Application of Simulation of Queuing Technique in the Recruitment process in present and Post Covid-19 Scenario

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Abstract — The coronavirus (COVID-19) is enduring its slit across the world. To diminish the feast of the disease, assorted organizations are taking substantial measures to ensure the safety of their current staff and they are also looking to protect forthcoming employees by putting special policies in place for the hiring process. The outburst of COVID-19 highlights a need for the recruitment process going to take place by the organizations. In this paper, we discuss how the recruitment process can be done during current and post COVID-19 both offline and online in order to optimize the waiting time of the candidates, and the ideal time of panel members, by using a simulation of queuing technique. The process is explained by considering an example.
Key Words: Covid-19, Coronavirus, Queuing Technique, Recruitment, Monte Carlo   Simulation, Simulation.

I. INTRODUCTION

The outbreak of Coronavirus disease 2019 (COVID-19) is caused by SARS-CoV-2 (a severe acute respiratory syndrome coronavirus 2) which is the causative agent of a potentially fatal disease that is of great global public health concern. In early December 2019, it occurred in Wuhan City, Hubei Province, China. It is creating havoc worldwide and spreading more rapidly due to increased globalization and due to inadequate risk assessment regarding the urgency of the situation and has entered a dangerous new phase when compared with SARS and MERS. The World Health Organization declared the outbreak as a Public Health Emergency of International Concern on January 30, 2020. As of July 2020, the coronavirus 2019 (COVID-19) pandemic continues to sweep across the globe, leaving significant trauma, loss, and hardship in its wake.

The Covid-19 corona virus has become the stimulator for one of our life's biggest workplace transitions. The current requirements and the variability of the economic environment arising in large part from demographic shifts, technological advances and globalization have made it imperative for the brightest talents of organizations if they hope to survive as a source of competitive advantage (Ekuma K.J,2012). So human is not a source they are resource if these resources are not optimally utilized, they will become liability to the organization. Therefore, people are the biggest asset of any organization. Recruiting and retaining the best talent are some of the key management activities which lead to the success of any organization. Imagine how much time a company spends to conduct an interview a day? Or half a day? to get the right talent, can any HR can figure out how many employees will retain for longer periods? (Barnett,2008) These are the two crucial tasks of HR in any organization, but often they are trying, but sometimes they are unable to complete the process in the scheduled time and unable to predict employee retention also. Therefore, HR need to be more strategic before hiring the employees. Because employees are expensive investment, therefore proper precautions need to be taken while spending cost and time on them. In traditional recruitment, organizations will be calling the selected candidates to the locations on particular date and they have to wait for the whole day till the process completes. Here waiting time of the candidates is more and even organizations has to invest cost on the candidates who attend for interview.

The purpose of this paper was to optimize the waiting time of the candidates and ideal time of the panel members during the recruitment process both online and offline during and post covid-19. This purpose is achieved by taking the advantage of simulation of queuing technique, which represent a relatively new approach in this field.

The rest of the paper is organized as follows. The section 2, reviews the literature. In section 3, we introduced the proposed model. In section 4, the recruitment process is explained by considering an illustration. Finally, a conclusion and research remarks are given in section 5.

II. LITERATURE REVIEW

One of the main organizational planning is human resource planning since the human Resource is one of the most treasured aspects in production and vital advantage of any organization and as the key basis of competitive advantage and creating of fundamental capabilities in every organization. (Azar et al., 2002). Therefore, the recruiting process is an integrated part of handling the human resources (HRM). This is not done without careful strategic planning. Using simulation of queuing technique helps us to call a limited candidate a day without making them to wait for a longer time in the queue, reduce the ideal time of panel members and it can enable the organization to save money and can improve the quality of service in its recruitment procedures.

The literature can be divided into: Traditional recruitment, current recruitment process due to changed scenario, and the use of queuing theory concepts and simulation in human resources management.

The first review on investigation on employment interviews were published by (Wagner,1949), Where he stated various recommendations like there should be a standardized form to conduct an interview in spite of the length and the procedure of the interview. Along with that the validity and reliability of the interview process must be specific in relation to the situation and to the interviewer. Finally, he said an interview is a evaluation tool which measures Three important aspects like a) Screening is sufficient or b) Number of applicants is too small or to develop any scientific method c) Certain traits has to measured more accurately in the interview process. But over the past few years the selection criteria in the interview process got many criticisms (May field ,1964), which is due to lack of reliability and validity, it was addressed by May field after fifteen years of Wagner recommendations, decision making was given mere importance than the results of the interview. So further investigation is required to study how the negative information are influencing the interview process in order to improve the procedure of the interview. But still interview remains constant in spite of developing various tools and techniques for appraising the aptitude for training or to predict the job performance (Ulrich &Trumbo, 1965). In support to Wagner suggestions personal interviews are the right way to set a standardized format for conducting interviews. Not only that how an interviewer can take an optimal decision when the information available to him is different. Of course, it may be true in cases like psychiatric, otherwise it differs from case to case, and sometimes flexibility and adaptive approach need to be followed in selection criteria. After observing May field and Ulrich &Trumbo studies (O. R. Wright, 1969) has identified that opinion statements, handbooks are followed by the interviewers for selection criteria. But in reality, none of these are not added any knowledge for the selection process. Because very few employees who are the above the lowest level of unskilled are hired without being subject to one or more interviews. So, a blind faith and efficacies persisted to validate the selection process. However still the interview continuous to be popular tool in the selection criteria. (Schmitt, 1976) identified that the most ignored area of the interview process is the decision-making process of the respondent during or after the interview. So, he suggested future research should focus on towards identification of various variables which are best and most suited to the employment interview purpose. After reviewing previous studies (Arvey & Campion 1982) observed that training, non-verbal behavior, minority characteristics, and interviewee characteristics are more concentrated in their study. They developed a model relating to interview process like applicants' details, situation and other variables like phycological factors, perceptions and other related attributes. One of the crucial elements both in public and private sector is selection of right candidate with high abilities (Hunter & Hunter 1984). To attain this many firms are using predictive devices with high validity and cognitive, psychomotor ability tests, to reduce the adverse impact also. Which is mainly to reduce the cost burden. Later (P. M. Wright et al. ,1989) conducted investigation on structured interviews after correcting for criterion unreliability, the mean validity. The authors noted that the interval did not include the mean validity. So structured interviews are having more credibility than unstructured interviews. Therefore, in the selection process interview is designed to predict the future job performance of employee based on oral responses (McDaniel, M. A et.al.,1994). But Interviews proved similarly true, for work performance and performance enhancement criteria but less justification for tenure criteria. Previous research studies suggested that one or two variables are mediating the recruitment process whereas (Werbel, J.D,1996) identified three variables like demographic variables, realistic expectations, perceived job-fit, and their relationship between recruitment and employee turnover.

According to David A De Cenzo "the recruitment needs are of three types they are: Planned needs, anticipated needs and unexpected needs". In the process of management, leading and development of people, recruitment and selection is essential in certain significant respects (French, R., & Rumbles, S.2010). In the organization the human resource needs are recognized by the efficacious human resource and then the recruitment process starts (Neeraj Kumari, 2012). So, the first step in recruitment process is hiring that continues with the selection and development of the candidate's placement (Mankikar, S, 2014). But in selecting the right candidates out of various applicants three important things need to be properly taken care of by the hiring team, they are performance of the candidate, cost of hiring and the third and important area legal obligations in relating to labor laws and other HR policies and practices as per employment laws. So proper care needs to be taken in the verification and scrutiny process of prospective employee background checks and other details relating to previous jobs. Therefore, a good selection process will ensure that the organization gets the right set of employees with the right attitude. Good human resources always an asset to the organization for improving the performance. To meet these goals organization should check into various attributes before hiring their skills, qualification, attitude and experience. Therefore, in the process

of selection a series of steps need to be followed to select the right candidates among various applicants, these steps vary from one organization to another. But time is the major factor in the entire process of selection. This is the general process of selection of prospective employee through a series of steps in various organizations. In fact, quality of hiring depends on time taken for the entire process. Time to fill out the amount of days it takes from the time a job opening is posted to the period the offer is accepted, while recruit process is estimated from the time the applicant joins the process before the offer is approved (Neelie,2018).

According to Gartner report 88% of the workforce are working remotely in spite of not effected to Coronavirus. And a record on 3.3 million are applied for unemployment benefits in United States (Meister,2020). But the problem is how it is going to impact the business? The findings of the recent HR survey on future workplace in US among 350 HR heads are scaling up skills and remote working, concentrate on employee well-being, and the third and most important is Coronavirus given new avenues to redefine the business. So, the entire recruitment funnel should fit and adapt as per new changes in COVID times (Rosie,2020).

The Coronavirus disease 2019 (COVID-19) is primarily feast between people during close contact, most often through small droplets formed by sneezing, talking, and coughing. The droplets usually fall to the ground or onto surfaces rather than travelling through air over long distances. Transmission may also occur through smaller droplets that are able to stay suspended in the air for longer periods of time. Less commonly, people may become infected by touching a contaminated surface and then touching their face. Keeping in view the safety and health of all, this pandemic has changed the entire ecosystem of business especially in recruitment process, companies are shifting from traditional recruitment to virtual platforms (Sreshtha,2020). So, it's the right time to take a call by HR to convert the regular mundane tasks in the recruitment process to a quality tasks with the help of digital technology. Various surveys already claimed that 75% of the talent acquisition process is going on technically. So, organizations have to undergo flawless recruitment process in order to decrease the interview time (Joshi,2020). Because in the whole recruitment process the main activity is interview. So, HR needs to be taken more precautions for scheduling and conducting interviews through online or offline without much delay for both panel and to the prospective employees. Alternative solutions need to carry throughout the recruitment process (Hightechpartners,2020). Therefore, hiring manager should strategically plan to acquire right talent with full transparency. Research shows that companies which are investing in technology especially in chat bots increasing year by year from 36% to 80%(Ribble,2020). In addition to that companies are also using more analytical tools to strengthen the process. Recent times Army recruitment process also done through video conferencing and nearly 8-10 candidates completing with in short duration (Scott,2020). So, even in the economic crisis companies are still able to make it possible in hiring due to technical advantage. And at the same time top management is expecting to get the right talent within the timelines of recruitment process. So, HR should optimize interview processes and eliminate non-value-added activities (Cadiga,2020). To attain this, companies should get ready with confidence by developing various innovations creatively to face various challenges in epidemic situations like COVID-19(Pia Yu,2020). Because the only two ways to attain profit by any organization is by increasing sales for their products or decreasing their expenditure. At present optimization is only feasible solution for competitive advantage. It's really futuristic cost reduction technique. Brain Solis, digital analyst and futurist said that "Employers are taking significant steps to ensure the safety of their employees". Caccavale said that "We can confirm that there has been a demonstrable impact on the hiring process due to the coronavirus. In fact, this can be seen in some of the world's biggest companies. Both Facebook and Amazon will be conducting the majority of upcoming interviews via video conferencing," Samuel Johns, HR specialist at Resume Genius said that "the company invites interviewees to speak via Skype, but also allows the opportunity to come into the office. However, for those who choose to come in, the company requires both the applicant and interviewer to wash their hands and have their temperature taken".

Due to technological advancements and computerization it was observed that many changes took place in the process of selection. Along with that for decision making, modelling techniques like simulation, queuing theory concepts were also helpful to take right decision both in terms of qualitatively and quantitatively. (Amini, 2004) stated that queuing theory techniques can be applied to indicate assessment parameters such as operational efficiency, response time and utilizing rate. Chen (2005) presented a model using a fuzzy membership function and considered fuzzy arrival rate and fuzzy cost regarding the fuzzy parametric planning method. (Tabari M, etal., 2012) applied the queuing technique to recognize the optimal number of required human resources in the organization. (S.Khalili, etal., 2014) stated that by applying fuzzy queuing techniques for the optimal assignment of human resources for maintenance departments able to minimizes the major part of maintenance related costs.(A. B. N. Yakubu, &U. Najim. 2014) applied queuing theory to determine optimal arrival time of the customers as well as to analyze the queuing behavior mathematically from the amount of time that a customer needs to wait in the system based on a real queuing situation. (B. T. Taylor, 2016) stated that reducing waiting time and providing quick service are very important in service-related operations. (N. Amit, N. A. Ghazali, 2018) describes that queuing system is a procedure to measure the effectiveness of the model in terms of utilization and waiting time and mentioned that Service-related companies place importance on reducing the waiting time of customers in order to increase customer satisfaction through improving their service quality. The queuing theory can be measured using the quantitative analysis technique to predict the characteristics of a waiting line. (Shtrichman, Oetal., ,2001) stated that simulation, queuing analysis and

decision support modelling techniques can be used for redesigning of recruitment process to address various important elements like time constraints and cost effectiveness in the process of hiring. Not only that a combination of simulation both in planning and in the recruitment, process gives successful results in the overall performance of the organization.

To the best of our knowledge, no one has used the simulation of queuing technique in recruitment process. This paper tries to fill the gap in the literature by introducing a new viewpoint to decreases the waiting time of the candidates and ideal time of the panel members. Where the arrivals and service time does not follow any kind of theoretical distributions like Poisson, Normal, Uniform, exponential and so on.

III. THE PROPOSED MODEL

Simulation can be used as a pre-service test to try out new policies and decision rules for operating a system before running the risk of experimentation in the real system.

3.1 Simulation of Queuing system

In the queuing situations, the characteristics of the situation described were based on the assumptions, that the arrivals are Poisson distributed while the service times follow an exponential distribution. Though such assumptions are often apt for the real -life queuing systems, they are not consistently so. Hence, where such assumptions fail to apply, proper mathematical analysis can be extremely difficult and even impossible. In such cases simulation provides the answer by simulating the given system and studying its behavior. Not only this, simulation is also employed to estimate the impact of system changes when carrying out tests with the real system may not be possible. It is a descriptive technique that encompasses developing a model of a real phenomenon which is followed by carrying out experiments on the model evolved. It purely describes how the given system is likely to perform under different sets of conditions hypothesized and allow the decision-maker to take apt decision. By itself it does not find 'Optimal solution' to the problem (N D Vohra, 2017).

3.2 Process of Simulation

There are four phases of the simulation process, they are
1. Description of the problem and statement of objectives
2. Building of an appropriate model
3. Testing with the model
4. Assessment of the results
Collection of right type and significant data are other basics connected with the formulation of model and its assessment.

3.3 Monte Carlo Simulation

If the given process has a random, or chance, component then Monte Carlo simulation approach can be used. In using this Monte Carlo method, the given problem is solved by simulating the original data with random number generators. Essentially, its use necessitates two things. First it should have a model that characterizes an image of the reality of the situation. The model here mentions the probability distribution of the variable in the question and the variable may not be known to clearly follow any of the theoretical distributions like Poisson, Normal and so on. The distribution may be obtained by direct observation or from past records.

IV. ILLUSTRATIVE EXAMPLE

In this section, the proposed model is illustrated the use of simulation in the study of queues by considering the following example.

During and post covid-19 a company wants to recruit candidates for managers, assistant managers, team leaders, sales people and marketing people and wanted to conduct offline/online interviews but wanted to maintain healthy environment of the company and keeping in the mind the safety of all, and wanted to interact with the candidate directly and to recruit, in this process the company wanted not only to maintain and practice safety and healthy practices but also to optimize the cost that going to incurred during the process of recruitment.

The Indicative size of selection and interview panel consists of 5-7 members comprising of Head HR, Functional heads and Senior member(s) of staff from the department, Expert adviser as appropriate (excluding support staff)

A company schedules all his selected candidates for 30-minutes appointment. Some of the candidates take more 30 minutes some less based on the type of category of the job they going to hold. The above summary is shown in table 1 i.e., the various categories of jobs, their probabilities and time actually needed to complete the process.

Here we going to simulate the company timings from 9a.m. to 6p.m. i.e., for 9 hours, and determine the average waiting time per candidate, idleness of the panel member and as well as the average waiting time for the candidates. By Assuming that all the candidates show up at the company or login into their devices at exactly their

scheduled arrival time starting at 9.00 a.m. Using the following random numbers for handling the above problem: 40, 82, 11, 34, 25, 66, 17.
First allocate random numbers 00-99 in proportion to the probabilities, as shown in the table 2 and arrival patterns and nature of interview is given in table 3. Computation of arrivals, service end time, waiting of candidates, idle time of the panel are given in table 4.

From Table 4:
The average waiting time per candidate is approximately 11 minutes
Average waiting time
= (total waiting time)/(number of candidates)
=180/17 = 10.58

The idle time of the panel members is 20 minutes.

The average waiting time for candidate that have to wait is approximately 15 minutes.
Average waiting time
= (total waiting time)/(number of waiting
   candidates)
=180/13 = 13.84

From the above we can conclude that by using the simulation of queueing technique the average waiting time per candidate is approximately 11 minutes, the idle time of the panel members is 20 minutes and the average waiting time for candidate that have to wait is approximately 15 minutes.

V.   CONCLUSIONS & REMARKS
In traditional recruitment the selected candidates were called for interview and they have to wait for longer durations and even the internal employees who applied for the promotion if they called for interviews have to wait till, they turn comes and general work in the organization will be assigned to the other employee. Now by applying this simulation of queueing technique we can reduce the waiting time of the candidates/employees and ideal time of the panel members. By this the other costs of the organisation can be directly decreased and can maintain the healthy environment of the organization and safety of the whole. As we are not aware that when this pandemic situation going to end and keeping in the view of safety of all, we can suggest that this process can be applied by any organization in any uncertainty conditions.

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Table 1: Various Categories of Jobs

Category of Job/interview	Interview Time Required (minutes)	Number of candidates	Probability of Category
Manager	50	8	0.08
Assistant Manager	40	12	0.12
Team Leader	30	18	0.18
Sales Person	25	32	0.32
Marketing person	25	30	0.30

Table 2: Allocation of Random numbers

Category of Job/interview	Interview Time Required (minutes)	Number of candidates	Probability of Category	Cumulative Probability	Random Numbers Interval
Manager	50	8	0.08	0.08	00-07
Assistant Manager	40	12	0.12	0.20	07-19
Team Leader	30	18	0.18	0.38	20-37
Sales Person	25	32	0.32	0.70	38-69
Marketing	25	30	0.30	1.00	70-99
		Total = 100			

Table 3: Arrival Pattern and Nature of interview

Candidate Number	Random Number	Category of Interview	Interview time needed (minutes)
1	40	Sales person	25
2	82	Marketing	25
3	11	Assistant Manager	40
4	34	Team Leader	30
5	25	Team Leader	30

6	66	Sales person	25
7	17	Assistant Manager	40
8	79	Marketing	25
9	65	Sales Person	25
10	77	Marketing	25
11	20	Team Leader	30
12	8	Assistant Manager	40
13	33	Team Leader	30
14	21	Team Leader	30
15	89	Marketing	25
16	10	Assistant Manager	40
17	6	Manager	50

Table 4: Computation of Arrivals, Service end time, waiting of candidates, Idle time of the panel

Candidate Number	Arrival time	Interview start time	Interview Duration (in minutes)	Interview end time	Waiting time (in minutes)	Idle Time (in minutes)
1	9.00	9.05	25	9.30	0	5
2	9.30	9.35	25	10.00	0	5
3	10.00	10.05	40	10.45	0	5
4	10.30	10.45	30	11.15	15	0
5	11.00	11.15	30	11.45	15	0
6	11.30	11.45	25	12.10	15	0
7	12.00	12.10	40	12.50	10	0
8	12.30	12.50	25	1.15	20	0
9	1.00	1.15	25	1.40	15	0
10	1.30	1.40	25	2.05	10	0
11	2.30	2.35	30	3.05	0	5
12	3.00	3.05	40	3.45	5	0
13	3.30	3.45	30	4.15	15	0
14	4.00	4.15	30	4.45	15	0
15	4.30	4.45	25	5.10	15	0
16	5.00	5.10	40	5.50	10	0
17	5.30	5.50	50	6.40	20	0
					180	20