International Journal of Innovation Engineering and Science Research
(ISSN: 2581-4591)

www.ijiesr.com

Analysis and Evaluation of the Theory Queue Management in a Company Instrument Branch Musical

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ABSTRACT

The present work was carried October aiming to analyze the behavior of the queue in the productive system of a musical instrument company, established in the city of Leopoldina MG, associated with the tools of the Operational Research discipline. The research is based on Evaluating the FIFO queue management method and system deploying the SJF - NP in order to optimize the time in the production process. The results Showed que there was a better use of production with the SJF-NP system, with a decrease of 16.4 minutes, equivalent to 21.7% reduction in production team.

Keywords— *FIFO Queue Management, SJF-NP*

I. Introduction

Today, with the increasingly competitive market, it is increasingly common for companies seeking for new tools and methodologies to achieve best practice in their production processes. Using these strategies the organization can raise their profits and minimize costs generated by time spent in the production process. These generated optimizations allow greater clarity and agility in the supply chain can thus find a balance with little investment.

Therefore, it uses operational research to diagnose operational problems, activities and routine operations and production. The finding of a problem leads to scientific method of construction was carried out with data collection and mathematical calculations in search of a better solution to the problem encountered [1].

Among the problems are commonly encountered is the formation of queues. According to Almeida et al (2016) these are routine in establishments where there is a large flow of people and operations [2]. For the authors waiting in lines is something uncomfortable to customers and can bring the same discontent. In operations research, in search of the solution to that problem applies to the Theory of Queues, which according to Romero et. al (2010), is understood as a science that is intended to address issues involving the waiting time for customers to services demanded [3].

In this context, the queuing theory is a methodology that applies the steps of positioning which offers several models processes for training queues, in order to minimize the waiting time and maximize production capacity.

The aim of this paper is to analyze the methodology applied in the order of lines of production of a branch company of musical instruments, and assess through comparative statements and the performance achieved.

II. METHODOLOGY

This work was carried out a quantitative and descriptive research based on the case study method in a branch company of musical instruments, established in Leopoldina City, Zona da Mata Mineira.

According to Gil (2010) case study is a research methodology in the social sciences which is characterized by a detailed study of one or a few objects, allowing for ample notice and detailed study of the object in generating knowledge[4].

Data for this study were collected by on-site visits at the date of 11.11.2019, when the measurement of time spent for making order products given the company's service was held for further calculation and analysis of the management of existing queue .

Therefore, we used an actual service order designed the Art Finalist sector of the organization, which are finished products already reach semi finished the painting and production sectors. The measurement of time has been realized with the help of a timer, so that were timed continuously all stages of production, so as not to interfere with the routine production workers. idle times were not recorded as a pause for rest, bathroom, coffee and lunch.

After the survey data, with the aid of Excel software were carried out simulations of time of completion of that work order, in the FIFO and SJF-NP methods of managing queues, to perform comparison and analysis in order to determine the model to better attend the production sector.

III. THEORETICAL

A. Queuing Theory

In designing Krajewski (2012) the queue happens when you have an unstable disharmony between the degree of demand for a given system and the ability of this to meet this demand [5].

With early in the twentieth century, the theory of queues is set by applications in various areas, and known to be a mathematical study of lines or queues from arrival in the queue, past the waiting until serviced. For this fact, allows the calculation and the derivation of various performance measures, some of them: average waiting time in the queue or the system, estimate of expected or performance of the service and the likelihood waited for a while to be served [6].

According to Pereira et al. (2016) this theory works the system clogging problems where the main feature is the service request by "clients" [7]. To this end, the queuing theory depicts a procedure whereby its function, distribution of arrival and service, plus the number of servers, system capacity and the size of the population can be represented as follows for each model differing in some specific aspects [8].

Are elements of queues, according to Prado (2014):

“a) customer arrival process: one can quantify the arrival process saying that the average rate is a number of entities per unit of time. It is common to work with the average time between arrivals. Thus, the rate of arrival (λ) of 20 customers per minute, representing the average interval between arrivals (CI) 3/2;

b) care process: it can also be quantified, as of the arrival process. Thus resulting in the pace of service (μ) and service time (TA);

c) Discipline of the Line: refers to the rule that the servers choose the next customer to be served. In practice it is adopted: First in First Out (first come first served - FIFO), Last In First Out (last come first served basis - LIFO) and Priority;

d) The ability of a system: Represents the maximum number of clients that support system and may be finite or infinite. [9]”

Andrade (2011), the study of queuing theory allows the organization to build information and a standby time of estimation of its customers in line, still determines the size of the queue and the best system to be used to minimize the waiting and enhance production or service [10]. According to Perera et al (2014, p 12) "management of queues and their variability deserve attention from service providers because of its influence with respect to the customer, they represent much of the satisfaction with the quality of service.[11]" For the authors, the management of queues is necessary in that it prevents customer dissatisfaction and brings agility and versatility in production. Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

B. Instrument

Latin American percussion instrument, the cajón, which has its origin from African slaves passed through the improvement process in Peru for decades and was taken to Spain in the 70s to adapt to the needs and European musical costumes [12].

The instrument is played when the musician sits on it, where practicing strokes with hands hurt sounds, and when it hit the top of the front cover produces high tones and hitting the central lid produces the bass [13].

With friendly instrument, also known as "magic box" can produce the most diverse arrangements, from a simple melody to the accompaniment to a more elaborate drumming. The instrument, which received the Peruvian government the title of "Cultural Heritage of the Nation", has been used to monitor many more styles for acoustic performances [14].

IV. Results and Discussion

A. Case Study

The organization analyzed is a company located in the city of Leopoldina, the region of the forest zone of the state of Minas Gerais, whose main activity is the manufacture of drawer musical instrument.

The company is in business for five years and currently has 27 employees and has its highest sales volume by virtual means. In addition to the cajón the company manufactures accessories for the instrument and the instrument Drum Box Set, developed by hand, consisting of a battery derived from Cajon.

The option for the organization was motivated by the availability of the same to provide data / information and allow the observation and analysis of the production system and application of queuing theory in their activities.

B. Application of the Theory of queues

In order to analyze the operation of the queue management system in the production process of the organization under study, we used the Excel software to perform simulations, analysis and comparison across the table where they were related 05 corresponding products of a production order, as shown in Figure 1 below:

Figure 1: Production Order

Ordem de Produção Nº 2019/00336

Tipo de Produto: 04 - Produto Acabado

Família	Quantidade a Produzir	Unidade
<não informado>	48,0000 UN	Unidade (UN)

Itens da Ordem de Produção

Descrição do Item	Quantidade	Unidade	Tipo do Produto			
WDPA-0013 [redacted]	6,0000	UN	04 - Produto Acabado			
Descrição do Item	**Quantidade**	**Unidade**	**Tipo do Produto**			
WDPA-0032 [redacted]	20,0000	UN	04 - Produto Acabado			
Descrição do Item	**Quantidade**	**Unidade**	**Tipo do Produto**			
WDPA-0018 [redacted]	7,0000	UN	04 - Produto Acabado			
Descrição do Item	**Quantidade**	**Unidade**	**Tipo do Produto**			
WDPA-0047 [redacted]	3,0000	UN	04 - Produto Acabado			
Descrição do Item	**Quantidade**	**Unidade**	**Tipo do Produto**			
WDPA-0008 [redacted]	12,0000	UN	04 - Produto Acabado			

Outras Informações

Início da Produção: 11/11/2019
Conclusão da Produção: 11/11/2019

Source: Company analyzed

Figure 1 shows a real model of a usual production order within the company. As proposed by the study in this figure contains five (05) being manufactured products in industry Art finalist company indicating its description, quantity and type of product respectively.

For structuring the tables, the columns were found (Process) for the products to be produced (Home / Prod) for sequencing the queue to be produced (weight) for the quantities to be produced (Temp / MED) for time Average production for each product (Length) to the total time of production and (Priority) for products with greater relevance to be produced, as shown in figure 1.

Figure 2: Table basis for the simulations

							Desmembramento da Duração em minutos.													
							1	2	3	4	5	6	7	8	9	10	11	12	13	14
Processos	**Início/Prod.**	**Quantidade**	**Tempo Médio**	**Duração**	**Prioridades**	**Formula**														
PI - CAB	0	6	00:05:00	00:30:00	5															
P2 - VAS	1	20	00:02:30	00:50:00	2															
P3 - CAR	2	7	00:07:00	00:49:00	4															
P4 - SHA	3	3	00:03:00	00:09:00	1															
P5 - CAN	4	12	00:06:20	01:16:00	3															

Source: The author

Figure 2 shows the table structure that has been used to obtain the simulation where the criterion for filling and reading thereof is 1 minute counts for each column of time intended for production of products.

The first method was subjected to simulation FIFO, where the sequencing was performed and filling of the squares in the order of production according to the time taken to obtain each product. After all the fills were calculated duration in minutes (Dismemberment duration in Minutes), minus the total manufacturing time (duration) and early manufacturing (Home / Prod.). From the obtained results were calculated from the average of manufacturing times and the final result in the average manufacturing minutes (quantity - Average).

Figure 3: Simulation method FIFO

FIFO							Desmembramento da Duração em minutos.													
							1	30		32	81		83	131		133	141		143	218
Processos	Início/Prod.	Quantidade	Tempo Médio	Duração	Prioridades	Formula														
PI - CAB	0	6	00:05:00	00:30:00	5	0														
P2 - VAS	1	20	00:02:30	00:50:00	2	30														
P3 - CAR	2	7	00:07:00	00:49:00	4	80														
P4 - SHA	3	3	00:03:00	00:09:00	1	129														
P5 - CAN	4	12	00:06:20	01:16:00	3	138														
					QUANT -Média	75,4														

Source: The author.

Figure 3 shows as a result the average amount of 75.4 minutes to manufacture products of certain production order. For best performance in the table analysis, we packed up the squares of the minutes at longer intervals of time (only informing start and end time).

Then we carried out a simulation using the queue management system SJF-NP, started from the sequencing and filling the square, initially following the listed production order. Then filler was used as criterion, the most relevant products to be produced until the end of the manufacturing process. After all fills, as in the previous methodology, we calculated the duration in minutes (Dismemberment duration in Minutes), minus the total manufacturing time (duration) and early manufacturing (Home / Prod.). With the results were calculated the average of the manufacturing times and with the end result in the average minutes of manufacture (Quant - Average).

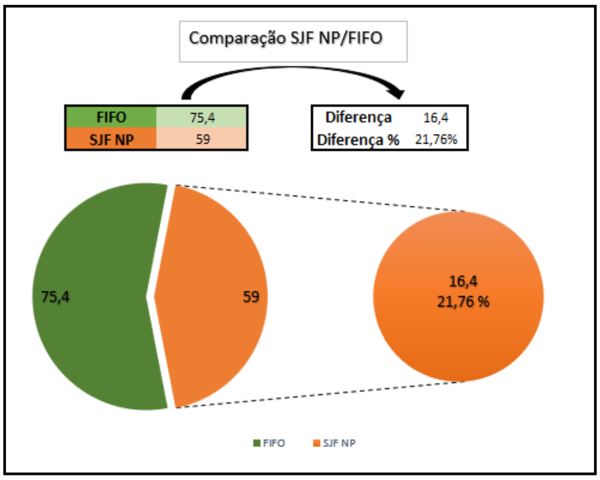
Figure 4: Simulation Methodology NP SJF

SJF NP							Desmembramento da Duração em minutos.													
							1	30		32	40		42	90		92	141		142	218
Processos	Início/Prod.	Quantidade	Tempo Médio	Duração	Prioridades	Formula														
PI - CAB	0	6	00:05:00	00:30:00	5	0														
P2 - VAS	1	20	00:02:30	00:50:00	2	90														
P3 - CAR	2	7	00:07:00	00:49:00	4	39														
P4 - SHA	3	3	00:03:00	00:09:00	1	28														
P5 - CAN	4	12	00:06:20	01:16:00	3	138														
					QUANT -Média	59														

Source: Author

Figure 4 shows the average amount as a result of 59 minutes to manufacture products of certain production order. For best performance in the analysis table, we used the same compression method as described in figure 2.

Figure 5: Comparison between the methods.



Source: Author

The data presented in Fig 5 are related to the results comparing the two methods used. In comparison it was observed that there was a decrease of 16.4 minutes in the production process, equivalent to 21.7% reduction in production time.

Thus, after analyzing for queue management, the tested methods, remains proven that the company and production in question the most effective method is the SJF NP due to optimization of time in the production process in its application.

V. Final Consideratios

The Operational Research aims to use one of its queue management theory of tools to optimize the management of time in production. The queue management allows the reduction of the waiting time in the queue, by optimizing the production process, thereby promoting certain agility in the production chain and avoiding the discomfort and dissatisfaction of customers waiting for products.

In the case study, analysis of the results of the application of simulations of the queue management methods, suggests the application of SJF-NP model, which according to the mathematical calculations promoted the optimization of the production system, which has succeeded in reducing 21.7 % in the average manufacturing time. Thus, it is evident that the objective proposed by the said work was achieved with the proposal of an ideal model for the management of queues in the company.

References

[1] HILLIER, Frederick. Stanford; Lieberman, Gerald J. Introduction to operational research. 9. ed. Porto Alegre: AMGH, 2013.

[2] ALMEIDA, Amanda Claunino; PINA, Gabriel Silva; LIMA, Lucas Erick Pereira; MONTEIRO, Robert Romano; SANTOS, Yvelyne Bianca Iunes. Application of the Theory of Queues in a bakery in the city of Belém / PA. Proceedings of the XXIII Production Engineering Symposium. Bauru - SP, 2016. Available at: <http://www.simpep.feb.unesp.br/abrir_arquivo_pdf.php?tipo=artigo&evento= 11 & art = 114 & cad = 22579 & option = com_id> Accessed on: 22.11.2019.J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.

[3] ROMERO, Camila Mendonça; SALES, Diego da Silva; VILAÇA, Luisa Lemos; CHAVEZ, Jose Ramon Arica; CORTES, Jacqueline Magalhães. Application of queuing theory on maximizing the flow of pallets in a chemical industry. Operations Research for Development, v.2, no.3, 2010, p.226-231.I.S. Jacobs and C.P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.

[4] GIL, Antonio Carlos. How to design research projects. 5th ed, São Paulo: Atlas, 2010K.

[5] Ritzman, Larry. P.; Krajewski, Lee. J. Administration of production and operations, 8th. ed. São Paulo: Pearson Prentice Hall, 2012.

[6] SANTOS, Paulo Henrinque;SILVA, Solange's; Bucchianeri, Juliano Resende; MATA, Nilson Oak; MORAIS, Thiago Moura.Analysis of the truck loading of a distribution center in Annapolis / GO: A study on modeling and simulation of M queuing systems / M / 1, comparing the analytical model to the simulated model. Proceedings of XLIX Symposium of Operational Research Blumenau-SC 27 to August 30, 2017.. J. Magn. Japan, vol. 2, pp. 740-741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].

[7] Pereira, Lucio Adan et al. Analysis of Congestion Problems of a Steel Plant Canteen. Brazilian Journal of Production Engineering-BJPE, v. 2, no. 1, p. 53-71, 2016.M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

[8] Merelles, Leonardo RO; Dantas, Maria JP; Menezes, Jose E .; Dias, S. Vivianequality control of the application to determine the heating period in simulation queues. Proceedings of XLIX Brazilian Symposium on Operations Research, Blumenau-SC 27 to August 30, 2017.

[9] PRADO, Darci. Queues theory and simulation. 5th ed. Falconi, 2014

[10] ANDRADE, Eduardo Leopoldina. Introduction to Operations Research: Methods and models for decision analysis. 4. ed. Rio de Janeiro: LTC 2011.

[11] PEREIRA, Ricardo Fazionato; SOARES Lorena Paula; GONÇALVES, Rafaela. Queue management: a case study of a company providing outsourced service in the digital printing industry.XXXIV NATIONAL PRODUCTION ENGINEERING MEETING, Curitiba, 2014. Available at: http://www.abepro.org.br/biblioteca/enegep2014_TN_STP_195_101_24487.pdf. Accessed on 20/11/2019

[12] EL CAJON Peruvian. Available in http://www.musicaperuana.com/cajon/ access 11.08.2019

[13] FAT CONGAS: Available at <http://www.fatcongas.com/Product_Review.html>. Accessed on 11/08/2019.

[14] WITLER DRUMS. Available in: https://www.cajonwitlerdrums.com.br/pagina.php?info_id=11. Accessed: 10/11/2019