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Bayesian Decision-Making with Weighted Risk Management for Human Resource Management

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***Abstract*—**Many of risks occur during the human resource management. During the time of recruitment and post-recruitment, HR needs to predict the events where risks occur of which decision can be made like selection, strategic planning, and training. These criteria vary between conditions ranging from sociology, health condition, degree of uncertainty, avoidance, and sequence of actions as a matrix in Bayesian decision model. The Bayesian decision-making (DM) framework includes risk identification, decision choices, outcomes of decisions, and described losses from HR risk. In this paper, the weighted risk management is developed from the existing context of HR risks. The weighted risk will be evaluated in term of losses and the mathematical modeling of the decision making scheme is made.

***Keywords*—**bayesian decision-making framework, expected losses,human resources risk management, weighted risk management factor.

I. INTRODUCTION

OVER theyears, it is very common to apply risk management to HR process. Many frameworks have been developed including decision making scheme. Thus, bayesian decision analysis is one of practical tools starting by identified the problems where the corresponding DM takes a single reward, i.e., a financial one or a result of chosen act. It is very important for HR analysis to understand the risk assets to indicate problems to make a decision on strategic planning and risks, operational risks, financial risks, hazard risks. Normally, risk management has four stages: Plan-Do-Check-Act (PDCA). In this paper we consider the similar methodology aspect for HR management [1], it can be depicted as Table I.

TABLE I
FIVE –STAGE METHODOLOGY OF HR MANAGEMENT

Stage	Description	Procedures
1	Preparation	A. Setting the objectives of HR risk management B.Formation of the HR risk management team
2	Analysis	A. Qualitative analysis of HR risks B. Quantitive analysis of HR risks
3	Planning	A. Elaboration of a plan of measures to manage HR risks B. Development of a budget for HR risk management C. Identification of funding sources for human resources management D. Documenting the management of HR risks
4	Organization	Implementation of action plan for management of HR risks is carried out.
5	Control	A. Assessment of the effectiveness of human resources management B. Operational control over HR risks of the organization C. Revision and updating of the HR risk assessment system

As a result from the above methodology we can find that there is a HR risk level as indicated in Table II can be shown from the least significant HR management system to the most significant negative impact, i.e. losses on the activities of HR of the entire organization.

TABLE II
PROFILE OF HR RISKS

Number	HR risks	HR risk level
1	Ineffective HR management system	0.80
2	Leaving of "narrow" specialists	0.76
3	Unfavorable socio-psychological climate in the team	0.72
4	Lack of a staff motivation program	0.72
5	Intellectual risks	0.71
6	Lack of incentive to retain staff	0.70
7	Lack of career progression	0.70
8	Inefficient functional division of liabilities and responsibilities for personnel management	0.70
9	Leaving of senior management	0.68
10	An employee's assessment based not on the performance	0.66
11	Lack of allocation of posts, from which the most dangerous threats of information, property, intellectual and other security can come	0.61

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12	Lack of activities aimed to motivate the loyalty of employees to the organization	0.60
13	Subjectivity of methods of personnel business evaluation	0.60
14	Irrational structure of the organization	0.60
15	Dismissed of employees after passing training program	0.60
16	Inefficient functional division of liabilities and responsibilities for personal management	0.60
17	Risks of unreliability	0.56
18	Non-compliance of training objectives with the needs of the organization	0.55
19	Lack of regulation of personnel security function	0.54
20	Unbalanced gender, age and educational groups of staff	0.52
21	Low qualification level and quality of intellectual potential of the organization	0.52
22	Absence of conclusions of business evaluation, management decisions	0.51
23	Absence of conditions aimed to increase the loyalty of employees	0.51
24	Low qualification level and quality of intellectual potential of the organization	0.51
25	Presence of conflicts, labour disputes, caused by the conflict of interests of employees and the employer	0.49
26	Lack of incentive for employees to make proactive proposals to improve the security of the organization	0.49
27	Socio-psychological risks	0.48
28	Lack of regulation of working hours and overtime work	0.48
29	Economic risks	0.48
30	Irrational modes of work and leisure time	0.39
31	Moral risks	0.33
32	Biological risks	0.24

Then, we apply the risk matrix level of one to three: low, medium, highas shown in Table III, and multiply by the HR risk level from Table II, we can derive multiplication as expected losses as indicated in Table IV. Noted that from the above models the risk level shown in risk matrix in Table III can be subcategorized into Strategic Risk (SR1-3), Operational Risk (OP1-3), Financial Risk (FR1-3), Hazard Risk (HZ1-3) [3]. For information technology department more risks can be included such as Technology Risk.

TABLE III
RISK MATRIX OF THREE LEVEL

PROBABILITY			
HIGH	1	2	3
MEDIUM	1	2	2
LOW	1	1	1
	LOW	MEDIUM	HIGH

IMPACT

CASE STUDY

A female employee is hired with business evaluation, and she has expressed interested and satisfaction upon arrival with the help of her co-worker for floor tour (no HR organization training plan only HR policy training upon arrival as discussed with her colleague), the psychological climate in the team is that they prefer female with satisfaction to work with the team, but evaluation is based on former male specialist who has ISO certification, whilst she has an expired knowledge of CCNA (with basic network concept) certification which is not really applied to the role as standardized information security officer. She can bring her own devices and also working on available resources at the office. The team found she has experiences and required educational background, but no certification (naïve to middle specialist in ISO). She has come up with new risk management proposal (with operation risk of level 1) plan to self-evaluation on her first week as a risk management officer given task and information from male supervisor. Thus, given expected losses in following table,

TABLE IV
EXAMBLE OF EXPECTED LOSSES

Number	Description	Expected Losses(l_i)
1	SR1	0.80
2	OP1(with certification)	0.76
3	OP2	1.44
5	SR1	0.71
11	HZ1	0.61
20	SR1	0.52
22	FR1	0.51
26	OP1	0.49
29	FR2(trained, optional)	0.96

The definition in the International Organization for Standardization (ISO) 31000 risk management standard is that ‘a risk is the effect of uncertainty on objectives’ [8], [9]. The ISO guide also emphasizes that a risk may be positive, negative or a deviation from the expected and that risk often

becomes visible in an event, a change in circumstances or a consequence.

II. Bayesian Decision making model

There are several methods of decision making such as binary search tree but in this paper we would consider only one methodology, Bayesian DM. As we understand that [2].

NOTATION 1Let D is the decision space denoted as the space of all possible decisions of that could be chosen by the DM andθ the space of all possible outcomes or states of nature θ. We could define that at each choosing decision, $d \in D$ and for each possible outcome $\theta \in \emptyset$. We can give that at any loss which can be written in form of $L(d,\theta)$ and probability mass function as indicated in Table II in form of $p(\theta)$.

If the spaces D and θ are finite of respective dimensions r and n then $p(\theta)$ is a vector of n probabilities, whilst $\{L(d,\theta): d \epsilon D, \theta \epsilon \emptyset\}$ can be specified as an m x n matrix all of whose components are real numbers. Given that both $D = \{d_1, d_2, \ldots, d_r\}$ *and* $\emptyset = \{\theta_1, \theta_2, \ldots, \theta_n\}$ are finite sets then the losses $\{L(d_i, \theta_j) = l_{i,j}: i = 1,2, \ldots r, j = 1,2 \ldots n\}$ can be illustrated as a table called a *decision table* and shown below.

Consequently,

		States of Nature				
		θ_1	θ_2	$\cdots \theta_j$	$\cdots \theta_n$
Decisions	d_1	$l_{1,1}$	$l_{1,2}$	$\cdots l_{1,j}$	$\cdots l_{1,n}$
	d_2	$l_{2,1}$	$l_{2,2}$	$\cdots l_{2,j}$	$\cdots l_{2,n}$
	$\vdots$	$\ddots$		$\vdots$	
	d_i	$l_{i,1}$	$l_{i,2}$	$\cdots l_{i,j}$	$\cdots l_{i,n}$
	$\vdots$			$\ddots$	$\vdots$
	d_r	$l_{r,1}$	$l_{r,2}$	$\cdots l_{r,j}$	$\cdots l_{r,n}$

To calculate the expected payoff, or equivalently, minimize the function

$$\bar{L}(d) = \sum_{\theta \epsilon \emptyset} L(d,\theta)p(\theta)$$

where$\bar{R}(d)$denotes her expected payoff.

III. Study the FEMALE case

Practically [2], we use expected loss, $l(d,\theta)$ to calculate the total loss $\bar{L}(d)$ as a summation of losses. For examples, from table IV from the case study, it can be evaluated that if there is two decisions to make whether she would be trained to have certain certifications,d_1, or to evaluate as a new specialist at the end of trial period $\theta_1$with or without $\theta_2$certification. Second decision is d_2 is to NO TRAINING period for her new role as new specialists in her field than existing required certification, i.e. her role need CCNA for basic roles to make a plan to audit for risk management policy for IT, but she also need ISO knowledge and certification. Consecutively, we get the total losses of 5.84 out of 24, given that LOW loss is evaluated between 1*x0.5* to 1*x1* of each asset out of eight assets as shown in Table IV.

Example 1 A female employee is recruited with evaluation of $I = 1$: pass evaluation;$I = 2$: NOT pass evaluation, and to$A$: recruit specialist or $\bar{A}$: NOT recruit new personnel from business evaluation model, the associated costs and probabilities are given below. Since the risk level is at 5.84 out of 24 from eight assets, i.e., she would pass the evaluation period from the measurement but using Bayesian DM with nine assets tells, under optimal action the amount we expect to spend is

$$\bar{L} = 125\pi + 187.5(1-\pi) = 187.5 - 62.5\pi$$

whereπ is probability where A is occur
$1-\pi$is probability where$\bar{A}$ is occur

From the example given, we can concluded that as of $\bar{L}$ = [123, 187.5] the situation A and $\bar{A}$ will occur, respectively.
We have,

$$l_{1,1} = 6.80$$
$$l_{1,2} = 7.56$$
$$l_{2,1} = 6.32$$
$$l_{2,2} = 7.08$$

In form of loss matrix,

$$L(d) = \begin{bmatrix} 6.80 & 7.56 \\ 6.32 & 7.08 \end{bmatrix}$$

with $\pi = 0.8$. Finally we get the result of

$$\bar{L}(d) = 21.66048$$

She will pass the evaluation and with NO FURTHER recruitment as the lower limit is not reached.

IV. Evaluation of DM model

More evaluation, e.g. job satisfaction can be measured and find the mean values [4] this decision making scheme. Moreover, it can be management by Quality Assurance method as well like doing p-test, t-test, etc. relating to hypothesis relations. However, it is not included in this paper.

V.Some problemencounters

Usually, error evaluation in decision-making scheme is encountered to indicate the accuracy of decision-making to find better training set in machine learning. This will also correspond with self-evaluation for improved decision-making framework [11].

VI. CONCLUSION

Loss experience is one of the topics in risk management of which in this context we made use of it as one of important factors in decision making [9] and scorecard may be of use as well in the process [10].This also includes in performance evaluation. Table V depicted risk description needs for HR evaluation.

TABLE V
RISK DESCRIPTION IN HR RISK MANAGEMENT

Number	Description	Category
1	Name or title of risk	SR, OP, FR, HZ
2	Scope of risk	SR, OP, FR, HZ
3	Nature of risk	SR, OP, FR, HZ
4	Stakeholders	SR, OP, FR
5	Risk evaluation	SR, OP, FR, HZ
6	Loss experience	SR, OP, FR, HZ
7	Risk Tolerance, appetite or attitude	SR, OP, FR, HZ
8	Risk response, treatment, and controls	SR, OP, FR, HZ
9	Potential for risk improvement	SR, OP, FR, HZ
10	Strategy and policy Development	SR, OP, FR, HZ

More research can be on the improvement and multi-dimension with Bayesian DM framework. Many risk description may be involved than the loss alone with weighted risks. Correlation between each risk factors may be evaluated to identify the problem solving for business continuity management.

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