

Predicting The Exit Time Of Employees In An Organization Using Statistical Model

Ahmed Al Kuwaiti, Vinoth Raman, Arun Vijay Subbarayalu, Palanivel R.M., Sivasankar Prabakaran

Abstract: Employees are considered as an asset to any organization and each organization provide a better and flexible working environment to retain its best and resourceful workforce. As such, continuous efforts are being taken to avoid or extend the exit/withdrawal of employees from the organization. Human resource managers are facing a challenge to predict the exit time of employees and there is no precise model existing at present in the literature. This study has been conducted to predict the probability of exit of an employee in an organization using appropriate statistical model. Accordingly, authors designed a model using Additive Weibull distribution to predict the expected exit time of employee in an organization. In addition, a Shock model approach is also executed to check how well the Additive Weibull distribution suits in an organization. The analytical results showed that when the inter-arrival time increases, the expected time for the employees to exit also increases. This study concluded that Additive Weibull distribution can be considered as an alternative in the place of Shock model approach to predict the exit time of employee in an organization.

Keyword: Additive Weibull Distribution, Employee, Exit, Organization, Shock model

1 Introduction

Organizational exit is the process of managing the conditions under which employees leave the organization and is often referred to as decruitment. An employee might exit from the organization because of his or her own actions or the exit might be inevitable based on organizational strategy which is beyond the control of the employee. Organizational exit can be controllable when it is the employer who determines when the employee leave the organization. It can be explained as voluntary, involuntary and functional. Voluntary organizational exit is an important issue often faced by an organization that when the best employees leave. In contrast, Involuntary organizational exit involves the termination of an employee due to his/her poor performance or layoffs or termination of excess employees when they are no longer required by the organization.

Lastly, Functional organizational exit is being executed with an expectation that the organization will be more efficient after the exit occurs. Moreover, Dysfunctional organizational exit results in a decline of human capital of the organization and decreased organizational capacity [1]. A theory by Hirschman (1970) suggested the option of exit chosen by an employee as a possible destructive reaction to decline in organizations. This kind of behavior also varies substantially from other constructive traits, such as voice (intention to stay and fight for one's beliefs and occupational goals) and loyalty (willingness to adjust and comply with the current environment) [2]. In contrast, Neglect is considered as a more negative/ passive response because of its covert image and potential long-term damage to the organization. An employee may remain with the organization but neglect his/her essential duties and assignments when he/she has no other job alternatives or wishes to requite the organization for being unfair [3], [4]. Consequently, Porter and Steers (1973) proposed four general categories and several factors are identified within each category that influence employee's withdrawal from the organization. These include: organization-wide (e.g., pay and promotion policies), immediate work group (e.g., unit size, supervisor, and co-worker relations), job content (e.g., nature of job requirements), and person-based (e.g., age and tenure) [5]. In addition, other factors are also leading to employees' resignation and it takes the form of organizational, individual work-related and individual non-work related [6]. Organizational factors include: insufficient pay, too many work responsibilities, too many requirements for advancement and lack of recognition for a job well done. Individual work-related factors are other priorities in life, frequent late night meetings and conflict between personal and organizational values. Likewise, the individual non-work related factors are attractive job offers, family obligations, being attracted to more money, work conflicting with personal responsibilities and lack of time to develop/maintain personal relationships. An earlier study pointed some other reasons for resignation and it include: new rules and policies by the organization; lack of monetary benefits, extensive work load and responsibility stress [7]. The relation between the employees and his/her manager may also create a conflict and lead to exit of employee [8]. Besides, several other factors such as time away from family, salary, lack of leadership and support, and

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unrealistic expectations are also contributing to the employee's decision to quit [9]. Hobbs (2010) pointed certain scenario where the management could not have control over the exit of an employee from the organization. i.e. health issues, relocation and early retirement and personal reasons [10]. While exploring the effect of exit of employees on productivity, resignations at any work place always harm the sentiments of existing employee who foresees his/her career within the organization and such sentimental distortion often create an unrest environment. Resignations or exit of employees are a ritual to any organization and the top management should know the art of handling it and to overcome the consequences in its surroundings. Whenever employees of any organization resign, there are chances that the employees of that organization may have a rage against some issues and there is possibility of getting into an act against the top management [7]. Furthermore, when an employee leaves, all their knowledge also exits, including their specific functional expertise, experience, skills and contacts. This might lead to two consequences: decreased organizational output [11] and decreased organizational productivity [12]. It is found that as an employee exits, it might highly impact on the turnover cost of the organization. Direct replacement costs can reach as high as 50%-60% of an employee's annual salary, with total costs associated with turnover ranging from 90% to 200% of annual salary [13]. For Example turnover costs of \$102,000 for a journeyman machinist, \$133,000 for an HR manager at an automotive manufacturer, and \$150,000 for an accounting professional [14]. Wiley (2011) also stated that replacing a manager will cost an organization approximately two times the earnings, based on the survey performed on 262 companies [15]. In such employee exit situations, exit interviews are considered one of the finest processes for obtaining feedback from employees exiting the company. This information can be utilized to benefit the organization in the future and perhaps prevent other employees parting the company for comparable reasons. As soon as data is collected it must be analyzed to recognize trends and patterns. Findings should be used to formulate and execute retention strategies [16]. In a reputed organization, length of service in a grade should necessarily be a natural criterion for promotion in order to create a healthy atmosphere among the employees. When the number of exit of employees exceeds a threshold level, then the organization is exposed to a break down situation. Therefore, it is mandatory to estimate the duration of exit time of employees in an organization by using appropriate tools. Previous studies utilized various statistical models to predict or address the issues of employees faced by organization. In a study by Saengsurepornchai (2011) used a human resource predictive model to address the complexity in workforce planning and generalizations with a logistic regression model. Here, the model estimated the employee turnover number and forecasts the expected remaining headcount for the next time period based on employee information such as age, working year, salary, etc. It also suggested the possible internal workforce movement in case of in-house manpower imbalance [17]. In another study by Khare et al. (2011) applied the logistic regression technique to predict employee attrition risk in an organization based on demographic data of separated

employees. This technique defined the risk attached with each employee should be modified and remodeled bi-yearly to refine coefficients based on data [18]. Similarly, Kannadasan et al. (2013), Pandiyan et al. (2013) and Kalaivani et al. (2014) have also discussed statistical models to find the time to recruitment in an organization by applying different distributions. Hence, this study aimed to predict the expected duration of the exit time of employee in an organization through statistical model [19], [20], [21].

2 Description of Statistical Model

In this study, Additive Weibull distribution, a statistical model is adapted to predict the expected duration of the exit time of employee in an organization. Further, Shock model approach is executed to check how well the Additive Weibull distribution suits in an organization. Additive Weibull distribution which is a quite flexible distribution for fitting lifetime data with bathtub-shaped failure rate function [22]. The probability density function (pdf) of the Additive Weibull distribution is

$$f(x) = (\alpha\theta x^{\theta-1} + \gamma\beta x^{\beta-1})e^{-\alpha x^{\theta} - \gamma x^{\beta}}$$

Therefore, the exit time of an employee is obtained under some assumption using the cumulative damage process of the reliability theory. The reliability function $R(t)$, which is the probability of an item not failing prior to sometime t , is defined by $R(t) = 1 - F(t)$. The reliability function of Additive Weibull distribution is given by

$$R(t) = 1 - F(x) = 1 - \left[1 - e^{-\alpha x^{\theta} - \gamma x^{\beta}}\right] = e^{-\alpha x^{\theta} - \gamma x^{\beta}} \quad (1)$$

3 Exit Time of the Employee through Additive Weibull Distribution

The movements of individuals are characterized by replacements (renewals) according to some probabilistic law, and such models of manpower systems are called renewal models. Smith (1958) gave an extensive review and highlighted the applications of renewal theory to a variety of problems. There may be no practical way to inspect an individual item to determine its threshold y . In this case, the threshold must be a random variable. In this study, Shock model approach is also utilized in order to test the suitability of the Additive Weibull distribution in an organization [23]. Esary, Marshall and Proschan (1973) also discussed the shock model approach and wear process [24]. The shock survival probability of employee given by

$$P(X_i < Y) = \int_0^{\infty} g_k(x) \bar{H}(x) dx = \int_0^{\infty} g_k(x) e^{-\alpha x^{\theta} - \gamma x^{\beta}} dx = [g^* e^{-x(\alpha+\gamma)}]^k \quad (2)$$

Lee and Mitchell (1994) argued that an alternative theory was needed to explain how and why people leave organizations and proposed the unfolding model of turnover. The major components of the unfolding model

include shocks, scripts, image violations, job satisfaction and job search. First, a shock is a particular, jarring event that initiates the psychological analyses involved in quitting. Second, a script is a pre-existing plan of action - a plan for leaving. Third, image violations occur when an individual's values, goals and strategies for goal attainment do not fit with those of the organization or those reflected in the shock. Fourth, lower levels of job satisfaction occur when a person, over time, comes to feel that his or her job no longer provides the intellectual, emotional, or financial benefits desired. Fifth, search includes those activities involved with looking for alternatives and the evaluation of those alternatives [25]. Morrell et al. (2004) reported that 44.3% of the nurses reported that shocks have a substantial influence on the decision to leave with most calling it a main or "overwhelming influence" on leaving. Key findings indicate that: (1) shocks that are expected are more likely to be positive, personal, and lead to unavoidable leaving; (2) shocks that are negative are more likely to be work related, associated with dissatisfaction, affect others and lead to avoidable leaving; (3) shocks that are more work related are less potent, associated with dissatisfaction and search for alternatives and lead to avoidable leaving; and (4) shocks tend to cluster into work and non-work domains [26]. Morrell (2005) reported three clusters of leavers from a cluster analysis. Cluster 1 (n=103) leavers had a work-related shock that was unexpected, negative and affected other workers. Cluster 2 (n=50) leavers had a personal shock that was expected, positive and private. Cluster 3 (n=196) leavers had no shock and followed a more traditional dissatisfaction induced process [27].

4 Survival of Employee

Survival analysis is a class of statistical methods for studying the occurrence and timing of events. The survival function which gives the probability that the cumulative threshold will fail only after time t . $S(t) = P(T > t)$, Probability that the total damage survives beyond t . It may happen that successive shocks become increasingly effective in causing damage, even though they are independent. This means that $V_k(t)$, the distribution function of the k^{th} damage is decreasing in $k = 1, 2, \dots$ or each t . It is also known from renewal process that

$$\begin{aligned} P(T > t) &= \sum_{k=0}^{\infty} V_k(t) P(X_i < Y) \\ &= \sum_{k=0}^{\infty} V_k(t) [g^* e^{-x(\alpha+\gamma)}]^k \\ &= \sum_{k=0}^{\infty} [F_k(t) - F_{k+1}(t)] [g^*(\alpha + \gamma)]^k \quad (3) \end{aligned}$$

Survival analysis can aid in answering questions about time that are often left unanswered by linear and logistic regression, modeling techniques, and longitudinal procedures. The technique was originally developed by biostatisticians for the analysis of clinical lifetime data. For example, it often has been used in medicine to determine survival duration for organ transplant patients, in substance abuse studies to determine recidivism rates, and in psychiatry to study longitudinal treatment outcomes for individuals with severe mental illness [28]. The survival

probability $S(t)$ is estimated non-parametrically using the Kaplan-Meier, or product limit, method [29]. Kaplan-Meier estimates are non-parametric because there are no mathematical assumptions made about the underlying hazard function.

5 Probability of the Conversion Time

Data that measure "the length of time" until the occurrence of an event are called lifetimes, failure times or survival data. $L(T) = 1 - S(t)$. Taking Laplace Transform of $L(T)$, on simplification, we get

$$= \left\{ [1 - g^*(\alpha + \gamma)] \sum_{k=1}^{\infty} F_k(t) [1 - g^*(\alpha + \gamma)] \right\}^{k-1} \quad (4)$$

By taking Laplace-Stieltjes transform, it can be shown that

$$l^*(s) = \frac{[1 - g^*(\alpha + \gamma)] f^*(s)}{[1 - g^*(\alpha + \gamma)] f^*(s)} \quad (5)$$

The random variable of inter arrival time of exit of an employee follows identically exponential with parameter c . Now $f^*(s) = \left(\frac{c}{c+s}\right)$, substituting in the above equation (5) we get,

$$= \frac{[1 - g^*(\alpha + \gamma)] c}{[c + s - g^*(\alpha + \gamma)c]} \quad (6)$$

6 Plan, Do and Act Measures of Employee Survival Time

Once the improvement needs are identified, goal should be set to establish the time frame for fixing the first prioritized problem. The elapsed time between $(n-1)^{\text{st}}$ and n^{th} is a sequence of inter-arrival time.

$$\begin{aligned} E(T) &= \frac{-d}{ds} l^*(s) \text{ given } s = 0 \\ &= \frac{(-1)[1 - g^*(\alpha + \gamma)]c}{[c + s - g^*(\alpha + \gamma)c]^2} \\ &= \frac{1}{c[1 - g^*(\alpha + \gamma)]} \quad (7) \end{aligned}$$

$$g^*(\cdot) \sim \exp(\mu), g^*(\lambda) \sim \exp\left(\frac{\mu}{\mu + \lambda}\right)$$

The probability of expected time to leave the organization by an employee is derived. The mean time for the exit of an employee in an organization is found in equation (8). The trend between the expected time to leave the organization and inter arrival time of employees is shown in Fig. 1.

$$E(T) = \frac{(\mu + \gamma)(\mu + \alpha)}{c[\alpha\gamma - \mu^2]} \quad (8)$$

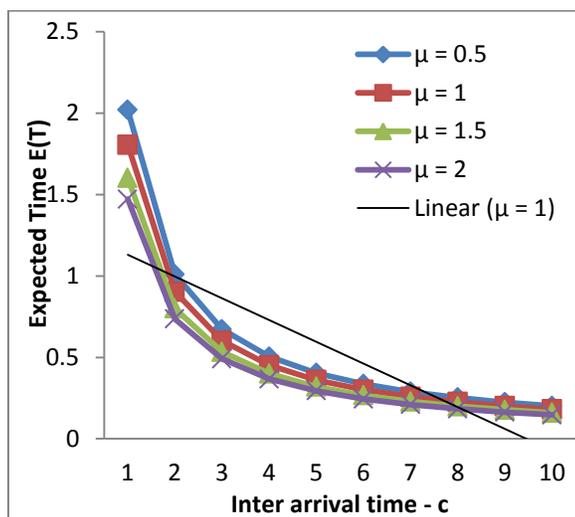


Fig. 1. Graph showing the trend between the expected time to leave the organization and inter arrival time of employees

7 Conclusion

In this study, probability that the employee leaves the organization with special criteria such as dissatisfaction, medical treatment, spouse is taken under consideration. By using the Additive Weibull Distribution, the expected time to exit of employees in an organization is derived. It is observed that as inter arrival time of exit of an employee increases then time to recruitment is needed. The inter-arrival time is increased ($c=1,2,3\dots 10$), and the parameter ($\mu = 0.5, 1, 1.5, 2$) is been fixed as the other parameters γ and α are constant. The trend line of Additive Weibull Distribution shows recruitment should be done regularly when the employee leaves the organization.

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