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Research Article

OPTIMIZING THE PROCESS OF TIME MANAGEMENT IN THE MANNER OF PROVIDING SERVICE FOR CUSTOMERS OF DUAL PURPOSE FUEL STATIONS THROUGH THE QUEUE PRINCIPLE TECHNIC (CASE STUDY: ABBASI-GHANBARI DUAL PURPOSE FUEL STATION IN SHAHIN-DEJ CITY)

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ABSTRACT
The purpose of this research is to optimize the process of time management in terms of manner of providing services for customers of dual-purpose fuel stations through the queue principle technic. For modeling, the existing queue system is divided into two sections according to servicing time. First is the case in which the time of servicing the customer by the first service provider is equal to or longer than the second service provider; and the second is the case in which the time of servicing the customer from the second service provider is longer than the first service provider, in other words, the servicing time of the first person is shorter than the second person. Findings of the research indicate that the average number of total individuals in the queue is equal to five. At the level of 0.05 and through the application of Cochran's formula, the calculated sample is 151. The sampling method was a simple random sampling method. The average number of the entire people inside the system was 6 and the average waiting time for customers in queues was 12. The average waiting time in the system was 16 minutes. The possibility of having all the service providers in idle state is estimated as 27 percent which is referred to non-peak hours of fueling. The possibility of having all the service providers busy is also 45.4 percent which is related to the hours before noon. The number of customers who abandon receiving services is estimated as 5 individuals per hour which indicates that they have chosen another fuel station for refueling.

Keywords: *Waiting Time, Service Provider, Dual-Purpose Fuel Stations, Queue Principles*

INTRODUCTION
The theory of queue was started in 1909 with research projects of a Danish engineer named as E.K. Arleng (Klein, 1974). The theory of queue includes the mathematical study of waiting queues and random processes related to it. A queue system could be defined as customers who enter a system for receiving services and if the service is unavailable at the time, they will have to wait for it and after receiving their service, they will leave the system. In queue systems, customers and service providers (Server) are two ends of a queue. In queue theory, customer is a general expression which is incorporated for a being which enters a system for receiving a service. The mechanism which provides the customer with such a service is called the server or the service provider (Sekti *et al.,* 2003).
Formation of queue is naturally expensive. On one hand the organization has to provide customers with a space for waiting time. Therefore, the numbers of customers who are waiting in the queue to get serviced or the number of customers inside the system are considered as criterions for evaluation of the queue system. Customer's presence satisfaction has an inverse relation with his or her waiting time at the queue and it means that remaining of the customer in the queue, imposes the expense of losing a customer on the organization. Therefore the expense of waiting time at the queue and the time of receiving the service are important criterions of evaluation of the queue.
Results of various researches have proved the importance of queue technic. Momeni *et al.,* (2007) conducted a research titled as "evaluation of the queue system of employee-teller in Sepah Bank" and stated that with no doubts, not unlike other countries, Banks of Iran are considered as the most important intermediate instruments among financial organizations, and help the government in execution of its

monetary policies. Momeni and Esmaeilian (2007) issued a paper under the title of "Modeling of dynamicity of queue systems through the system dynamicity approach" and stated that the queue theory is the science of analysis and management of waiting lines. Queue theory is a branch of mathematics science which was developed during the beginnings of 20th century while studying telephone waiting lines. It should be considered that in humans are not present in all queue systems but in queue systems in which humans take part as providers of services, the queue system can be considered as a dynamic system; because in these types of systems the components of the system interact with each other and have more actions. In this paper, through the system dynamicity approach, a dynamic model of dynamics of a queue system is presented. In the view of Abed *et al.*, (2012) production institutes and service providing institutes should make use of queue technics for reducing the waiting time for their customers in order to in addition to defining the required resources for investing, obtain the maximum level of customer satisfaction. This issue is of extreme importance for survival of organizations in entirely competitive situations.

With respect to relative growth of consumption of fuel in Iran and also increased number of vehicles and cars, we have witnessed the growth in number of fuel stations throughout the country especially in large cities. Therefore the modeling of queue systems of fueling for analysis of performance of the system with respect to heavy investments for establishment of stations in large cities in terms of high costs of land and related facilities and equipment is a crucial issue.

The sorting of gas stations in our country is set in a way that vehicles are not provided with freedom of movement after their refueling is complete except for the first car in each row of refueling and this fact leads to increased servicing time and consequently increased waiting time for receiving services. The queue model of existing system includes a main line or queue which is formed outside the allocated space of the station and after passing an undetermined amount of time in the main queue, vehicles can enter subsidiary branches of the main queue. It is worth mentioning that the choice of each subsidiary branch or queue for the decision maker is based on the shortest subsidiary branch.

At the final step, they enter the refueling spot for refueling. In this system if both nozzles were idol, the person would use the first nozzle for refueling and if the first nozzle was busy, the person may choose the second nozzle. As long as the first person in the row is still busy with refueling, the second person is not able to leave the station even if his work is finished. Also in this system, if the second nozzle is busy and the first nozzle is idle, still the other vehicles in the row are not able to reach for the idle nozzle and refuel. Growth of city populations and in addition to this, increased number of vehicles and existence of a large number of worn-out vehicles, increased waiting times in traffic lines and fuel stations, increased number of urban travels and suburban trips, shortage of public transportation vehicles, lack of appropriate organization of urban utilities and lack of benefiting from up to date technologies have all made the increasing fuel consumption trend as a main challenge in our country in a way that in additions to streets and highways, we are witnessing long lines of traffic in fuel stations. The purpose of this research is to optimize the process of time management in terms of the manner of servicing the customers of dual-purpose fuel stations in the city of Shahin-Dej and we are also trying to answer this question: what elements are effective on optimization of the process of time management in terms of the manner of providing services for the customers of dual-purpose fuel stations and what is its' appropriate queue model?

MATERIALS AND METHODS

The present research is an applicable study and with respect to presence of dependent and independent variables and analysis of their effects on each other, the research method is descriptive and since we require calculation of time of customers' entrance and exit in addition to other effective elements, the type of research is survey. Since in this research we are required to measure the type and the required time of servicing and it is not practically possible to include all customers for these calculations, we are required to determine the sample size. In each hour, 10 customers go to each servicer. In the middle of this, we have to consider our calculations for 6 days of week and there are also a total number of four service providers. Therefore, the sample size was determined as 151 through the Cochran's formula via a simple random sampling method.

RESULTS AND DISCUSSION

Results

The Proposed Queue Model

In this system if both nozzles were idol, the person would use the first nozzle for refueling and if the first nozzle was busy, the person may choose the second nozzle. As long as the first person in the row is still busy with refueling, the second person is not able to leave the station even if his work is finished. Also in this system, if the second nozzle is busy and the first nozzle is idle, still the other vehicles in the row are not able to reach for the idle nozzle and refuel. The following figure provides a schematic view of fuel stations.

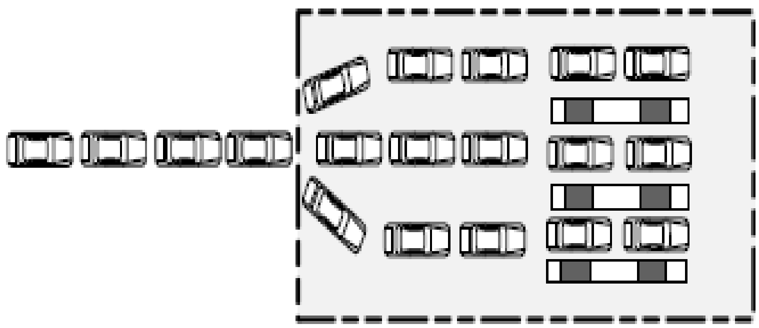

Figure 1: A schematic view of fuel station

As you can see, the upper queue system with respect to variable rate of servicing and existing physical limitations in the system cannot be analyzed via the existing models in queue system. Therefore, we suppose that customers enter the station according to the process of Pusan and λ parameter and that there are two service providers in each row and the time of service providing is a random variable with μ_i parameter. With respect to this point, practically the performance of each row is independent but similar to the performance of other rows. Therefore, at first, the existing queue system should be modeled according to two service providers with parameters of μ_1 and μ_2 respectively through chain concepts of Markov and definition of new parameters with expanded model of M/M/C and ultimately, the proposed model is expanded in I rows and the final model is then able to be extracted.

Final Analysis of the System

Analysis of Gas Station

Table 1: Information regarding the analyzed fuel station

title	parameter	First state value	Second state	Dual state	purpose
The average servicing time for the first nozzle	μ_1	3/1	2/8	2/95	
The average servicing time for the second nozzle	μ_2	4/1	3/4	3/75	
The average time between entrance of two parties into the system	λ	2/55			
Possibility of occurrence	θ_1, θ_2	48	52	100	
Number of existing gas stations	C	4			
Number of subsidiary branches	I	2			
Maximum capacity of each branch	n_i	2			

Considering that there are two branches in this station, the average servicing time for the first nozzle and the average servicing time for the second nozzle should be compared with the average time between the entrances of two parties into the system and if this distance is short, the station or the branch requires analysis. Since according to the aforementioned table, this value does not have a significant difference, it is required to analyze it. The importance of this issue lies in the problem that if we have λ μ>, then the queue limits towards infiniteness.

Analysis of Gas Stations via WINQSB 2.0

With respect to yielded data and through the application of dual-purpose model, the results of analysis of the existing system in a two-purpose row in long term are defined according the following table:

Table 2: Information regarding the analyzed fuel station

Title	Parameter	First state Value	Second state
Working rate	ρ	31/7	**34/0**
Possibility of lack of presence of anyone in the system	P_0	27/92	**49/25**
Average number of people in the queue	L_q	6	**4**
Average number of the people inside the system	L	9	**7**
Average waiting time at the queue		1/53	**2**
Average waiting time at the system	W	20	**18**

With respect to efficiency coefficient of 31% in the first state and the efficiency coefficient of 34% in the second state it can be stated that the system is not using its' entire potential. Here we can see that averagely there are 9 people in the waiting lines in first state and 7 people waiting in the line in the second state. These issues indicate the importance of the issue.

And finally through the table 5, and performance of possibility coefficients of and also the corrected entrance rate of, the final result of analysis of the system with two service providers according to the following table is equal to:

Table 3: Final analysis of the system

Title	Parameter	Value	Unit
Corrected entrance rate		2/55	Person per minute
Average number of total people in the queue		5	individuals
Average number of total people in the system		8	individuals
Average waiting time for people in the queue		2	individuals
Average waiting time for people in the system		3	minute
Possibility of having all the nozzles idle	Po	27/92	percent
Possibility of having all the nozzles busy	Pb	4/45	percent
Average number of customers who leave the queue	abb	3	individual

Findings of the research indicate that the average number of total people in the queue is equal to five individuals. The average number of the entire people inside the system is 8 and the average waiting time for people in the queue was 2. The average total waiting time for people inside the system is three minutes and the possibility of having all the nozzles idle is estimated as 27% which is related to non-peak hours of fueling. The possibility of having all the nozzles busy is estimated as 4.5 percent which is related to before noon hours. The number of customers who abandon the queue in each hour is equal to three individuals which indicate that they have chosen another station for refueling.

Analysis of CNG Station

Table 4: Information regarding the analyzed fuel station

Title	Parameter	First state value
Average servicing time from the first nozzle		7.55
Average servicing time from the second nozzle		7.64
Average time between two entrances to the system		2.26
Possibility of occurrence		-
Number of existing stations	*C*	2
Number of subsidiary branches	*I*	1
Maximum capacity of each branch		2

With respect to yielded data from the upper table and through the application of the combined model, the results of analysis of the existing system in a two purpose row in long term are defined according to the following table:

Table 5: Information regarding the analyzed fuel station

Title	Parameter	Value
Working rate		14.96
Possibility of lack of presence of anyone in the system		63.96
Average number of people at the queue		4.3
Average number of the people at the system	*L*	6
Average waiting time in the queue		12
Average waiting time in the system	*W*	16

With respect to efficiency coefficient of 14% it can be stated that the system is not using its' entire potential. And this value is far distant from 100%. Here it can be seen that averagely, there are 6 individuals waiting to receive services in a CNG fuel station and this indicates the importance of this issue.
Finally through the application of table (5) and performance of possibility coefficients of in addition to corrected entrance rate of, the final results of analysis of the system with two service providers according to the following table is equal to:

Table 6: Final analysis of the system

Title	Parameter	Value	Unit
Corrected entrance rate		2.26	Person per minute
Average number of total people in the queue		3.4	individuals
Average number of total people in the system		6	individuals
Average waiting time for people in the queue		12	individuals
Average waiting time for people in the system		16	minute
Possibility of having all the nozzles idle	Po	14.23	percent
Possibility of having all the nozzles busy	Pb	78.89	percent
Average number of customers who leave the queue	abb	5	individual

Findings of the research indicate that the average number of total people in the queue is equal to five individuals. The average number of the entire people inside the system is 6 and the average waiting time for people in the queue was 12. The average total waiting time for people inside the system is 16 minutes and the possibility of having all the nozzles idle is estimated as 14% which is related to non-peak hours of fueling. The possibility of having all the nozzles busy is estimated as 78 percent which is related to before noon hours. The number of customers who abandon the queue in each hour is equal to five individuals which indicate that they have chosen another station for refueling.

Discussion and Conclusions

The purpose of this research was to optimize the process of time management in terms of the manner of providing services for the customers of dual-purpose fuel stations through the queue principle technic in the city of Shahin-Dej. With respect to results of analyses of data we may conclude that the distribution of entrance rate of customers to the fuel station is under a negative visual distribution. With respect to the fact that there are two branches in this station, the customers' servicing time from the first nozzle and also customers' servicing time from the second nozzle should be compared with average time between entrances of two parties to the system. If this distance is short, the station or the branch requires further analyses. Since this value does not have a significant difference, then it needs to be discussed. The importance of this problem lies in the case that if we have μ>, then the queue limits towards infiniteness.

With respect to efficiency coefficient of 31% in the first state and the efficiency coefficient of 34% in the second state it can be stated that the system is not using its' entire potential. Here we can see that averagely there are 9 people in the waiting lines in first state and 7 people waiting in the line in the second state. These issues indicate the importance of the issue. Findings of the research indicate that the average number of total people in the queue is equal to five individuals. The average number of the entire people inside the system is 8 and the average waiting time for people in the queue was 2. The average total waiting time for people inside the system is three minutes and the possibility of having all the nozzles idle is estimated as 27% which is related to non-peak hours of fueling. The possibility of having all the nozzles busy is estimated as 4.5 percent which is related to before noon hours. The number of customers who abandon the queue in each hour is equal to three individuals which indicate that they have chosen another station for refueling.

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REFERENCES

Abedi Sadeg, Hamidi Naser and Porkhavan Mostafa (2011). modeling system possible Mhay queue using Markov chain with layout constraints. *Research Management Journal* **8**(22) 66-54.

Helms Marilyn (2006). *Encyclopedia of Management*, fifth edition.

Kleinrock Leonard (1975). *Queueing Systems* (A Wiley- Interscience Publication) **I** 22-28.

Momeni Mansour and Majid Ismailian (2006). Application of multi-criteria decision-making process simulation uncertainty. *Social Work* **10**(4) 251-231.

Momeni Mmansour, Farhad Matin Nafas and Ali moagar (2006). Line employee performance evaluation system of Bank Sepah between. *Knowledge Management* **19**(4) 131-111.

Seki Yoichi and Hoshino Naoto (2009). Transient behavior of a single-stage kanban system based on the queueing model. *International Journal of Production Economics* **1**(2) 369-374.