 30-50 years of age who are having school-age children. This segment of employees prefers to report to work after dropping their kids to school. However, a few male employees are willing to come to work early morning to get the benefit of disturbance allowance. Because they like to come in the early morning, fulfill their daily target easily and return home early in the evening to engage in some extra earnings through some other external sources. Further, around 65% of the bank employees are females. Due to the issues related to domestic and family affairs, most of the female employees preferred to wok from 8am and they will not be benefited by having the 4th allowance. Further most of the ladies uses office transport services which arrives to their banks at 8am. This is another reason for the unpopularity of this allowance. Therefore, the bank should seriously reconsider this allowance and review it to make this allowance a very effective and worthy one.

Further the strategy 5 or the value of P_5 is also 0% out of total allowance. Which indicates that the popularity of this allowance is also not significant. This reflects the reality in the practical world. If needed, most the officers can load a small amount of cash and they can frequently go out for loading purpose and claim this allowance many times a day. Then it is a meaningless and additional cost and a burden to the bank. The Game theory application will provide us the best value to allocate many funds on a fair basis, which brings benefits to the player as well as to the opponent. This allowance is a very common allowance in the banking industry and all the employees including minor staff can claim this type of allowance. In addition, the officers, clerical grade employees, and the minor staff members are eligible for this allowance due to the less risk. The riskiest part and the responsibility of this cash loading activity is borne by the security department and the transport department. In addition, this allowance can be claimed by both male and female employees, as this transaction is done during office hours, and anyone can attend for this task without doing overtime work. However, the researchers noted that this allowance is not that popular among staff grade employees as only assigned people can claim these allowances and only a limited number of employees privileged to get the benefit but not all staff grade employees.

However, considering the bank's perspective as well as the majorities of the employees, the state bank should revise their employee benefits to enhance the satisfaction on their staff grade employees by introducing appropriate financial benefits and allowances through various attractive schemes which brings benefit to both employer and employees.

Therefore, the suggested model can be employed to bring right balance between financial benefits and employee satisfaction not only to the above-mentioned state bank but also to other private banks and other organizations.

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