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In Number is presented an article *Optimization of import transfers from a customs bonded warehouse using a server model* by NUÑEZ-PEREZ, F.A. & ESCOTO-SOTELO, E.A. with adscription at Universidad Politécnica de Lázaro Cárdenas, in the next article *Productive potential to contribute to food sovereignty througth technolgy packages generated by INIFAP* by MOCTEZUMA-LÓPEZ, Georgel, ROMERO-SÁNCHEZ, Martín Enrique, GONZÁLEZ-HERNANDEZ, Antonio and PÉREZ-MIRANDA, Ramir with adscription at INIFAP, in the next article *Elements to consider the video game as a support tool in the university classroom* by GONZÁLEZ-NERI, Aarón Iván, PÉREZ-BRAVO, Julia, ARELLANO-ROCHA, Francisco Javier and VILLARREAL-ALCALDE, Jorge Gabriel with adscription in Universidad Autónoma de Querétaro, in the next article, *Productivity of the millennial generation in institutions of higher education*, by NAVARRO-HERNANDEZ, Ana Rosa & CASTRO-VALENCIA, Alberto Merced, with adscription at Universidad Autónoma de Guadalajara.

Content

Article   **Page**

Optimization of import transfers from a customs bonded warehouse using a server model

Optimización de transferencias de importación de un recinto fiscalizado aplicando un modelo de servidores

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Abstract

It is currently necessary to implement proposals that reduce service level times in the area of customs control. For this it is necessary to carry out a study of mathematical models that adapt to the reduction of possible problems. Once an appropriate predictive pattern is found, it is necessary to carry out an implementation to find the best option allowing to obtain a continuous flow of service, achieving optimal scaling. But above all achieving a better control in all the processes developed with better fluidity in the input and output modules and in the operational area.

Optimization, Mathematical models, Customs

Resumen

En la actualidad es necesario implementar propuestas que disminuyan los tiempos de nivel de servicio en el área de control de aduanas. Para ello es necesario realizar, un estudio de modelos matemáticos que se adapten al abatimiento de posibles problemas. Una vez de encontrar un patrón predictivo apropiado, es necesario llevar a cabo una implementación para encontrar la mejor opción permitiendo obtener un flujo continuo de servicio, alcanzando un óptimo escalamiento. Pero sobre todo alcanzando un mejor control en todos los procesos desarrollados con una mejor fluidez en los módulos de entrada como de salida y en área operativa.

Optimización, Modelos matemáticos, Aduanas

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Introduction

The inspected enclosures are concessions granted by the tax administration service, with the objective of having an adequate service that involves the handling, storage and custody of merchandise. The case study reported in this project was carried out in the audited premises 199 and 221 according to appendix 6 of the customs law. Attached to customs law, site 221 provides the following services: Loading / unloading of merchandise from ship to ship side or vice versa. Shipment of merchandise from ship side to storage area. Delivery / receipt of merchandise from storage area by means of transport or vice versa (rail or truck), examinations of goods (prior), deconsolidation, consolidation, labeling and conservation of goods. With the knowledge of the cause of the multiple services listed, a search for the optimization of the audited area was performed, analyzing the following optimization models:

Optimization models

Queue theory: is responsible for the mathematical analysis of the phenomena of waiting lines or queues. These types of models are frequently presented when a service is requested by a series of clients and both the service and the customers are probabilistic. The study of the waiting lines tries to quantify the phenomenon of waiting in queues, through representative measures of efficiency, such as the average length of the queue, the average waiting time in it, as well as the average use of the facilities.

Elements of a queue model: the main actors in a queue situation are the client and the server. Clients arrive at an installation (service) from a source. Upon arrival, a customer can be serviced immediately or wait in a queue if the facility is busy. When an installation completes a service, it automatically "pulls" a customer who is waiting in the queue, if any. From the point of view of queue analysis, the arrival of customers is represented by the time between arrivals (time between successive arrivals), and the service is measured by the service time per customer. Usually, the time between arrivals and service are probabilistic or deterministic.

The size of the tail plays a role in queue analysis. It can be finite, for all practical purposes, infinite. Queue discipline represents the order in which customers are selected in a queue. This factor is of great importance in the analysis of queue models. Having the following disciplines.

A) The first to arrive is the first to be attended (the most common).

B) The last to arrive is the first to be served.

C) The service in random order.

D) Select customers from the queue, based on some order of priority.

Queue behavior plays a role in the analysis of waiting lines. Customers can switch from a longer to a shorter queue to reduce the waiting time, they can stop queuing due to the long anticipated delay, or get out of a queue because they have been waiting too long.

The service installation design may include parallel servers. They can also be arranged in series or arranged in a network. The source from which customers are generated can be finite or infinite. A finite source limits the number of customers that arrive. An infinite source is, for all practical purposes, forever abundant.

A queue system is specified by six main features:

* The type of distribution of tickets or arrivals (time between arrivals).

* The type of distribution of exits or withdrawals (service time).

* The service channels.

* The discipline of service.

* The maximum number of clients allowed in the system.

* The source or population.

The objectives of queue theory consist of:

- Identify the optimal level of system capacity that minimizes its overall cost.

- Evaluate the impact that the possible alternatives for modifying the capacity of the system would have on its total cost.

- Establish a balanced ("optimal") balance between quantitative considerations of costs and qualitative considerations of service.

- Pay attention to the time spent in the system or in the queue: the "patience" of customers depends on the type of specific service considered and that can cause a customer to "leave" the system.

Role of exponential distribution

In most queuing situations, arrivals occur randomly. Randomness means that the occurrence of an event (for example, the arrival of a customer or the termination of a service) is independent of the time elapsed since the occurrence of the last event. Random times between arrivals and service are quantitatively described by means of an exponential distribution, which is defined as Eq. (1).

$$f(t) = \sum_{k=0}^{n} \lambda e^{-\lambda t}, t > 0 \qquad (1)$$

For exponential distribution Eq. (2)

$$E\{t\} = 1/\lambda \qquad (2)$$

$$P\{t \le T\} = \int_0^T \lambda e^{-\lambda t}\, dt = 1 - e^{-\lambda T}$$

The definition of E (t) shows that it is the rate per unit of time at which events (arrivals or departures) are generated. The exponential distribution describes a totally random phenomenon. For example, if the time is now 8:20 AM. Whereas the last arrival was at 8:02 AM. The probability that the next arrival will occur at 8:29 is a function only of the interval from 8:20 to 8:29, and is totally independent of the time that has elapsed since the occurrence of the last event (8:02 a 8:20 AM). The totally random property of the exponential is known as forgetfulness or lack of memory. Since f (t) is the exponential distribution of time t, between successive events (arrivals), if S is the interval from the occurrence of the last event, then the forgetfulness property implies that:

$$P\{t > T + S | t > S\} = P\{t > T\} \qquad (3)$$

To verify this result, we observe that for the exponential with mean $1 / \lambda$, Eq. (4).

$$P\{t > Y\} = 1 - P\{t < Y\} = e^{-\lambda Y} \qquad (4)$$

Therefore:

$$P\{t > T + S | t > S\} = \frac{P\{t > T+S, t > S\}}{P\{t > S\}} = \frac{P\{t > T+S\}}{P\{t > S\}}$$

$$= \frac{e^{-\lambda(T+S)}}{e^{-\lambda S}} = e^{-\lambda T}$$
$$= P\{t > T\}$$

Pure birth and death models (relationship between exponential and poisson distribution)

This section presents two queue situations, the pure birth model in which only arrivals occur, and the pure death model in which only exits occur. An example of the pure birth model is the creation of birth certificates of newborn babies. The model of pure death can be demonstrated through the random withdrawal of an item in existence in a store. The exponential distribution is used to describe the time between arrivals in the pure birth model and the time between exits in the pure death model. A byproduct of the development of the two models is to demonstrate the close relationship between the exponential distribution and that of Poisson, in the sense that one distribution automatically defines the other.

Pure birth model

Only arrivals occur.

Define: P0 (t): probability that no arrivals will occur during a period of time t. Since the time between arrivals is exponential and the arrival rate is λ clients per time unit, then: Eq. (5)

$$P0(t) = P\{ \text{time between arrivals} \ge t\} \qquad (5)$$

$$= 1 - P\{time\ between\ arrivals \le t\}$$

$$= 1 - (1 - e^{-\lambda t})$$

For a sufficiently small time interval $h > 0$, we have: Eq. (6)

$$P0(h) = e^{-\lambda h} = 1 - \lambda h + \frac{(\lambda h)^2}{2!} - \cdots = 1 - \lambda h + 0(h^2) \quad (6)$$

The exponential distribution is based on the assumption that during h> 0, when much an event (arrival) may occur. Therefore, as $h \to 0$, Eq. (7)

$$P1(h) = 1 - P0(h) \approx \lambda h \qquad (7)$$

This result shows that the probability of an arrival during h is directly proportional to h, with the arrival rate, λ, as a constant of proportionality. To derive the distribution of the number of arrivals during a period t when the time between arrivals is exponential with average $1 / \lambda$, define:

$Pn(t)$ = Probability of n arrivals during t. For a h> 0 small enough, Eq. (8).

$$Pn \text{ (t+ h)} \approx Pn \text{ (t) (1-}\lambda h) + Pn \text{ -1 (t)}\lambda h, n > 0 \qquad (8)$$

$$Po \text{ (t + h)} \approx P0 \text{ (t) (1- } \lambda h), \qquad\qquad n=0$$

In the first equation there will be n arrivals during t + h if there are n arrivals during t and no arrival during h, or n - 1 arrivals during t and one arrival during h. not all other combinations are allowed because, according to the exponential distribution, at most there may be an arrival during a very small period h. The law of the product of probabilities is applicable to the right side of the equation because arrivals are independent. As for the second equation, during t + h there can be 0 arrivals only if there are no arrivals during t and h. Rearranging the terms and taking the limits as h → 0 to obtain the first derivative of Pn (t) with respect to t, we have:

$$P'n(t) = \frac{\lim\limits_{h \to 0} Pn(t+h) - Pn(t)}{h} = -\lambda Pn(t) + \lambda Pn - 1(t), n > 0$$

$$P'0(t) = \frac{\lim\limits_{h \to 0} P0(t+h) - P0(t)}{h} = -\lambda P0(t), \; n = 0$$

The solution of the above differential equations gives Eq. (9)

$$Pn(t) = \frac{(\lambda t)^n e^{-\lambda t}}{n!}, n = 0,1,2,\dots \qquad (9)$$

This is a poisson distribution with mean E {n | t} = λt of arrivals during t. The previous result shows that, if the time between arrivals is exponential with average 1 / λ, then the number of arrivals during a specific period t is Poisson with average λt. The opposite also works. The following table summarizes the relationships between the exponential distribution and Poisson, given the arrival rate λ:

Pure death model

In the model of pure death, the system starts with N clients at time 0, with no new arrivals allowed. Departures occur at the rate of m customers per unit of time. To develop the differential equations of the probability Pn (t) that n clients remain after t units of time, we follow the arguments used with the pure birth model. Thus,

$$PN(t + h) = PN(t)(1 - \mu h)$$
$$PN(t + h) = PN(t)(1 - \mu h)$$
$$Pn(t + h) = Pn(t)(1 - \mu h) + Pn + 1(t)\mu h, 0 < n < N$$
$$P0(t + h) = P0(t)(1) + P1(t)\mu h$$
As h → 0, we get
$$P'N(t) = -\mu PN(t)$$
$$Pn(t + h) = Pn(t)(1 - \mu h) + Pn + 1(t)\mu h, 0 < n < N$$
$$P'0(t) = \mu P1(t)$$

The solution of these equations gives the following truncated Poisson distribution Eq (10):

$$Pn(t) = \frac{(\mu t)^{N-n} e^{-\mu t}}{(N-n)!}, n = 1,2,\dots,N \qquad (10)$$

$$P0(t) = \sum_{n-1}^{N} Pn(t)$$

General Tail Model of Poisson

In this model, arrivals and departures are combined based on Poisson's assumption, that is, times between arrivals and service times follow the exponential distribution. The development of the model is based on the long-term or steady-state behavior of the queue situation, achieved after the system has been in operation for a sufficiently long time. This type of analysis contrasts with the transient (or heating) behavior that prevails during the start of the system operation.

The general model assumes that both entry and exit rates depend on the state; which means that they depend on the number of customers in the service installation. For example, in a toll booth on a highway, managers tend to accelerate the collection of fees during peak hours. Define:

n = number of customers in the system (queuing, in addition to those being served).

Λn = arrivals rate, if n customers are the system.

Mn = Departure rate, if n customers are in the system.

Pn = stable status probability that n customers are in the system.

The general model derives Pn as a function of λn and μn. These probabilities are then used to determine the performance measures of the system, such as the average queue length, the average waiting time, and the average utilization of the installation. The probabilities Pn are determined by means of the transition rate diagram. The queue system is in state n when the number of clients in the system is n. for n> 0, the state n can change only to two possible states: n - 1 when an output occurs at the rate of μn, and n + 1 when an arrival occurs at the rate of λn. State 0 can only change to state 1 when an arrival occurs at the rate of λ0. Note that μ0 is undefined because no outputs can occur if the system is empty. Under steady state conditions, for n> 0, the expected rates of inflows to and from state n must be equal. Based on the fact that state n can change only to states n - 1 and n + 1, we have: (Expected input flow rate to the state) = λn - 1Pn - 1 + μn + 1Pn + 1 Also, (Expected output flow rate of state n) = (λn + μn) Pn By matching the two rates, we get the following balancing equation Eq. (11).

$$\lambda n - 1Pn - 1 + \mu n + 1Pn + 1 = (\lambda n \; + \; \mu n)Pn, n = 1,2 \dots \quad (11)$$

The balancing equation associated with n = 0 is

$$\lambda 0P0 = \; \mu 1P1$$

The balancing equations are solved recursively as a function of P0. For n = 0, we have: Eq. (12)

$$P1 = \left(\frac{\lambda 0}{\mu 1}\right) P0 \qquad (12)$$

Then, for n = 1, we have: Eq. (13)

$$\lambda 0P0 + \mu 2P2 = (\lambda 1 + \mu 1)P1 \qquad (13)$$

Then, for n = 1, we have Substituting P1 = (λ0 / μ0) P0 and simplifying, we obtain Eq. (14):

$$P2 = \left(\frac{\lambda 1\lambda 0}{\mu 2\mu 1}\right) P0 \qquad (14)$$

We can demonstrate by induction that Eq. (15)

$$Pn = \left(\frac{\lambda n-1\lambda n-2\dots\lambda 0}{\mu n\mu n-1\dots\mu 1}\right) P0, n = 1,2, \dots \qquad (15)$$

The value of P0 is determined with the equation Eq. (16)

$$\sum_{n=0}^{\infty} Pn = 1 \qquad (16)$$

Specialized Poisson Tails

In the situation of specialized Poisson queues with c parallel servers. A client is selected from the queue to start the service with the first available server. The rate of arrivals to the system is λ clients per time unit. All parallel servers are identical, that is, the service rate of any server is μ clients per unit of time. The number of customers in the system is defined to include those in the service and those in the queue. A convenient notation to summarize the characteristics of the queue situation is given by the following format:

(a/b/c): (d/e/f)

Where:

a = arrivals distribution.

b = distribution of outputs (service time).

c = number of parallel servers.

d = line discipline.

e = maximum number (finite or infinite) allowed in the system (queuing or in service).

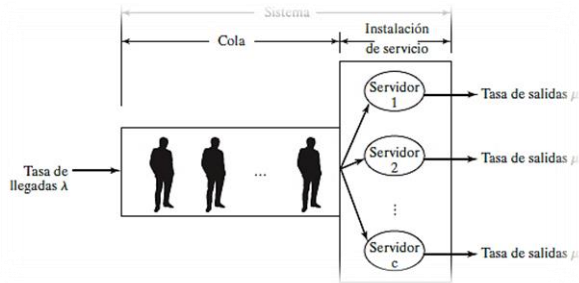f = Requesting font size (finite or infinite).

Figure 1 Schematic representation of a queue system with c parallel servers

As can be seen in figure two, it is a clear example of how a multi-server system works.

The standard notation to represent the distributions of arrivals and departures (symbols a and b) is:

M = Markovian (or Poisson) distribution of arrivals and departures (or equivalently exponential distribution of time between arrivals and service).

D = Constant time (deterministic).

Ek = Erlang distribution or time range (or equivalently, the sum of independent exponential distributions).

GI= General (generic) distribution of time between arrivals.

G = General (generic) distribution of service time.

The notation for queuing discipline (symbol d) includes:

FCFS = First to arrive, first to be served.

LCFS = Last to arrive, first to be served.

SIRO = Service in random order.

GD = General discipline (ie, any type of discipline).

To illustrate the use of the notation, the model (M / D / 10): (GD / 20 / q) uses Poisson arrivals (or time between exponential arrivals), constant service time, and 10 parallel servers. The discipline in queues is GD, and there is a limit of 20 clients throughout the system.

The font size from which customers arrive is infinite.

As a historical note, the first three elements of the notation (a / b / c) were devised by D.G. Kendall in 1953, and they are known in the literature as Kendall's notation. In 1966, A.M. Lee added the symbols d and e to the notation. This author added the last element, the symbol f, in 1968.

Measures of steady state performance

The most commonly used performance measures in a queue situation are:

Ls = Expected number of customers in a system.

Lq = Expected number of customers in a queue.

Ws = Timeout in the system.

Wq = Early waiting time in the queue.

$\hat{C}$ = Expected number of busy servers.

Remember that the system includes both the queue and the service facilities. We now demonstrate how these measurements are derived (directly or indirectly) from the probability of a stable state of n in the pn system as Eq. (17)

$$Ls = \sum_{n-1}^{\infty} npn \qquad (17)$$

Eq. (18)

$$Lq = \sum_{n=c+1}^{\infty}(n-c)Pn \qquad (18)$$

The relationship between Ls and Ws (also between Lq and Wq) is known as Little's formula and is given as Eq. (19):

$$Ls = \lambda efec W_s \qquad (19)$$

Eq. (20)

$$Lq = \lambda efec W_q \qquad (20)$$

These relationships are valid under rather general conditions. The λefec parameter is the effective arrival rate to the system. It is equal to the arrival rate λ (nominal) when all arriving customers can join the system. Otherwise, if some clients cannot join because the system is full (for example a parking lot), then λefec <λ. Later we will demonstrate how λefec is determined. There is also a direct relationship between Ws and Wq. By definition (Early waiting time in the system) = (early waiting time in the queue) + (operating time operated).

This translates as Eq. (21):

Ws= Wq + 1/μ   (21)

Then we can relate NO to La by multiplying both sides of the last formula by λefec, which together with the Little da formula: Eq. (22)

Ls = Lq + λefec/ μ   (22)

The difference between the average amount in the system, Ls, and the average amount in the queue, Lq must be equal to the average number of servers occupied. Thus Eq. (23)

$$\hat{c} = Ls - Lq = \frac{\lambda efec}{\mu}$$ (23)

Se deduce que (Installation use) = ĉ/c.

Single Server Models

Two models are presented for the case of a single server (c = 1). The first model does not limit the maximum number in the system, and the second represents a finite system limit. Both models assume an infinite capacity of the source. Arrivals occur at the rate of λ clients per unit of time and the service rate is μ clients per unit of time. **(M/M/1): (GD/q/q).** Using the general model notation, we have

$$\begin{matrix} \lambda n = \lambda \\ \mu n = \mu \end{matrix}\}, n = 0,1,2, \dots$$

Even, λefec = λ and λ lost = 0, because all clients can join the system.

If p = λ / μ, the expression for Pn in the generalized model is reduced to
$$Pn = p^n P0, n = 0,1,2, \dots$$

To determine the value of p0 we use the identity Eq. (24)

$$p0(1 + p + p2 + \cdots) = 1$$ (24)

The sum of the geometric series is (1 / 1-p), provided that p <1. Therefore $P0 = 1 - p, p < 1$ Consequently, the following geometric distribution gives the general formula for pn Eq. (25)

$$Pn = (1 - p)p^n, n = 1,2, \dots (p < 1)$$ (25)

The mathematical derivation of pn imposes the condition p <1, or λ <μ. If λ ≥ λ, the geometric series diverges, and the steady state probabilities pn do not exist. This result makes intuitive sense, because unless the service rate is greater than the arrival rate, the length of the queue will continue to grow and no stable state can be reached. The performance measure Lq is derived as follows Eq. (26):

$$Ls = \sum_{n=0}^{\infty} nPn = \sum_{n=0}^{\infty} n (1 - p)p^n$$ (26)

$$= (1 - p)p \frac{d}{dp} \sum_{n=0}^{\infty} p^n$$

$$= (1 - p)p \frac{d}{dp} \left(\frac{1}{1-p}\right) = \frac{p}{1-p}$$

(M/M/1): (GD/N/∞). This model differs from (M / M / 1): (GD / q / q) in that there is a limit N on the number in the system (maximum queue length = N - 1). Some examples include manufacturing situations where a machine can have a limited intermediate space and a service window in your car in a fast food restaurant. New arrivals are not allowed when the number of customers in the system reaches N. Therefore,
$$\lambda n = \begin{cases} \lambda, & n = 0,1, \dots, N - 1 \\ 0, & n = N, N + 1 \end{cases}$$
$$\mu n = \mu, \ n = 0,1, \dots$$

Using p = λ / μ, the generalized model of the section gives:

$$n = \begin{cases} p^n p0, & n \leq N \\ 0, & n > N \end{cases}$$

The value of p0 is determined from the equation $\sum_{n=0}^{\infty} Pn = 1$, which gives Eq. (27)

$$P0(1 + p + p^2 + \cdots + p^N) = 1$$ (27)

O Eq. (28)

$$Pn \begin{cases} \frac{(1-p)p^n}{1-p^{N+1}}, p \neq 1 \\ \frac{(1-p)p^n}{1-p^{N+1}}, p = 1 \end{cases}, n = 0,1,\dots,N \qquad (28)$$

The value of $p = \lambda / \mu$ does not have to be less than 1 in this model, because the limit N controls the arrivals to the system. This means that λefec is the rate that matters in this case. Because customers get lost when there is N in the system, then,

$$\lambda perdida = \lambda pn$$
$$\lambda efec = \lambda - \lambda perdida = \lambda(1 - PN)$$

In this case, λefec $<\mu$.

The expected number of customers in the system is calculated as: Eq. (29)

$$Ls = \sum_{n=0}^{N} nPn \qquad (29)$$

$$= \frac{1-p}{1-p^{N+1}} \sum_{n=0}^{N} np^n$$

$$= \left(\frac{1-p}{1-p^{N+1}}\right) p \frac{d}{dp} \sum_{n=0}^{N} p^n$$

$$= \frac{(1-p)p}{1-p^{N+1}} \frac{d}{dp}\left(\frac{1-p^{N+1}}{1-p}\right)$$

$$= \frac{p[1-(N+1)P^N + Np^{N+1}]}{(1-p)(1-p^{N+1})}, p \neq 1$$

Multi-server models

Three queue models with several parallel servers are considered. The first two models are the versions of several servers. The third model deals with the case of self-service, which is equivalent to having an infinite number of parallel servers. (M/M/c):(GD/∞/∞). This model deals with c identical parallel servers. The arrival rate is λ and the service rate per server is μ. In this situation λefec = λ because there is no limit on the number present in the system.

The effect of using c parallel identical servers is a proportional increase in the service rate of the installation. In terms of the generalized model, λn and μn are therefore defined as:

$$\lambda n = \lambda, \ n \geq 0$$
$$\mu n = \begin{cases} n\mu, \ n < c \\ c\mu, \ n \geq c \end{cases}$$

So, Eq. (30)

$$Pn = \begin{cases} \frac{\lambda^n}{\mu(2\mu)(3\mu)\dots(n\mu)}P0 = \frac{\lambda^n}{n!\mu^n}Po = \frac{p^n}{n!}P0, & n < c \\ \frac{\lambda^n}{(\Pi_{i=1}^{c} i\mu)(c\mu)^{n-c}}P0 = \frac{\lambda^n}{c!c^{n-c}\mu^n}Po = \frac{p^n}{c!c^{n-c}}P0, & n \geq c \end{cases} \qquad (30)$$

If $p = \lambda / \mu$, and assuming that $p / c <1$, the value of p0 is determined from, $\sum_{n=0}^{\infty} pn = 1$ which gives, Eq. (31)

$$P0\left\{\sum_{n=0}^{c-1} \frac{p^n}{n!} + \frac{p^c}{c!}\sum_{n=0}^{\infty}\left(\frac{p}{c}\right)n - c\right\} - 1$$
$$= \left\{\sum_{n=0}^{c-1} \frac{p^n}{n!} + \frac{p^c}{c!}\left(\frac{1}{1-\frac{p}{c}}\right)\right\} - 1, \frac{p}{c} < 1 \qquad (31)$$

The expression for Lq is determined as follows Eq. (32):

$$Lq = \sum_{n=c}^{\infty}(n - c)Pn \qquad (32)$$

$$= \sum_{k=0}^{\infty} kPk + c$$
$$= \sum_{k=0}^{\infty} k \frac{p^{k+c}}{c^k c!}P0$$
$$= \frac{p^{c+1}}{c!c}P0 \sum_{K=0}^{\infty} K\left(\frac{p}{c}\right)k - 1$$
$$= \frac{p^{c+1}}{c!c}P0 \frac{d}{d\left(\frac{p}{c}\right)}\sum_{K=0}^{\infty}\left(\frac{p}{c}\right)k$$
$$= \frac{p^{c+1}}{(c-1)!(c-p)^2}Po$$

Because λefec = λ, Ls = Lq + p. The measures Ws and Wq are determined by dividing Ls and Lq by λ.

Methodology

In order to meet the main objective of the project, it was first described the processes that are carried out related to container transfers and the customs control area. Below is a table representing the number of transfers made from January to December for four years.

Year	July	Aug	Sep	Oct	Nov	Dec
2018	115	90	171	142	224	248
2017	45	88	47	29	51	52
2016	137	95	25	31	181	90
2015	95	70	85	110	102	97
Total	392	343	328	312	558	487
Year	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2018	239	224	247	578	0	0
2017	46	90	156	112	119	124
2016	105	78	40	91	69	64
2015	113	139	229	247	254	127
Total	503	531	672	1028	442	315

Table 1 List of transfers made during 4 years

On the other hand, it was also necessary to observe the distribution of the containers in the yard, or, in the warehouse in case they required a service requested by the customer. They are stowed as follows:

- Three tall containers.

- They accommodate for days.

When they are downloaded to the warehouse they are distributed as follows:

- 13 containers per ship.

- They are placed from ship one to three for any service to perform.

The transfer time per container is 40 minutes to 1 hour depending on the position in which the container is located in the terminal from which it will be sent. A tract can transfer two 20-foot containers on its flat. A unit lasts in the module five minutes, which is what it takes to register:

- Check container seal against article 15.

- It is linked to the reference.

- Income and notification of sicrefis.

Based on the research carried out, it was found that the main problem is originated in the transfer of transfers normally for the entry of a unit takes half an hour to forty minutes but lately it took more than an hour to transfer a container and an increase of Containers which generated more time and more costs to customers so it was decided to implement the model of a single server and several servers to observe the level of service and observe the profitability of the company. The single server model will be used. It was applied to the following times.

Single server model

Model applied at forty minutes

We will convert the minutes to hours.

$$X = \frac{5\ minutes * 1\ hour}{60\ minutes} = \frac{5\ hours}{60} = 0.08\ hours.$$

$$X = \frac{40\ minutes * 1\ hour}{60\ minutes} = \frac{40\ hours}{60} = 0.66\ hours.$$

$$\lambda = \frac{1}{0.66\ h} = 1.5 \approx 2\ units.$$

$$\mu = \frac{1}{5\ min.} = 0.20\frac{units}{min}\left(\frac{60\ min}{hour}\right) = 12\ units\ per\ hour.$$

A)   Average number of units in the system.

$$Ls = \frac{\lambda}{\mu-\lambda} = \frac{2}{12-2} = \frac{2}{10} = 0.2 \approx 0\ units.$$

B)   Total time consumed by a unit in the module.

$$Ws = \frac{1}{\mu-\lambda} = \frac{1}{12-2} = \frac{1}{10} = 0.1\ hour.$$

C)   System Usage Factor.

$$p = \frac{\lambda}{\mu} = \frac{2}{12} = 0.166 * 100 = 16.6\%$$

D)   Average number of units queuing.

$$Lq = \frac{\lambda^2}{\mu(\mu-\lambda)} = \frac{2^2}{12(12-2)} = \frac{4}{120} = 0.03 \approx 0\ units.$$

E)   Probability that the module is empty.

$$po = 1 - p = 1 - 0.166 = 0.833 * 100 = 83.3\%$$

F)   Probability that two units are found in the system.

$$P2 = (1 - 0.1666)(0.1666)2 = 0.023 * 100 = 2.31\%$$

G)   Time in which customers wait in line.

$$Wq = \frac{\lambda}{\mu(\mu-\lambda)} = \frac{2}{12(12-2)} = \frac{2}{120} = 0.01666666 * 60 = 1\ minute.$$

Model applied in half an hour

We will convert the minutes to hours

$$X = \frac{5\ minutes * 1\ hour}{60\ minutes} = \frac{5\ hours}{60} = 0.08\ hours.$$

$$X = \frac{30\ minutes * 1\ hour}{60\ minutes} = \frac{30\ hours}{60} = 0.50\ hours.$$

$$\lambda = \frac{1}{0.50\ h} = 1.5 \approx 2\ units.$$

$$\mu = \frac{1}{0.08\ h} = 13\ units\ per\ hour.$$

A)   Average number of units in the system

$$Ls = \frac{\lambda}{\mu-\lambda} = \frac{2}{13-2} = \frac{2}{11} = 0.18 \approx 0\ units.$$

B)   time consumed by a unit in the module.

$$Ws = \frac{1}{\mu - \lambda} = \frac{1}{13-2} = \frac{1}{11} = 0.09 \; hour.$$

C)   System Usage Factor.

$$p = \frac{\lambda}{\mu} = \frac{2}{13} = 0.1538 * 100 = 15.38\%$$

D)   Average number of units queuing.

$$Lq = \frac{\lambda^2}{\mu(\mu-\lambda)} = \frac{2^2}{13(13-2)} = \frac{4}{143} = 0.027 \approx 0 \; units.$$

E)   E) Probability that the module is empty.

$$po = 1 - p = 1 - 0.1538 = 0.8462 * 100 = 84.62 \; \%$$

F)   Probability that two units are found in the system.

$$P2 = (1 - 0.1538)(0.1538)2 = 0.0199 * 100 = 1.99 \; \%$$

G)   Time in which customers wait in line.

$$Wq = \frac{\lambda}{\mu(\mu-\lambda)} = \frac{2}{13(13-2)} = \frac{2}{143} = 0.0139 * 60 = 0.83 \; hour \approx 1 \; minute.$$

Multi-server model

With two servers

a)   Probability that no unit is in the system.

$$P0 = \frac{1}{\sum_{n=0}^{S-1}\frac{\left(\frac{\lambda}{\mu}\right)n}{n!} + \frac{\left(\frac{\lambda}{\mu}\right)s}{s!}\left[\frac{1}{1-\left(\frac{\lambda}{s\mu}\right)}\right]}$$

$$P0 = \frac{1}{\sum_{n=0}^{1}\frac{\left(\frac{4}{12}\right)\wedge n}{n!} + \frac{\left(\frac{4}{12}\right)\wedge 2}{2!}\left[\frac{1}{1-\left(\frac{4}{2*12}\right)}\right]}$$

$$P0 = \frac{1}{\frac{\left(\frac{4}{12}\right)\wedge 0}{0!} + \frac{\left(\frac{4}{12}\right)\wedge 1}{1!} + \frac{\left(\frac{4}{12}\right)\wedge 2}{2!}\left[\frac{1}{1-\frac{4}{24}}\right]}$$

$$P0 = \frac{1}{1+0.3333+0.0555\left(\frac{1}{1-0.1666}\right)} = 0.7248$$

b)   Average number of units in the system.

$$Ls = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)\wedge sP0}{(s-1)!(s\mu-\lambda)\wedge 2} + \frac{\lambda}{\mu}$$

$$Ls = \frac{4(12)\left(\frac{4}{12}\right)\wedge 2(0.7248)}{(2-1)!(2(12)-4)\wedge 2} + \frac{4}{12}$$

$$Ls = \frac{48(0.3333)\wedge 2(0.7248)}{400} + 0.3333 = 0.3429 \; units.$$

c)   Average time in which a unit is within the system.

$$ws = \frac{0.3429}{4} = 0.0857 \; hours.$$

d)   Number of units in the row.

$$Lq = P0\left[\frac{\left(\frac{\lambda}{\mu}\right)\wedge s+1}{(s-1)!\left(s-\frac{\lambda}{\mu}\right)\wedge 2}\right]$$

$$Lq = 0.7248\left[\frac{0.3333^3}{(1)(2-0.3333)\wedge 2}\right]$$

$$Lq = 0.7248\left[\frac{0.0370}{2.7778}\right] = 0.1449 \; units.$$

e)   Waiting time in line.

$$Wq = ws - \frac{1}{\mu} = 0.0857 - \frac{1}{12} = 0.002 \; hours.$$

Model with four servers

a)   Probability that no unit is in the system.

$$P0 = \frac{1}{\sum_{n=0}^{S-1}\frac{\left(\frac{\lambda}{\mu}\right)n}{n!} + \frac{\left(\frac{\lambda}{\mu}\right)s}{s!}\left[\frac{1}{1-\left(\frac{\lambda}{s\mu}\right)}\right]}$$

$$P0 = \frac{1}{\sum_{n=0}^{3}\frac{\left(\frac{5}{12}\right)\wedge n}{n!} + \frac{\left(\frac{5}{12}\right)\wedge 4}{4!}\left[\frac{1}{1-\left(\frac{5}{4*12}\right)}\right]}$$

$$P0 = \frac{1}{\frac{\left(\frac{5}{12}\right)\wedge 0}{0!} + \frac{\left(\frac{5}{12}\right)\wedge 1}{1!} + \frac{\left(\frac{5}{12}\right)\wedge 2}{2!} + \frac{\left(\frac{5}{12}\right)\wedge 3}{3!} + \frac{\left(\frac{5}{12}\right)\wedge 4}{4!}\left[\frac{1}{1-\frac{5}{48}}\right]}$$

$$P0 = \frac{1}{1+0.4166+0.0868+0.0120+0.0012\left(\frac{1}{1-0.1041}\right)} = 0.6594$$

b)   Average number of units in the system.

$$Ls = \frac{\lambda\mu\left(\frac{\lambda}{\mu}\right)\wedge sP0}{(s-1)!(s\mu-\lambda)\wedge 2} + \frac{\lambda}{\mu}$$

$$Ls = \frac{5(12)\left(\frac{5}{12}\right)\wedge 4 \; (0.6594)}{(4-1)!(4(12)-5)\wedge 2} + \frac{5}{12}$$

$$Ls = \frac{60(0.4166)\wedge 4(0.6594)}{11,094} + 0.4166 =$$

$$0.4167 \; units.$$

c)   Average time in which a unit is within the system.

$$ws = \frac{0.4167}{5} = 0.0833 \; hours.$$

d)   Number of units in the row.

$$Lq = P0\left[\frac{\left(\frac{\lambda}{\mu}\right)\wedge s+1}{(s-1)!\left(s-\frac{\lambda}{\mu}\right)\wedge 2}\right]$$

$$Lq = 0.6594 \left[\frac{0.4166^5}{(6)(4-0.4166)^{\wedge}2} \right]$$

$$Lq = 0.6594 \left[\frac{0.0125}{77.0412} \right] = 0.0001 \; units.$$

e)   Waiting time in line.

$$Wq = ws - \frac{1}{\mu} = 0.0833 - \frac{1}{12} = 0 \; hours.$$

Results

When carrying out the transfer of the containers by transfer, different times were usually carried out, but lately they were delayed to 1 hour 20 minutes which generated more costs since it caused the delay in the operations. Therefore, the model of a single server was applied at different times to analyze the behavior of said transfers and observe how long the unit is registered in order to enter the warehouse or yard where the download is carried out according to the service programmed by the client. The multi-server model was also developed.

Model applied at forty minutes

Landa throws us that it is possible to enter two units per hour and mu indicates the speed at which the server can serve units which threw us 12 units per hour, the average number of units in the system throws us 0 units, the time that provides the module to serve a unit is six minutes per unit, there is 16.6% of the system being in use when a unit arrives and 0 units would be queuing in the system since the unit present in module will be attended and the possibility arises that the system is empty with 83.3% and gives us a 2.31% probability that two units are found in the system.

Model applied in half an hour

Landa tells us that two units can be served per hour and mu represents that 13 units can be served per hour and there are 0 units in the system and the time elapsed by registering a unit is 5 minutes and there is a 15.83 % probability that the system is in use and that no unit is found in the system lining up and there is 84.62% that the input module is empty when a unit is being entered and with a 1.62% probability that two units are found in the system.

With this resolution in methods there is not a big difference in the time of forty minutes and half an hour, so it will be possible to enter between that time the number of transfers during an eight hour shift, which reduces the costs to customers by operators, machinery and units used in overtime. If the arrival speed of units were greater than the service speed, what would cause the queue to grow infinitely and the system would become saturated and cause the service to be delayed and more costs will be generated due to delayed operation. The multi-server model was also applied to analyze the level of service since the organization only has one server. The multi-server model was applied to two servers and to four servers performing the analysis, the proposal is given:

●   Have two servers to meet the demand for service.

●   Acquire two more units for the transfer of containers by transfer or loose cargo.

●   Hire the services of a carrier when there is a high number of transfers.

By acquiring two more units you would already have four units and over time you can save the costs of contracting the services of a third party to cover the demand for transfers and you can also provide the service of moving empty containers from terminal to terminal, the number of customers will be increased and revenues would increase to 40% over a period of two years.

By having two servers, you avoid generating a long line of units waiting for their entry either transfer, loose cargo, vehicles, container dispatch, the more this generates a bottleneck and therefore the operation is delayed.

Conclusion

After analyzing the possible models to be developed and carrying out the application of the mathematical models of the theory of selected queues that for this case was of one server and several servers, it was possible to analyze the time in which it is carried out the registration of a unit in modules, the waiting times, the possibilities that the system is empty, that a bottleneck may arise.

Also, the possibilities of increasing the number of customers and improving the level of service provided and keeping a better control in all the developed processes were found, allowing a better fluidity in the input and output modules, as well as in the operational area. By having two servers, the waiting time in the units is reduced by 30%, there is even a 70% chance that when a unit is present, no unit is found on the server and there are not many delays in the service provided to the clients and it is finished in a timely manner and it is possible not to generate more time and more costs to the client and the bottlenecks are eliminated.

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Productive potential to contribute to food sovereignty througth technolgy packages generated by INIFAP

Potencial productivo para contribuir a la soberanía alimentaria mediante paquetes tecnológicos generados por el INIFAP

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Abstract

The research objective was to quantify INIFAP´s contribution to food sovereignty by generating technological packages in the agriculture sector. The methodological process began with the integration of two research teams: one at the central level that was responsible for the coordination and elaboration of the productive potential mapping that was classified as high and medium of the most representative product systems in each state of the Mexican Republic and the other, he was responsible for updating the technological packages generated for the agricultural sector; subsequently, the review, homogenization, editing and publication of 32 Agricultural Technical Agendas was carried out. INIFAP contributed 483 technology packages nationally and the Northwest region was the one that contributed the most with 86 of them and at the entity level was the Estado de Mexico, which generated the most with 30 packages and the grasses were the most worked with 165 in which it was relevant corn that had a national cover and with 31 of them. Finally, the scientific community has a technological bibliographical collection that can be consulted for free on the INIFAP portal.

Innovation, Productive potential, Technological Packages

Resumen

El objetivo de la investigación fue cuantificar la contribución del INIFAP a la soberanía alimentaria mediante la generación de paquetes tecnológicos en el sector agricultura. El proceso metodológico se inició con la integración de dos equipos de investigación: uno a nivel central que se encargó de la coordinación y de la elaboración del mapeo de potencial productivo que se clasificó como alto y medio de los sistemas producto más representativos en cada estado de la República Mexicana y el otro, se encargó de la actualización de los paquetes tecnológicos generados para el sector agrícola; posteriormente se realizó la revisión, homogenización, edición y publicación de 32 Agendas Técnicas Agrícolas. El INIFAP contribuyó 483 paquetes tecnológicos a nivel nacional y la región Noroeste fue la que más aportó con 86 de ellos y a nivel de entidad fue el Estado de México, quien más generó con 30 paquetes y las gramíneas fueron las que más se trabajaron con 165 en las que es relevante el maíz que tuvo una cobertura nacional y con 31 de ellos. Finalmente, la comunidad científica cuenta con un acervo bibliográfico tecnológico que puede se puede consultar de manera gratuita en el portal del INIFAP.

Innovación, Potencial productivo, Paquetes tecnológicos

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Introduction

The National Institute of Forestry, Agricultural and Livestock Research is an entity that is dedicated to research for the rural sector and whose part of its functions is to generate in its experimental fields, knowledge known as technological packages which are disseminated through publications among which stand out those known as Agricultural Technical Agendas (ATA) and each of the federal entities of Mexico have one of them. Publications of research results, since the 1960s, of the then National Institutes of Agricultural, Livestock and Forestry Research (INIA, INIP and INIF), served as reference material for producers, students, teachers and researchers. These guides evolved, in the decade of the 90's, in which the INIFAP is formed, technologies are published at the institutional level by agricultural sector with application in the different agroecological areas of the country.

Currently, research activities, academic teaching and the work of society are permanently interrelated, as they provide knowledge and solutions to the present and future problems of society. In this context of constant exchange between research groups and academic bodies, of institutions dedicated to research and training of human resources associated with the rural sector; the project called "Update and improvement of agricultural technical agendas" was developed by INIFAP. This, broadly consisted of the compilation at national level of the agricultural technological packages generated in the research centers that make up the institute, with the purpose of capturing the knowledge and technological development available to the country's farmers, as well as the academic bodies that work in educational institutions in Mexico, to provide technological elements that affect the development of new research and support in the training of human resources dedicated to addressing the problems of the primary sector.

The ATA are prepared primarily as a source of dissemination of knowledge of the technologies that researchers generate at the national level and whose predominant vision is the welfare of the Mexican countryside.

The first beneficiaries in transferring this knowledge are agricultural producers, however, in the work of transmitting knowledge to producers, it is the extensionists who are trained by different academic bodies of education centers and research institutions. In this sense it is important to mention that the academic bodies are the set of departments, schools, faculties or academic units that belong to a Higher Education Institution (HEI) with thematic or disciplinary affinity, which are associated for the optimal use of human resources and materials (Moctezuma, 2017, Battista et al., 2015). Therefore, the importance of providing tools that are constantly updated and improved, since it is known that a good part of the production in the agricultural sector continues to present certain restrictions, which mainly include the lack of technological innovation, the result of the important lag in competitiveness consequence of the low levels of productivity in the productive structure that currently characterizes the sector, which is expressed in an agriculture with technological lag, as a result of the abandonment by the State policies towards smallholder farmers (Reyes, 2013, Chacue 2019). It is vital that the extension programs (agricultural, livestock, forestry and aquaculture) of Mexico continue with the budgetary support for their operation and even that the monetary resources are raised so that the technology transfer of the innovations that are generated arrive with greater promptness to the peasants. The objective of the research was to quantify the contribution of INIFAP to food sovereignty by generating technology packages in the agriculture sector so that they are freely available to farmers.

Methodology

A work team was integrated that fulfilled the necessary profiles to monitor and control the project activities, which included a team at the central level and another at the regional level. The first one was constituted in the National Center for Disciplinary Research in Conservation and Improvement of Forest Ecosystems where 5 researchers with multidisciplinary experience in areas such as dissemination, productive potential, agroecology, soils, planning, agrometerology, agronomy and socioeconomics were responsible for plan and coordinate the project and concentrate information nationwide.

The second team was formed in the 43 Experimental Fields (CE) and eight Regional Research Centers (CIR): Northwest, North Center, North Center, Pacific Center, Center, Gofo Center, South Pacific and Southeast of INIFAP.

Subsequently, the following steps were followed for the development of the project:

1. The management was carried out before the General Directorate of the Institute for the designation of those responsible and support links for each Regional Research Center (CIR), where the collaboration of the 8 CIR (Northwest, North Center, Northeast, Pacific Center) was determined. Center, Gulf Center, South Pacific and Southeast). In addition, 74 researchers from the agricultural area were assigned to the project as responsible for the review, update and improvement of agricultural technology packages in each state of the republic.

2. A tuning workshop was held with the research team to discuss the scope, planning and logistics of the project, the impact and scope of the project. The activities and dates committed to the Produce Foundations Coordinator (COFUPRO) were presented. The fundamental idea was that the research team had the same level of knowledge and understanding of the research project.

3. The background of the 31 Agricultural Technical Agendas (ATA) that were prepared in the year 2015 (second edition) for the description of the characteristics of the states, the main technological packages of the regions, as well as the mapping was made descriptive of the soil (referenced by INEGI) so that the authors of the technological packages were based and familiarized with the structure of the agendas and so that the information was improved and updated.

4. An information validation meeting was held to receive feedback, review and make the necessary adjustments to the requirements requested from the CIR, which consisted of a videoconference to inform the coordinating researchers of the eight Regional Centers and Experimental Fields, the tonic to follow through a critical route of activities for the coordination and implementation of the project.

- Information on the specifications of the requirements of the database of the technological packages was requested, requested by the Agrifood and Fisheries Information System (SIAP) of SAGARPA.

- The reception of the databases (technological packages), delivered by the Experimental Fields researchers, was coordinated by the central research team.

5. The project collaborators in the CIR made the drafting and correction of the technological packages that were selected and included in the ATA.

6. The technological information was concentrated in the CENID COMEF to monitor and verify the homogeneity of the data corresponding to the CIR, a comparative analysis was also made between what was generated in 2015 and 2017, both at the state and system level product and for this the following activities were carried out:

- Abbreviations of the ATA technology packages were approved.

- The corrections of the ordering of the technological packages were verified.

- The use of restricted pesticides in technology packages was justified.

- Prohibited pesticides were replaced by those established in the Official Pesticide Catalog of the Intersecretarial Commission for the Control and Use of Pesticides, Fertilizers and Toxic Substances (CICOPLAFEST).

- Technical adjustments of the technological packages were reviewed.

- Work was carried out on the development of maps of potential crop distribution by District of Rural Development (DDR) of the 31 States of the Mexican Republic.

- The representative photographs of each technological package were attached, as well as the photographs that illustrated the most relevant activities of the technological package.

In the case of productive potential and in general, the following aspects were taken into account:

Agroecological requirements.- the crops that are listed in each of the ATA, thrive in a great diversity of environments, from the arid to the humid tropical ones and the requirements for each product system were the following: climate, temperature in its maximum meanings, average and minimum, rainfall, soil and topographic variables, altitude and slope.

The potential areas referred to the classification of land suitability, as a partial result of the evaluation and grouping of specific surfaces, in terms of their aptitude for specific use, which is based on the ecological requirements of the particular crop and conditions and characteristics of the sites, variables that condition the product systems and their levels of production and productivity.

For the delimitation of areas with productive potential in each state, the Hierarchized Analytical Process (AHP) that Saaty developed in 1997 was used, which solves complex problems with multiple criteria. Its functionality was structured in three levels: i) hierarchy, which represents the breakdown of the problem in its integral parts, ii) establishment of priorities between the elements of the hierarchy and iii) qualification of the relative preferences of the elements, based on a underlying scale, with scale of values from 1 to 9.

Results and Discussion

In this sense, the project carried out by INIFAP updated and improved 31 agricultural technical agendas (one for each state of the country, with the exception of Mexico City), which are made up of different technological packages for crops established in the entities of the country, and that were generated by researchers working in the institute, in this work a technological package is conceptualized as the integration of a series of technological components aimed at improving the production and productivity of a specific productive system (for example technology for the cultivation of temporary beans in the Potosino highlands).

It should be noted that the National Service of Agrifood Health, Safety and Quality (SENASICA) in 2015 called for institutions (in addition to INIFAP) such as the International Maize and Wheat Improvement Center (CIMMYT); the Graduate College (COLPOS); the "Antonio Narro" Autonomous Agrarian University (UAAAN) and the Chapingo Autonomous University (UACh), to collaborate in the generation of 31 technical agendas; Due to the above, in the first part of the presentation of results, a comparison is made between the two years in which these agendas were published to determine the progress achieved with the INIFAP-led project.

The first comparison between the results obtained from the technical agendas generated in 2015 and 2017 is related to the amount of technological packages generated for the agricultural product systems grouped according to the regionalization of the eight INIFAP Regional Research Centers, Graphic 1 The regionalization presented in Graphic 1 is based on the categorization of the regions established by INIFAP according to the research centers that it has located throughout the national territory, the distribution of the states by regions is as follows:

- Northwest: Baja California, Baja California Sur, Sinaloa and Sonora.

- North Center: Aguascalientes, Chihuahua, Durango and Zacatecas.

- Northeast: Coahuila, Nuevo León, Tamaulipas and San Luis Potosí.

- Pacific Center: Colima, Jalisco, Michoacán and Nayarit.

- Central Gulf: Puebla, Tabasco and Veracruz.

- Center: State of Mexico, Guanajuato, Hidalgo, Querétaro and Tlaxcala.

- South Pacific: Chiapas, Guerrero, Morelos and Oaxaca.

- Southeast: Campeche, Quintana Roo and Yucatán.
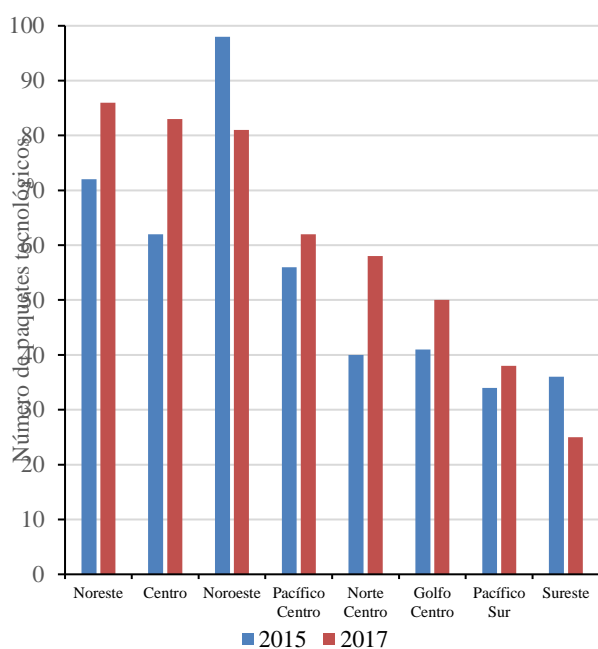
Graphic 1 Technological packages included in the agricultural technical agendas by INIFAP Regional Research Centers in 2015 and 2017
Source: own elaboration with INIFAP data

The region that contributed the largest number of technological packages was the Northeast, which includes the states of Tamaulipas, Nuevo León, Coahuila and San Luis Potosí, which represented 17.8% of the national total and between both entities they went from 72 packages to 86, which it meant an increase of 19.4%; followed in order of importance, the Central region, which concentrates five states (Guanajuato, Querétaro, Hidalgo, Tlaxcala and the State of Mexico), which went from 62 technology packages to 83, and with a participation of the technological offer of 17.2% and reached a growth of 33.9%. The third place was occupied by the Northwest region that includes Baja California, Baja California Sur, Sonora and Sinaloa with 81 technology packages, however, it had a reduction in its growth of -17.3% and its participation nationwide was 16.8%. In the three regions mentioned above, 51.8% of the total offer of technology packages generated by INIFAP was reached. The region with the lowest participation was the Southeast, which includes Campeche, Yucatán and Quintana Roo, with only 5.2%, which meant 25 technological packages and which, like the Northeast region, decreased by -30.6%.

At the level of the federal entity of the Mexican Republic, Graphic 2 shows the participation that each of the states had in the technological offer of the technological packages.
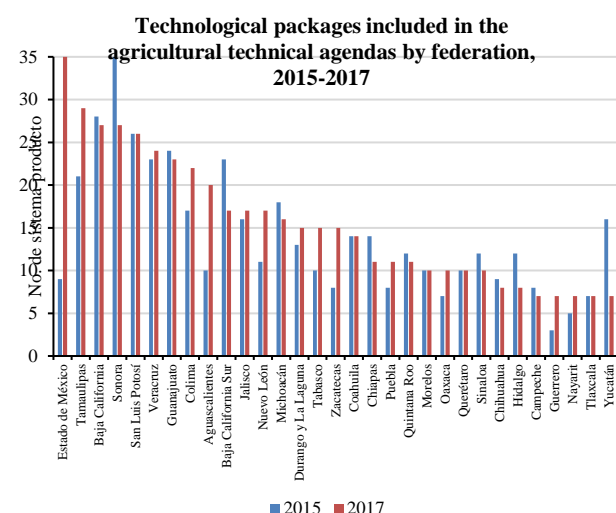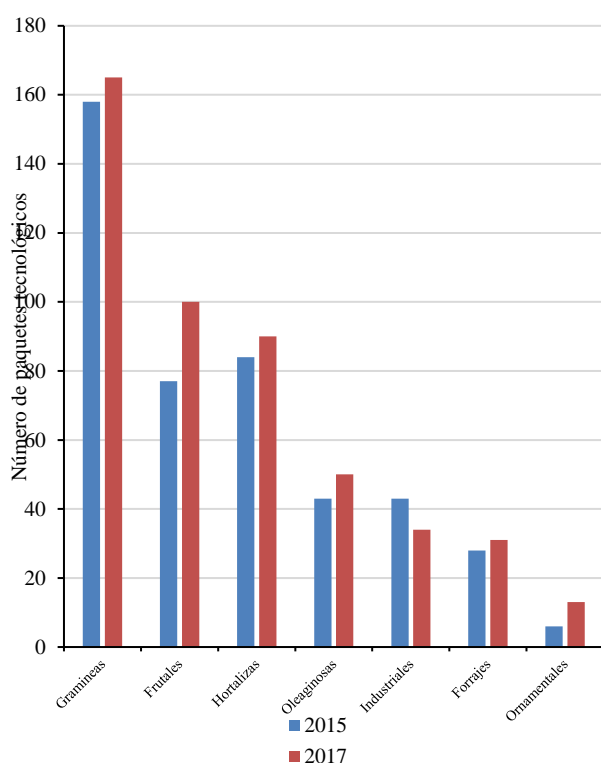

Graphic 2 Technological packages included in the agricultural technical agendas by federative entity of the Mexican Republic in 2015 and 2017
Source: own elaboration with INIFAP data

From the previous figure it follows that, in 2015, 107 product systems were published and in 2017 they were 113, which meant an increase in the period of 5.6%. For the year of 2017, the State of Mexico was the one with the greatest contribution to the generation of technological packages since it reached the figure of 35 and represented 7.2% of the total, Tamaulipas followed in order of importance with 29 packages that meant 6.0% and thirdly, two states: Baja California and Sonora, both with 27 packages that represented 5.6% of each, among these four states, 24.4% (almost a quarter) of the technological offer is concentrated; On the other hand, the states with the lowest participation were five: Campeche, Guerrero, Nayarit, Tlaxcala and Yucatán, which contributed 35 packages (seven each state) and which accounted for 7.0%. By way of illustration, a sample of 13 Agricultural Technical Agendas in various states of Mexico is shown in Annex 1.

A grouping was carried out by type of crop in seven classifications according to the INIFAP research programs, which were: grasses, fruit, vegetables, oilseeds, industrial, forages and ornamentals and are shown in Graphic 3.

Technological packages included in the agricultural technical agendas grouped by crops, 2015-2017
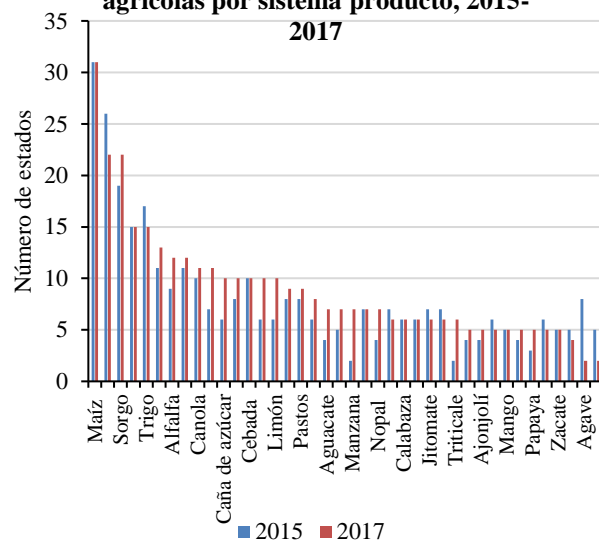

Graphic 3 Technology packages included in the agricultural technical agendas grouped by crops in 2015 and 2017.
Source: own elaboration with INIFAP data

Cobertura de los paquetes tecnológicos incluidos en las agendas técnicas agrícolas por sistema producto, 2015-2017

Graphic 4 Coverage of technological packages included in agricultural technical agendas by type of product system, 2015 - 2017
Source: own elaboration with INIFAP data

With the exception of industrial crops, all other classifications increased their participation and the most representative is that of grasses, since in 2017 it represented 34.2% of the technological packages, which shows the vocation of INIFAP to attend the basic crops that are essential in the food diet of the Mexican people, immediately appear the fruit trees of temperate and tropical climate, deciduous and evergreen with 20.7% coverage, thirdly appeared vegetables that reached 18.6%; Among these three types reached coverage of 73.5% (almost two thirds) of the technological offer and those that had a lower participation were ornamentals and forages, between both reached 9.1%.

When analyzing the quantity of agricultural product systems that appear in the ATA's, 113 were reported and to make their graphic representation only 75% of them were taken, which are shown in Graphic 4,

The fact that corn has a national coverage stands out from the above, in all states it is produced and in them INIFAP generated technological packages that adapt to the agroecological conditions of each entity. Corn represents its culture for Mexico and is a contribution to the world, since this grass is native to Mexico and is the staple food of the Aztecs since the founding of the Great Tenochtitlan and the coverage is in all the states of the republic; two other crops followed in order of importance: beans and sorghum in 22 entities, the first fundamental as a complement to human food and the second for livestock and essential in the preparation of balanced food, thirdly, also two grasses, oats and wheat, with coverage of 20 states and in fourth place was Chile with a coverage of 13 states and this confirms INIFAP's attention to what the Mexican people have: corn, beans and chili which are also fundamental in the production system known as milpa.

Among the product systems that had a low participation in terms of the number of states in which they were present are crops such as aloe and agave in two states, coffee in four and five, forage grass, tomato, papaya, walnut , peanut mango, sesame and garlic.

The results obtained regarding the update and improvement of the ATAs in 2015 presented important similarities with those of the previous year, since the product systems such as corn, beans and sorghum remained the most important crops in terms of territorial quantity and coverage refers, in the case of corn, the number of states covered are the same (31), however, beans decreased their participation by 15%, from 26 to 22 technological packages incorporated in the agricultural agendas of this year, on the contrary, sorghum increased its coverage by 16% when passing from 19 to 22 states, while technology linked to oat cultivation remained with the same proportion (15), while wheat decreased its participation in 12% (2 entities less compared to 2015), and Chile had an 18% increase from 11 to 13 states; In this sense, similar behavior is shown in 2017 with respect to those published in 2015, in terms of the number of technological packages available per state for the different crops established throughout the national territory.

In the same order of ideas and to complement the analysis of the results obtained from the project related to the conformation of agricultural technical agendas, it is important to show interregional differences in the generation of technological innovations that in this case result in the amount of technological packages included in each agenda, this in order to observe the contrasts that exist between the different regions that make up the country.

The information that was spilled is consistent with the socioeconomic and productive polarization that characterizes the regions of the country, since on the one hand there are the northern and central states, which have a greater dynamism in terms of economic growth, in addition to own a mostly technical agriculture and dedicated to the production of crops of high commercial value (such as fruits and vegetables for export), while at the other end are the southern entities that have historically been marginalized and excluded from the processes of national development, which is expressed in an agriculture with technological lag resulting from the abandonment by the State policies towards smallholder farmers, in this sense the need to intensify research, innovation and technology transfer processes especially for small producers with scarce resources and low levels of well-being.

In this sense, the ATA's turn out to be fundamental tools to succeed in the production processes, improve the productivity of the economic units and increase the income of the farmers with a direct impact on their living conditions, because the packages Technological agendas are submitted, after being generated to a validation, transfer and adoption process by Mexican farmers.

This is due to the fact that the technological packages that make up the agendas contain the recommendations for the proper development of the different phenological stages of each crop, from the preparation of the land, seed varieties, sowing and fertilization, cultural work and irrigation, and therefore they are a substantial instrument, so that the technicians and institutions that are linked to the country's rural development processes, have at hand the most recent results of the research and technological innovations generated in this case by INFAP.

Regarding the productive potential, in each of the entities ATAS's, the maps of their distribution correspond to their areas with homogeneous socio-economic characteristics for agricultural activity under irrigation, temporary, drainage conditions defined by the SADER through the Rural Development Districts (DDR).

As an example, in the state of Chiapas, 80 maps are shown that considered 15 crops (garlic, coffee, cane, chili, beans, fig, tomato, Persian lemon, corn, mango, potato, pine nut, banana, sorghum and soy) in the 10 DDR of the entity and also the map of edaphology of the entity, its population in five levels, rainfall, average temperature and land and vegetation use.

Finally, as a result and output, the 31 Agricultural Technical Agendas are available on the platform of the INIFAP institutional page: http://www.inifap.gob.mx/SitePages/inifap2015/Inicio/Agendas_Tec.aspx) to facilitate the Access to the general public, where they can view and download all files in reading format and which are also free.

Conclusions

The work of the more than 70 INIFAP researchers that reflected in the 31 Agricultural Technical Agendas shows a great effort to compile improvement and update in technological packages of 113 product systems (20% grasses, 29% fruit trees, 23% vegetables, 9% oilseeds , 11% ornamental and 9% industrial), throughout the country. This tool has three main users: producers, extension agents and the scientific community.

The ATAs are an instrument of economic development because the primary producer will find technologies that allow him to increase his average yields per hectare of the crops in which he works, which will allow him greater income or production technologies that reduce costs and by this means having a saving or not making a disbursement that make their production less profitable. The updating and improvement of the agendas was achieved, and they represent a variety of technological options as a support in the decision making of the producer, with the technical advice of their respective extension agents so that they can take options of other crops that they consider can take them to a better agronomic management of technological packages and to become experimental farmers that help the transfer of diverse technologies.

The scientific community obtains with the ATA´s of the INIFAP a tool that has updated information of the technological packages that allows the diffusion of the knowledge generated and validated in the different regions of the country. It allows the technological understanding of the packages of your interest; The adoption of knowledge will have as a consequence a technological impact on the students and technicians that they train, which in turn tend to unleash a multiplier effect in their different work and development fields, which guarantees a contribution to the best development of the Mexican countryside.

Annexes

Figure 1

Photograph of some publications of Agricultural Technical Agendas.

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Elements to consider the video game as a support tool in the university classroom

Elementos para considerar el videojuego como herramienta de apoyo en el aula universitaria

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Abstract

The video game represents a great opportunity for the student community to refresh and diversify the activities and tasks inherent in teaching and learning, taking advantage of the immersive, interactive and multimedia features offered by videogames to improve the use of university students. The objective of this work is to identify and make known the characteristic elements that certain videogames must have so that they can be used in university work, since there are endless options in the market whose general purpose is to entertain, however , you can highlight certain elements within them that can support the teaching practice. The present investigation methodology is of the theoretical type with descriptive study through which it is tried to offer validity, utility and universality to the phenomenon of study. The contribution is led towards the improvement of certain university educational procedures by identifying certain distinguishing parameters in video games that provide certainty that they could be used as support to improve the university teaching practice.

Videogame, Tool, University

Resumen

El videojuego representa una gran oportunidad para la comunidad estudiantil de refrescar y diversificar las actividades y tareas inherentes a la enseñanza-aprendizaje, aprovechando las características de inmersión, interactividad y multimedios que ofrecen los videojuegos para mejorar el aprovechamiento de los estudiantes universitarios. El objetivo de este trabajo es el identificar y dar a conocer los elementos característicos que deben tener ciertos videojuegos para que puedan ser utilizados en la labor universitaria, ya que existen un sinfín de opciones en el mercado cuyo propósito general es el de entretener, sin embargo, se pueden destacar ciertos elementos dentro de los mismos que pueden apoyar la práctica docente. La metodología de la presente investigación es del tipo teórica con estudio descriptivo a través de los cuales se pretende brindar vigencia, utilidad y universalidad al fenómeno de estudio. La contribución esta conducida hacía la mejora de ciertos procedimientos educativos universitarios mediante la identificación de ciertos parámetros distinguibles en los videojuegos que brinden certeza que los mismos podrían utilizarse como apoyo para mejorar la práctica docente universitaria.

Videojuego, Herramienta, Universitaria

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Introduction

The current context assumes that university educational institutions must take care of promoting the adaptation and use of more and better instructional and training tools for their students to provide better professionals to society. In addition to the above, it is well known that information and communication technologies are relevant to improve any process, and in this case, in education the videogame tool is addressed as university support; and it is approached from the perspective of identifying the characteristics and types of video games that can best be directed towards the achievement of significant learning in the university classroom.

It is important that if an out-of-traditional tool is to be used for the teaching-learning process, it can be tested and verified under certain analysis and observation parameters, in order to determine if it is feasible to use it also identifying how it could be more efficient.

Although there are teachers in educational institutions that carry out learning activities using some video games, it is necessary to reflect on the characteristics and knowledge of the video game universe to better identify which are the parameters to be distinguished from them that increase the possibility of designing learning activities based on video games that contribute to improve the significant learning of university students.

The problem that is sought to be solved is to distinguish types and characteristics of video games that support university educational work, in order to reduce the list of the existing video game universe so that teachers have greater certainty of which can support them and which do not. The work is integrated by justification, problem, hypothesis, objectives, theoretical framework, research methodology, discussion and analysis, results and conclusions.

Justification

It is found that, as in any field of life, teachers must find ways to reinvent their work, to increase their chances of encouraging their students to be interested and work to improve their knowledge and skills to take on future challenges aimed primarily at the workplace.

Video games represent a very important possibility for the promotion of the educational practice of the new times, where the use of information and communication technologies have transformed the way of understanding education, changing from being unidirectional to being multidirectional and moving books away. of text of the center of the educational scene. (Batalla, 2017). The video games have multimedia and interaction elements that test the coordination, skill and mental ability of the video gamers, therefore, it is visualized that thanks to these elements it is possible to develop proposals for educational situations based on video games that help the actors of the game University educational process to increase its efficiency, of course, as long as these video games have the necessary and sufficient characteristics to provide that possibility, elements that are sought to be discovered in this work.

Problem

The problem is focused on the identification of the characteristics of video games that can really be used in the university educational field. It is therefore necessary to also identify the nature of most video games, which are created to meet entertainment needs for gamers, and commercial and market needs for developers. However, you can find some types of video games whose objective of being created is to generate learning in its users such as "serious games", which for Diaz (2016), are those games that are used to educate, train and inform.

It is also the reason for this work to highlight that even though most video games are made to entertain, they should not automatically be discarded for use in university education, since they can still contain elements that can be used to generate an analysis, a situation, a decision or some reflection that helps the teaching-learning process.

Hypothesis

The hypothesis of this work is determined by the premise of determining the distinguishable elements of a videogame that allows us to identify it as a potential use for university education. Therefore it is as follows:

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In the video game distinguishable elements of interactivity, plot, game mechanics, history, context, music, type or any other are identified that allow them to be identified as usable to generate from them learning activities applicable to meaningful learning in the university classroom.

Objectives

General objective.

Determine what are the elements to consider so that a video game can be used as a tool to improve meaningful learning in the university classroom.

Specific objectives.

- Specify what types of video games can contribute to university teaching practice.

- Specify which elements of the characteristics of a video game are distinguishable to highlight in a possible learning activity design.

- Knowing better or in greater depth the structure and elements of a videogame to propose in turn better and more accurate learning activities.

Theoretical framework

The videogame

The video game for more than three decades has become part of the vocabulary of people, understanding this, according to the Royal Spanish Academy (2019) as: "an electronic game that is displayed on a screen" and "electronic device that allows, using appropriate controls, simulate games on the screens of a television, a computer or other electronic device ". The simple definition of videogame proposed by the Royal Spanish Academy is somewhat limited for what is proposed in this work, which is why the proposal by Burgun (2012, cit. In Benítez, 2018) is retaken who determined that: "a videogame is a system of rules where participants compete making ambitious decisions, in addition to the fact that the opponents must not necessarily be human, since one can be a person while the other player can be the computer using artificial intelligence ".

To pay with the definitions you can share the proposal of Jiménez and Araya (2010, cit. In Córdoba and Ospina, 2019) for whom a video game is: "a computer program in which the user or player maintains an interaction through images that appear on a device that has a screen that can vary in size". It is necessary to emphasize that to talk about videogames is to talk about a set of very complex elements, ranging from the use of a hardware platform that allows them to be launched, to a variety of software layers, where rules, methods, environments, characters are found, very specific actions, tools and mechanics, where the user interacts with them, using any type of command, screen or movement, to meet certain objectives that arise within the aforementioned setting.

Types and characteristics of video games.

There are several ways to classify video games, since there are many of them and the way to approach the classification depends a lot on the approach that needs to be analyzed, for example, there is a classification according to the type of content that the videogame includes, according to Videogames101 (2019) medium specialized in the subject; This classification is regulated by international organizations where the standard that applies to most of the world, including Mexico, is the Entertainment Software Classification Board also known by its acronym in English as ESRB. The mentioned classification is divided into the following elements:

- Ranking Categories: These suggest an appropriate age for each game. (Pending Classification, Young Children, All Ages, All 10+, Teens, Older 17 and Adults Only)

- Content descriptors: Elements that argue the possible classification and that may be of interest, for example: "Strong Language" that implies the use of high-sounding words or "Violence" which means that in the game you can find conflicts and / or aggressions.

- Interactive elements: Determines whether user information can be shared with third parties and / or the ability to interact with other users.

For egamers (2018), also specialized in videogames, videogames are classified by type, in this case determined by the genres to which their characteristics respond, and these are:

- Action: They put the player in situations of passing obstacles, defeating enemies and testing reflexes and reaction.

- Platform: Move forward and dodge obstacles, avoiding falling into gaps.

- Fight: End the enemy's health points by using punches, kicks, grabs and / or weapons.

- Fight progression or Beat 'em up: Make your way through waves of enemies by hitting or kicking.

- Shooter: Make your way through waves of enemies using gunshots mainly.

- Hack and slash: Advance between waves of enemies by using weapons, swords, spears or any other, mainly using keystrokes of a button repeatedly.

- Arcade: Fast action characterized by simple and repetitive movements.

- Adventure: Explore places and discover important elements for plot development.

- RPG: RPG, characterized by improving the skills of the characters through battles and missions.

- Sports: Sports-inspired games.

- Strategy: Management of huge numbers of characters and resources. Intelligence and ability must be used to manage them in the best way.

- Simulation: Video games that try to recreate some activity or situation as faithful as possible.

- Musicals: Those who place the main elements so that the player can imitate playing a song with a simulated instrument, dancing a melody or singing.

- Party game: Amuse family and / or friends with activities and challenges where anyone can participate.

- Of cards: Adaptations of card games under virtual environments.

- Educational: Its main objective is to leave some learning in the players.

Likewise, Cuenca (2011) classifies video games according to their contents in a very similar way to egamers, as follows: shooters, simulators, role, platform, adventure, action, survival horror, strategy, musicals, party, sports, racing , sandbox, multiplayer and online, where multiplayer and online apply for simultaneous interactions of several players at the same time, where the difference lies only in itself the interaction is local or in the same place, or through the Internet; The racing ones can be included in the sports, the survival horror are survival with dyes of terror and the sandboxes do not have a development line, they simply give freedom to perform what the player wants without limits of times, missions, activities or resources.

Videogame Features

Just as there can be different approaches when classifying video games, so is it to determine their characteristics. For this work the ideas of Cáceres and González are shared, which are detailed below.

Cáceres (2013) who conducted a study of the characteristics of videogames and their possibilities in education, shares his analysis of four characteristics of videogames that he considers distinguishable which are: rules, goals and objectives, narrative and fantasy.

The rules represent the limits, that is, the determination of what can or cannot be done, as well as the conditions to meet the objectives of the game.

The objectives and goals are what you want to reach, will be determined by the specification of certain events or situations that must be done and achieved in the game. If you get it, you win, but you lose.

The narrative according to Simons (2007, cit. In Cáceres, 2013) is the core of the video game, where are the explanations and understandings for the interpretation of identities and stories.

Through the narrative, the development of events that happen as the game progresses is shaped.

Fantasy is an element that most videogames contain, if not all, since it implies the presentation of a world that does not exist in real life, is a series of contextualized elements that are under a virtual environment. In these worlds there are certain rules and conditions that can be adjusted to reality or not.

Now, González's ideas have to do with videogame characteristics that are related rather, with their design, but which, however, is interesting to review some of them for purposes of this work.

There is a very important element in videogame design, this is the design document. Within the design document according to González (2011) you must find all the information related to it, which allows you to understand and land all the edges of the project to create a video game. It is a guide that guides developers by determining the elements that should be considered to structure the video game. These elements are specified below and briefly described:

- Project description: Explanation of what the project is about, what benefits and positive characteristics it has.

- Key points of sale: Describe how important or relevant the game is. That innovation will differentiate it from others or put it in a place of greater interest.

- Technology: Specify which graphics engine you will use (software to create it) and on which platform you will run (hardware).

- Storyline: Summary of the script, where you can perfectly distinguish where the story and plot of the game is directed.

- Game modes: Explanation of the different ways in which the game will be assumed. Whether for single player, online multiplayer, etc.

- Game options: How to configure the controls, buttons or general settings such as the screen or difficulty level.

- Game mechanics: How the video game is going to be played. Specify how the movement of the characters will be, what events and objects will react and in what way. In general, it implies how the characters will behave regarding the movement and interaction with the entire virtual environment to which they are subject.

- Environments: Specify scenarios and sub-scenarios, as well as detail their characteristics and possibilities of interaction with them.

- Items: Define and describe which ones and what they are for are the objects and aids that the videogame will offer to the characters.

- Characters: Description of the appearance, character and roles that the characters will have.

- Vehicles: Physical description and characteristics of being usable, destructible or not, and where to find them among others.

- Cameras: Definition of where the video player's viewing angle will be with respect to the characters or the action, as well as the possible interaction and movement through the controls.

- Artificial Intelligence: Behavior of non-controlling characters by the gamer.

- Kinematics: Function and characteristics of illustrative videos that support improving the understanding of the plot.

- Audio and music: Determine how the video game's sound setting will be.

- Walkthrough: Step by step description of what needs to be done to finish a video game.

- Fun ends and elements: Determine conditional elements that allow the gamer to find different alternatives and conclusions for the same story.

- Ideas and references: Motivational or inspirational elements that were presented to determine the current characteristics of the characters, settings, etc.

It is important to emphasize that the videogame catalog is so extensive that some games can fall into several categories and / or contain several of the features mentioned above or simply have only a few. This is mainly due to their nature, that is, a video game resulting from a Halo or God of War blockbuster will have many more elements than a puzzle-type smarphone videogame for example.

The understanding of the characteristics and representative elements that a videogame can contain can bring the teacher closer to understand better what scope and possibilities it can offer for use in a classroom.

University classroom and significant learning.

The university classroom refers to the physical or virtual space, where processes and activities related to learning of a subject related to a curricular plan belonging to a specific degree are carried out, that is, it refers to the actions and measures taken for the development of higher education students.

Higher education has very important challenges and obligations in today's times, which is why those responsible for designing and carrying out learning activities must meet certain requirements and expectations regarding the demands and contexts in which they live today.

Therefore, the situation arises to identify what are the learning goals that are sought in higher education. For Ramsdem (2007, cit. In Guzmán, 2011) they are classified in:

- The abstract, generic and personal development.

- Those referring to the domain of disciplinary knowledge including particular skills and techniques that distinguish each profession.

The first point above can be summed up in the following premises: teaching students to analyze ideas and issues critically, developing intellectual and thinking skills in students, as well as teaching students to understand principles and generalizations. The second point is summarized in analyzing, understanding, appreciating the meaning or interpreting. (Guzmán, 2011)

In turn, to pay for the previous premises, it is shared that for Hierro (1994, cit. In Bautista, 2008), higher professional education pursues two basic objectives, which are: to meet the needs of highly qualified personnel required by the state and train intellectuals that preserve, disseminate and establish a new culture. In any case, it is considered that, to achieve the goals of both learning and social impact, it is necessary to address the concept of meaningful learning.

The concept of meaningful learning can be approached with the ideas of Ausubel, considered an institution in the subject. For Ausubel (1976, cit. In Rodriguez, 2004), meaningful learning is: "the process according to which a new knowledge or information is related to the cognitive structure of the one who learns in a non-arbitrary and substantive or non-literal way. This interaction with the cognitive structure does not occur considering it as a whole, but with relevant aspects present in it, which are called subsumers or anchor ideas".

The foregoing determines that significant learning is based on a constructivist paradigm because knowledge is built on previous knowledge and also that the figure of the student becomes more protagonist, since it is the same student who reflects on his learning process interacting cognitively in all directions and at your own pace. Meaningful learning is also the one that implies that the student finds and identifies perfectly in the knowledge that he acquires, a well-defined purpose, that he knows what it is for and how to apply it correctly in different activities, as well as in different levels of significance or value that can be given to that same knowledge, as stated by Carranza (2017) based on Coll's studies. Carranza (2017) himself presents a summary of the levels of significance of Coll, who names them learning dimensions, thus defining them:

- Motivation: Real commitment to the learning process by the student.

- Understanding: Relationships between new content and prior knowledge are established.

- Functionality: That the knowledge acquired can be effectively used.

- Active participation: the study, analysis, discussion and preparation of the information received.

- The relationship with real life: Application or use of the information received to solve possible real problems.

These learning dimensions range from psychological aspects, mental efforts and the union of knowledge with real life. Now, the vision of Alvarado, Munguía and Castellanos (2017) is shared, who carried out a study of significant learning in higher education teaching, where the following statement is especially rescued: "… the mission of higher education is not so much to teach to the student a multitude of knowledge that belong to very specialized fields, but, above all, to learn to learn, to ensure that the student comes to acquire an intellectual autonomy.

Give rise to stimulate learning in the classroom, understanding this as meaningful learning." Thus, and according to the previous information, it can be noted that the University from higher education is requiring the granting of its students with significant learning, of course, through its teachers, in order to meet the particular goals and generals to which it is due.

Learning activities.

To achieve the meaningful learning addressed in the previous section, it is necessary to make a link between the teacher and the student, this link may well be materialized with the learning activities, which, through their correct use, guarantee student learning.Learning activities can be identified as actions and / or resources that serve to learn or acquire knowledge of a particular subject or discipline. (Penzo, 2010).

Likewise, the Ministry of Education, Science and Research of the region of Murcia in Spain, through the General Directorate of Educational Promotion and Innovation (s / f), publishes that the activities are put into practice of the content previously selected through procedures , activities or exercises that must be designed, which may contain pedagogical, psychological elements (age, motivation, interaction) and / or elements of planning and management of classroom activities.

In turn, Taba (1974, cit. In Delgadillo, 2005) points out that learning activities can also be understood as learning experiences that must fulfill a function to promote knowledge and respond to the maturity stages of the subjects, and that should be raised according to the following domains: reasoning ability, inductive reasoning activities, deductive ability activities, visospatial relationship activities and verbal abilities. However, learning activities can be linked to videogames through the work of Montero (2010), who states that to work with video games contemplated in learning activities is required: set the objectives, find and choose the tools you want to use , schedule the intervention, develop the activity, evaluate and share the activity. It can be noted that the use of well-established learning activities and aimed perfectly at the learning objectives, as well as the identification of the cognitive abilities of the subjects who are going to interact with them, implies the practice or exercise required to achieve meaningful learning.

Research methodology

The methodology of the present investigation is of the theoretical type with descriptive study through which it is intended to give validity, usefulness and universality to the phenomenon of study.

The above is framed under the premise of the literature review related to the phenomenon of study to find validity or rejection of the hypothesis raised, as well as address the issues necessary to achieve the objectives of the research.

Discussion and Analysis

It is necessary to deepen the relationship between the characteristics that make up a video game, the learning activities and the university classroom to be able to decide if the identification of the characteristics of the video game can help a possible formulation and design of activities that contribute to the achievement of significant learning in the university classroom.

As for what is seen in the literature reviewed in relation to the characteristics of videogames, it can be highlighted that there are classifications according to the content, according to the type of mechanics and design, if they are large productions or if they are simple low-resource videogames.

While most try to meet the objective of entertaining, there are also educational video games, serious games and simulators that have features completely focused on learning.

Thus it is also found that video games have very distinguishable elements within their general structure, you can mention the game mechanics, which is the way or way in which the user controls the movements of the character and how he reacts to them, the history, which is the description of the sequence of actions that the character or characters perform during the development of the plot and how they affect the surrounding environment; and music, which implies the sound sequences that accompany the moments that are experienced in the development of the video game.

Related to the aspect of university teaching-learning, it was identified that universities need to meet the need of society to generate qualified personnel, who can apply their knowledge in organizations, as well as disseminate culture. Some types of video games can contribute in this regard, such as simulators or some action games that tell history and explain how some past and present societies and cultures work or functioned.

In the studies of Gamo (2015, cit. In Martínez, García and López, 2019) it is shared that he managed to identify that the development of virtual laboratory platforms as a complement to the classroom leads to the development of knowledge, socio-communication and collaboration that students should acquire.

Now addressing the theme of the learning activities reviewed in the bibliography, we can distinguish that they imply practical exercise, they must be oriented towards a certain student profile, and they must reflect some pedagogical reflection in their design so that they can really serve to generate meaningful learning.

Therefore, it seems important to share the studies of Montero (2010) who assures that to select a videogame as a tool for learning, it must take into account: the group to which it is addressed, the objectives that are intended with the intervention through video games, the sequence methodological method by which it will be used and the technical and economic resources available to them.

In this last point it would be added that the Ludologos work group (s / f, cit. In Montero, 2010) also chooses to prioritize videogames with the following characteristics: low cost or free, discontinued and online. The justification of the above is in the premise that the selected videogames do not require large computer requirements so that they can be used with the means available in most educational centers, as well as that the configuration and commissioning is very simple and basic for both teachers and students.

Under the same vision of Montero (2010), a series of guidelines to be followed for the selection of video games is shared according to the methodological sequence that is required to be used, and these are: as an introduction to a topic, within a sequence of learning, as a synthesis of contents, in specific moments and for the pure pleasure of playing. In the end, the same author states that it is the task of the educator to define their activities, try different types of games, different times, use different methodologies and record the process, regardless of which video game is selected.

Regarding the revised information on research related to the use of video games in the university classroom, the study by Borro (2015) is shared, who carried out a work where educational simulations with game strategy are systematized in the medical field. This work is interesting to highlight the following aspects related to the characteristics of the video game that in the study considered very relevant for its efficiency and are listed below:

- Script: The player is placed in a context, the objectives, the rules and the role he has are presented.

- Logic: The game should encourage player decision making.

- Feedback: Feedback is essential during the game because in this way you learn while playing and retaining information.
- Ludification: Inclusion of game elements such as lives, time or bonus, to increase motivation.

- Difficulty adjustment: To maintain a balance between design elements and complexity over time and the achievement of objectives.

Apart from the elements mentioned above, it should be noted that Borro (2015) specifies in his conclusions that students find motivating and with high acceptance the use of medical simulators, since the learning they obtain is real. It should also be mentioned that the simulators used were specially developed to be educational, and although the author concludes that they are not too expensive, it should be specified that each University has its own characteristics and budgets, and that in the end, that may be relative.

To conclude with the analysis and discussion section, the work of Urquidi and Calabor (2014) is addressed, who conducted a study of the factors that determine the pedagogical efficiency of simulation games during a university course in the business area. Among its conclusions it is found that students who took the course using simulations valued two major factors, the first, the realism of the simulation, the second, the immediate feedback. It should be noted that it was also found that the ease of use is not so significant for the students, perhaps motivated to the fact that most of the respondents were digital natives who use video games normally.

Results

Taking up the hypothesis that is: In the video game distinguishable elements of interactivity, argument, game mechanics, history, context, music, type or any other are identified that allow them to be identified as usable to generate from them learning activities applicable to learning significant in the university classroom; It can be affirmed according to the conclusions of the documentation addressed that is feasible. The hypothesis is not accepted or rejected because in general there is a great diversity of videogames and typecasting some combinations of characteristics of some types of them as determinants to be used in the university classroom would be very unfair.

It must be distinguished that while some features of video games such as game mechanics, history or type may work for a particular learning situation, they do not necessarily work well for entertainment and / or vice versa. Each video game can be approached or designed to entertain, motivate or teach depending on the characteristics offered, but also the objectives for which it is required.

Regarding the general objective, it can be shared that there are characteristic elements of video games that contribute to university learning. Placing the focus on the types of video games that mostly contribute to meaningful university learning are serius-games and simulators, since they are designed and designed to generate user learning, first, and secondary entertainment appears and / or fun.

Another important element to highlight is that videogames that are selected to be used as support for learning are online, with few computer requirements or even abandonware. Large productions are not easily affordable and implementable in schools of any level. Likewise, some elements were found that were not contemplated in the hypothesis or in the objectives, these are the level of realism and immediate feedback in reference to what a videogame includes to help generate significant learning, and in terms of design, it helps to define a script, the logic, again the feedback, the gamification and the adjustment of difficulty. In turn, in terms of specific objectives, it is denoted that in order to design learning activities, the characteristics of the video game to occupy do not seem to really matter. However, if certain recommendations are found. The main weight of the design of learning activities lies with the teacher. It must be soaked in the context in which it works, the Educational Institution, the type of students and previous university training they may have, as well as the technological tools available for the activities. You must define specific and achievable objectives, as well as establish a methodological sequence and a plan to follow for the same activity.

It should be noted that it is very important that the teacher who designs, must use and practice with different video games, scenarios and moments, record the events happened and reflect on this, all this, before, during and after the application of the same activity. It is also necessary to verify that video games are suitable for certain areas of knowledge, if the mechanics are sound and if the nature of the video game does not contradict the basic ethical and moral principles, both of the teacher, of the students and of the same educational institution, since as Ortega and Fuentes (2009) conclude in their study of video games and violence, that violent video games have little or no ethical-educational value.

Conclusions

There are elements that are usually very attractive for a video game to sell well, such as graphic detail or music, however, for education it may not be the same way, since the goal of education is learning, while the games pretend to entertain and bring unforgettable experiences to its users, regardless of whether or not they learned something in the process.

It is shared that there are characteristic elements of video games that can support in university education, mainly the type of video games, in this case they are of the serius games or simulators type. It is also recommended that they are not large productions to opt for online games, freeware (free license) or abandonware (discontinued software). Thus it was also discovered that it is important that video games that support meaningful university learning reflect a high level of realism, immediate feedback and that they have the basic elements of the design of a videogame, as an adequate script, logic for decision making, ludification that includes elements such as lives and items, as well as the adjustable difficulty level.

Finally it is clarified that regardless of the video game, it is the work of the teacher who designs learning activities based on video games consider the university educational context, the objectives, moments, methodology, as well as registration and reflection to perform that work, since there is no specificity clear that indicates if a set of features of a video game increase or decrease their chances of being used in education, although what can be done is to reduce the list, to the types and characteristics mentioned above and especially to discard violent games, that it is proven that they do not conform to the ethical and moral principles of the actors of the educational process or to those of the institutions.

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Article

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Productivity of the millennial generation in institutions of higher education

Productividad laboral de la generación millennial en instituciones de educación superior

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Abstract

General objectives: evaluate the relationship that exists between job satisfaction, organizational climate and leadership within higher education institutions in the Metropolitan Area of Guadalajara. Specific: analyze the relationship between job satisfaction and productivity in the millennial generation (GM), analyze the relationship between the labor climate and productivity (GM) and analyze the relationship between leadership and productivity (GM). Methodology: It is about making a comparison between the generations: millennial (1980-2000), baby boomers (1945-1965), "X" (1965-1980) and "Z" (2000-present), it is a theoretical support of articles, a quantitative research is carried out, in which up to now the application of 50 instruments has been carried out in a simple random pilot sample which gathered people of all ages who are currently responding at the Autonomous University of Guadalajara. Contributions The theory aims to contribute to the generation of a model on the characteristics that millennials are interested in their work. In the methodological aspect a specific instrument is used for each variable: job satisfaction in Meliá and Peiró (1998), organizational climate of Koys and Decottis (1991), leadership of Bargavi, Paul & Samuel (2006) and for productivity Sources (2012).

Resumen

Objetivos generales: evaluar la relación que existe entre la satisfacción laboral, el clima organizacional y el liderazgo dentro de las instituciones de educación superior en la Zona Metropolitana de Guadalajara. Específico: analizar la relación entre la satisfacción laboral y la productividad en la generación milenaria (GM), analizar la relación entre el clima laboral y la productividad (GM) y analizar la relación entre liderazgo y productividad (GM). Metodología: Se trata de hacer una comparación entre las generaciones: millennial (1980-2000), baby boomers (1945-1965), "X" (1965-1980) y "Z" (2000-presente), es un apoyo teórico de los artículos, se lleva a cabo una investigación cuantitativa, en la que hasta ahora la la aplicación de 50 instrumentos se ha llevado a cabo en una simple muestra piloto aleatoria que reunió a personas de todas las edades que actualmente están respondiendo en la Universidad Autónoma de Guadalajara. Contribuciones La teoría tiene como objetivo contribuir a la generación de un modelo sobre las características que los millennials están interesados en su trabajo. En el aspecto metodológico se utiliza un instrumento específico para cada variable: satisfacción laboral en Meliá y Peiró (1998), clima organizativo de Koys y Decottis (1991), liderazgo de Bargavi, Paul & Samuel (2006) y para fuentes de productividad (2012).

Prodcutivity, Labor Satisfaction, Organizational Climate, Leadership

Productividad, Satisfacción Laboral, Clima Organizacional, Liderazgo

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Introduction

The issue of organizational climate is known and most people talk about it, especially at the managerial level, to define it, several authors are taken into account, who due to their studies make several proposals, for the purpose of this work Salazar is taken , Guerrero, Machado and Cañedo (2009), where it is stated that it is made up of three characteristics: the general ones which deal with the economic, social, legal and technological context that in turn impact the decisions of the managers and executives of the companies, then the operability is observed, in which the client, the work and the suppliers play a very important role to carry out the organizational plans and finally there is the intern which is the totality of the strategies and actions that are takes internally, impact on the direction and performance of all, compared to the previous two, the latter has the characteristic of acting within the organization.

In the relevant characteristics of the organizational climate are the history of the company, that is; since its foundation, the expansion of the same and the criteria they take for the hierarchy of the same, as well as the profile of the people who work in the company, the training that is carried out, the conditions of the hiring package as the benefits, the attitudes and aptitudes of the employee, the technology that is at your disposal among others. The SWOT analysis should be taken into account as a follow-up of the strategies that have been previously implemented, the strengths, weaknesses, threats and opportunities lead to employee safety at least to the sense of security and this is how productivity is intended of the same increase.

However, the issue of productivity is analyzed which involves certain aspects that are implicit in the human being such as: health, well-being, happiness, fulfillment of dreams and expectations which are valuable for their work and directly impact on labor productivity , it is said that the motivation that arises from the individual is totally self-directed, that is, the subject exercises it for himself, that is why companies strive to make people productive but the most important factor for this to be achieved is that the same worker decides.

Theoretical framework

Generations are identified by the year of birth, age, location and events that are characteristic of the formation of his personality, Guha (2010). Generations of people can also be classified by means of events that live in their time, for example: values, expectations, wars, technologies and economic situations (Howe and Vos, 2010), currently the work areas are basically dominated by three generations, which are "baby boomer", "generation x" and "millennials" (Kafi, Nefi, Khanfar and Kaifi, 2012). Each of the generations is specified below and throughout the reading the various definitions that place people through the ages will be reviewed, the "baby boomer" generation 1943 - 1960 begins, they are called so because of that when men returned from the Second World War, a large number of babies were born at that time and a baby boom was created, at that time the economy was prosperous and with respect to technology the people of these years did not grow with it , therefore the dependence on it would not be the same as today, (Kaifi et. Al, 2012; Smola and Sutton, 2002).

The "X" generation is the people who were born between 1961 and 1979, this generation is defined by the period of decay in the light of the baby boom, that is, the "X" generation was the first to return home after from school and did not find their parents since they were working outside, the same happened with their breasts since they also went to work, the "X" generation grew around a divorce, a not very stable economy and high crime (Cahill and Sedrak, 2012). The generation born between 1980 and 2000, mostly known as Millennials, is called that because of its proximity to the millennium and they are mostly influenced by technology and computer issues, they have a greater acceptance of families and values that are not traditional (Andert, 2011). For greater retention and understanding of the employer with his subordinate, one must take into account what motivates the person and what satisfies him (Guha, 2010), a notable difference in millennials is that they have more confidence in themselves which allows them to move up or develop new forms of work, young millennials have greater assertiveness and a high level of self-esteem compared to other generations when they were the same age, which can also generate greater productivity (Deal, Altman and Rogelberg , 2010).

Below are the characteristics of which the millennial generation take as an important part to decide to enter or remain in a job:

* Corporate social responsibility:

It is a business vision that integrates respect for people, ethical values, the community and the environment with the management of the company, regardless of the products or services it offers. CEMEFI 2018

* Training and Feedback:

One of the suggested objectives for the achievement of the growth of productivity at work is training, which is a concept of the union of the elements of intrinsic motivation, factors such as decision making, work strategy, theory of social learning and self-management knowledge (Rowlinson, 2007)

* Significant work experience:

Murray, (2011) mentions that the NET generation (millennials) have perfected the culture in regard to the behaviors they have throughout their lives, whose behaviors are personalization which refers to the identification of the individual and know how to detect their needs, experimentation, empirical learning, quick reward, balance between life and home, high expectations regarding their careers, quality of life and inspiring leadership by their boss.

* Teamwork:

It has been reviewed that millennium young people adapt better in the form of teamwork and that they have a greater tolerance in the subject of tattoos since they know that there is a diversity of cultures and they know how to respect it (Andert, 2011 and Kaifi et. al, 2012).

* Leadership:

The leader is the one who leads the team to achieve their goals and their personal skills are valued to the extent that they are useful to the group. The leader is not because of their ability or ability in themselves, but because these characteristics are perceived by the group as necessary to achieve the objective. (Andert 2011).

* Technology:

In most areas it is identified that recent information technologies, as well as new business strategies, increased employee productivity, globalization among others. (Mazzotti and Constantino, 2010).

* Good pay:

Salary based on sales or other clear and attainable goals is one of the main reasons for millennials in choosing a place to work (Salonen, S. 2017).

* Opportunity to Advance Fast:

Twenge and Campbell, (2008) quoted in Ng & Gossett, (2013) comments that millennials have been living with the belief that they have talent and intelligence to achieve their goals, so they concentrate heavily on their own success. all the time a way of life which has extrinsic rewards, they comment "I want to work for those companies that go beyond just making money".

It is clear that motivation is a key element when it comes to productivity, because this factor is a main issue among people of human resources, the motivating factors influence the desires to perform an activity as well as the extrinsic factors, the way of being able to captivate colleagues with the fact of doing a task well, as well as the relationship between labor activities in general Ryan and Deci, (2000) cited in Ertas, (2015). Administration researchers have not lost sight of human resources management, the relationship between human resources management and the rotation of personnel and productivity, as well as the motivations that exist intrinsically or extrinsically, in this context enters the performance that has been one of the elementary foci in the federal service (Hamilton, 2010).

The axis of rotation of personnel and productivity is known to generate setbacks with regard to the provision of services which can lead to logistics delays or quality problems (Bertelli, 2006). To carry out this study, questionnaires were carried out taking as a reference the survey of "Point of View for Federal Employees", which was carried out electronically in the months of April and May (2011).

The response rate is reviewed from 49.3%. , in a very differentiated way, the hypothesis is identified, which tries to recognize if it is true that millennilas are prone to warn the intention to leave their jobs, the result is that the probabilities for the young millennium to leave their employment were approximately 5 times more than an older employee with more years in the company, the statistical difference is significant which is accepted the previous hypothesis (Ertas, 2015).

It is interesting to know the expectations of young people who are about to graduate, to know the requirements of what they will ask for in their workplaces, it is important because in this way employers can prepare the land of their companies to receive them, without a doubt The financial situation has high influence at the time of job selection for young millennials which helps to know how to manage the positions in the company, (Howe and Vos, 2010) cited in (Córdova, 2017), employers worry too much in these aspects because a better work harmony creates a better work environment which causes more productivity and is attractive for the millennium generation (Hasluck, 2012).

Armstrong cited in Obisi, Ashuonye, Gbadamosi, & Aderotimi, (2016) mentions that through experiences and traits, which are less stable, new expectations and ways of understanding life situations can be formed, in this sense It handles a point which is about apathy at work, that is, there is no measurement of the attitude which allows evaluating the productivity of employees, therefore it is an area of opportunity for universities which can contribute with respect to employees with the review and measurement of attitudes and forms of interaction in labor relations, as well as, the union of the group, union with the university and non-academic activities. In the study carried out by Aderotimi (2016), what is attempted is to avoid misunderstandings among the company's employees, as well as frictions, reasons for distractions, quarrels, attempts are made to take or lead to productivity, an effective organization, growth and well-being In general for employees.

In the selected university the diverse cultures were taken into account, which are valuable for the study, some characteristics that may be similar among the employees are those that have a desire for personal dominance, and have influence as leaders in the organization, once again the interest of obtaining promotions within the company, independence as well as high self-esteem for decision making, Roethlis and Simón, (2012) cited in Obisi, Ashuonye, Gbadamosi, & Aderotimi, (2016) are mentioned. Leaders must preserve prudence in relation to people's attitudes since they change and must be observed carefully all the time, (Satter, 2011) cited in Obisi, Ashuonye, Gbadamosi, & Aderotimi, (2016), work under the hypothesis that there is no statistical dependence on working conditions and ways of being of employees, in the end the relevance of productivity associated with variables such as punctuality, publications, classification of results over time and The relationship with the elderly, co-workers and students, the elaboration of tasks over time lead to the absence of service messages and a very bad planning of strategic actions. A 5-point Likert scale was used where the very good rating was 5 and very bad 1, but 240 of the respondents who were extracted from a 1600 population, the selected universities were Business Administration, Engineering, Science Social and Medical Sciences.

If what Armstrong (2012) argues, labor contexts in which there is well-being in general, specify what measure of productivity they have, that is, commitment to duty, work circumstances surround important aspects such as incentives, benefits as well as the attitude of the superiors with the collaborators (Miner and Luchsinger, 1985) cited in Obisi, Ashuonye, Gbadamosi, & Aderotimi, (2016). If what is required is to increase productivity in the company, it is necessary to have attitudes in the workers which have clear goals in the organization and are aimed at university management (Stevans, Palut and Burks, 2008) cited in Obisi, Ashuonye, Gbadamosi , & Aderotimi, (2016).

The study cited in Wolke (2015) conducted by Great Smoky Mountain reviews reports related to abuse and intimidation between the ages of 9 and 16, which are the mental situation of adults between 19 and 25 years, it is stated that the exhibition.

Long term of a rigid environment and of bad treatment present low productivity in general, for which the idea that a healthy context that promotes the well-being of the person translates into productivity is retaken.

According to Osibanjo, Gberevbie, Adeniji, & Oludayo, (2015) in their study carried out in 2015, the fact that the collaborators of the competent companies retain the correct and necessary indications is observed, so they also have experiences and knowledge which includes financial value in the issue of quality to experience greater productivity in the organization (Rao, 2000). Says McCroskey (2006) "the attitude towards a source of communication that took place at a certain time by a receiver", the above means that the most reliable supervisor is easily recognized by his receivers in this case the people in charge, is assuming that the leader takes into account the objectives of a worthy agent and an administrator who pays a reward for feeling satisfaction in his work with respect to his subordinates. Definitely job satisfaction is essential for high productivity in employees (Osibanjo, Gberevbie, Adeniji, & Oludayo, 2015).

Theoretical model

The particular theoretical model of this research is shown in Figure 1. where you can see how the organizational climate variable tries to measure labor productivity. The relationship is subject to verification in subsequent studies, it is only proposed as theoretical support.
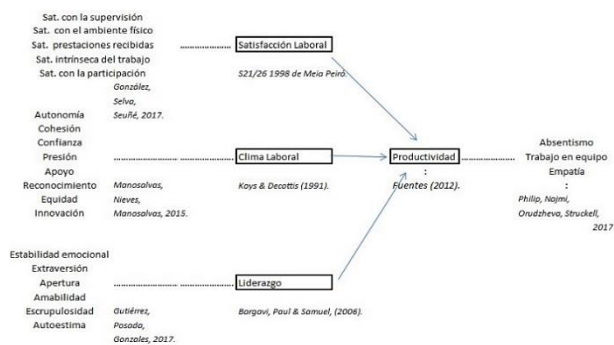
Figure 1 Particular theoretical model, subject to verification
Source: self made (2019)

Method

Investigation

The research is carried out by means of quantitative, non-experimental analysis with cross-section (Hernández, Fernández and Baptista, 2014; and Bernal, 2016).

Variables

Independent variable: Organizational Climate

Conceptual definition: It deals with the organizational commitment that lies in the sample of a direct impact of the attitudes of the employees, such as: the acceptance of goals, values and culture of the organization, less absenteeism and low turnover among others, (Betanzos Days and Peace Rodríguez, 2007).

Operational definition: The processes that affect the measurement of the work environment, such as: autonomy, cohesion, trust, pressure, support, recognition, equity and innovation (Koys & Decottis 1991).

Dependent variable: Productivity.

Conceptual definition: Faisal & Whyte, (2015) mentions that productivity is the amount of production per unit of input (labor) and in the field of construction is predominant. Durdyev and Mbachu (2011), say that productivity is strongly associated with the commercial feasibility that is indispensable for the understanding of the factors that positively affect the improvement of growth in this area, such as levels that lack focused knowledge.

Operational definition: The factors that affect the measurement of productivity, such as: absenteeism. teamwork and empathy, Fuentes (2012).

Sociodemographic Variables

The sociodemographic variables are: sex, age, job and schooling.

Measurement tools

The Organizational Climate is measured with the instrument of Koys & Decottis (1991) in a complete version of 40 items that evaluate eight dimensions: autonomy, cohesion, trust, pressure, support, recognition, equity and innovation; Likert scale from 1 to 5 is applied, with 5 being the highest rating.

While Labor Productivity is measured with the Fuentes instrument (2012) in the full version of 25 items with the following three dimensions: empathy, teamwork and absenteeism with the Likert scale from 1 to 5, with 5 being the highest rating high.

Participants (sample characteristics)

50 instruments which belong to all the work areas of the Autonomous University of Guadalajara, of any age and sex is indifferent, by the type of non-probabilistic sampling for convenience (Hernández, Fernández and Baptista, 2014; and Bernal, 2016). The characteristics of the selected sample are detailed below (see table 1).

Sociodemographic Variables	Sample Profile
Age	Mean = 31 years
Gender	Male = 28.30%; Female = 71.70%
Scholarship	High School = 100%; Bachelor's degree = 93.20%; Mastery = 12.97%
Work variables	
Position	Average controls = 87.20%; Management controls = 12.80%

Table 1 Sample characteristics
Source: self made (2019)

Process

The method used to collect the information was through surveys carried out on paper with a total of 130 items on a Likert scale from 1 to 5, with 5 being the maximum score to be obtained. Divided into the two variables: organizational climate and productivity.

Data analysis

Non-experimental correlational-causal cross-sectional quantitative research that allows obtaining results from an inferential statistical analysis.

The hypotheses will be tested using a model of structural equations, for which an instrument based on the above-mentioned methodology will be used. Pilotage: 50 instruments, reliability (Cronbach's alpha) and validity, (factor analysis). Hypothesis testing: 50 valid questionnaires through structural equations using R2, partial least squares test. Tools: Qualtrics, SPSS version 24, AMOS, EXCEL and Normality with Kolmogorov-Smirnoof. Statistical tests of reliability and validity of the instrument were performed, as well as descriptive statistics, normality tests and correlations between elements. The data is processed with the statistical software SPSS (Statistical Package for the Social Sciences) version 25.

Results and Discussion

Descriptive results

In the present work, the various statistical tests were carried out to review the instruments of each of the variables: organizational climate and productivity, in relation to the work environment in general, the statistical tests validate the reliability and normality of each of the items in a 90%, to finish in the productivity instrument, good tests are argued from 90% to 100%. By dimension, the alpha starts and ends mentioned how many items were removed.

Variable or Dimension	Alpha	If the question is deleted	New alpha
Work satisfaction	.947		
Sat. With the Supervision	.885	If P.10 is deleted	.894
Sat. With the Physical Environment	.805	It is the best Alpha	
Sat. Benefits Received	.758	It is the best Alpha	
Sat. Intrinsic of Work	.850	It is the best Alpha	
Sat. With the Participation	.731	If P.9 is deleted	.793
Working environment	.911		
Autonomy	.705	If P.4 is deleted	.713
Cohesion	.832	It is the best Alpha	
Trust	.896	If P.11 is deleted	.897
Pressure	.751	If P.16 is deleted	.791
Support for	.904	If P.25 is deleted	.918
Recognition	.584	If P.30 is removed	.638
Equity	.808	If P.34 is deleted	.890
Innovation	.882	It is the best Alpha	
Leadership	.803		
Emotional stability	.806	If P.27 is deleted	.823
Extraversion	.209	If P.23 is deleted	.270
Opening			
Amiability	.612	If P.24 is deleted	.637
Conscientiousness	.616	It is the best Alpha	
Self esteem	.577	If P.20 is removed	.589
Productivity	.942		
Absenteeism	.858	It is the best Alpha	
I work in a team	.889	It is the best Alpha	
Empathy	.857	It is the best Alpha	

Table 2 Descriptive statistics of the Cronbach Alpha Organizational Climate variable
Source: self made (2019)

The following tables show each of the variables compared with a categorical variable that in this case is "sex" in the first table of each one, you can see the groupings of the results according to the items and the dimensions of each one, and In the second table of each variable the rotated variable component was applied, for which "Varimax" was helpful, it was rotated several times and the final results are obtained in this work.

Rotating component matrix.

	Component							
	1	2	3	4	5	6	7	8
ORGANIZATIONAL CLIMATE - AUTONOMY 1	-0.012	0.028	-0.166	-0.173	0.137	0.851	0.090	0.137
ORGANIZATIONAL CLIMATE - AUTONOMY 2	0.245	0.126	0.016	-0.245	0.120	0.691	-0.472	-0.146
ORGANIZATIONAL CLIMATE - AUTONOMY 3	-0.064	0.281	0.168	-0.038	0.696	0.403	-0.003	0.081
ORGANIZATIONAL CLIMATE - AUTONOMY 4	0.301	0.516	0.169	0.052	0.255	0.175	-0.062	-0.418
ORGANIZATIONAL CLIMATE - AUTONOMY 5	0.137	0.185	0.005	-0.439	0.332	0.254	-0.104	-0.036
ORGANIZATIONAL CLIMATE - COHESION 6	-0.069	0.697	0.089	-0.199	0.226	0.206	-0.101	-0.126
ORGANIZATIONAL CLIMATE - COHESION 7	-0.051	0.841	0.247	0.064	-0.012	-0.217	-0.078	-0.063
ORGANIZATIONAL CLIMATE - COHESION 8	0.102	0.799	0.085	0.204	-0.087	0.071	0.207	0.089
ORGANIZATIONAL CLIMATE - COHESION 9	0.183	0.620	0.173	0.194	0.034	0.298	0.392	0.072
ORGANIZATIONAL CLIMATE - COHESION 10	0.112	0.757	-0.104	-0.193	0.323	-0.002	-0.058	0.049
ORGANIZATIONAL CLIMATE - TRUST 11	0.755	0.003	0.239	-0.009	-0.089	0.169	-0.040	-0.098
ORGANIZATIONAL CLIMATE - TRUST 12	0.765	0.031	-0.048	-0.073	0.061	0.223	0.193	-0.004
ORGANIZATIONAL CLIMATE - TRUST 13	0.762	0.082	0.037	-0.053	0.101	0.156	0.067	-0.165
ORGANIZATIONAL CLIMATE - TRUST 14	0.913	-0.071	0.026	-0.038	0.064	0.053	0.020	0.065
ORGANIZATIONAL CLIMATE - TRUST 15	0.733	0.062	0.042	0.203	0.335	-0.252	0.084	-0.044
ORGANIZATIONAL CLIMATE - PRESSURE16	0.279	0.021	0.100	0.327	-0.655	-0.127	-0.002	-0.017
ORGANIZATIONAL CLIMATE - PRESSURE17	0.308	0.286	0.086	0.095	0.624	-0.169	0.100	0.005
ORGANIZATIONAL CLIMATE - PRESSURE18	-0.082	0.100	0.236	0.851	-0.036	0.061	-0.040	-0.047
ORGANIZATIONAL CLIMATE - PRESSURE19	-0.200	-0.069	0.005	0.863	-0.002	-0.136	0.048	-0.079
ORGANIZATIONAL CLIMATE - PRESSURE20	0.050	0.116	-0.176	0.646	-0.063	-0.242	0.050	0.440
ORGANIZATIONAL CLIMATE - SUPPORT 21	0.911	0.041	0.109	-0.016	0.011	-0.104	-0.075	0.108
ORGANIZATIONAL CLIMATE - SUPPORT 22	0.789	-0.162	0.307	-0.159	0.182	-0.077	-0.176	0.034
ORGANIZATIONAL CLIMATE - SUPPORT 23	0.790	-0.204	0.274	-0.167	0.012	-0.047	-0.257	0.057
ORGANIZATIONAL CLIMATE - SUPPORT 24	0.860	0.175	0.070	-0.138	-0.110	0.045	0.043	0.053
ORGANIZATIONAL CLIMATE - SUPPORT 25	0.729	0.237	-0.010	0.165	-0.127	0.304	-0.089	-0.219
ORGANIZATIONAL CLIMATE - RECOGNITION 26	0.440	0.339	0.136	0.323	-0.223	0.019	-0.267	-0.060
ORGANIZATIONAL CLIMATE - RECOGNITION 27	-0.111	0.093	-0.011	0.129	0.058	-0.044	0.861	0.120
ORGANIZATIONAL CLIMATE - RECOGNITION 28	0.757	0.165	0.255	0.042	-0.090	0.296	0.095	0.192
ORGANIZATIONAL CLIMATE - RECOGNITION 29	0.402	0.373	0.504	0.047	0.019	-0.063	0.072	-0.119
ORGANIZATIONAL CLIMATE - RECOGNITION 30	0.344	-0.184	0.100	-0.025	0.239	0.268	-0.016	0.755
ORGANIZATIONAL CLIMATE - EQUITY 31	0.714	0.419	0.002	-0.126	-0.055	-0.188	-0.086	0.252
ORGANIZATIONAL CLIMATE - EQUITY 32	0.798	0.227	0.167	-0.100	0.162	-0.187	-0.084	0.155
ORGANIZATIONAL CLIMATE - EQUITY 33	0.261	0.240	0.476	0.130	-0.446	-0.094	0.136	0.505
ORGANIZATIONAL CLIMATE - EQUITY 34	0.606	-0.056	-0.047	-0.130	-0.294	-0.151	0.054	-0.027
ORGANIZATIONAL CLIMATE - EQUITY 35	0.398	-0.072	0.049	-0.212	-0.044	-0.026	0.640	-0.202
ORGANIZATIONAL CLIMATE - INNOVATION 36	0.676	0.076	0.427	0.132	-0.159	-0.051	0.197	0.242
ORGANIZATIONAL CLIMATE - INNOVATION 37	0.231	0.077	0.871	0.009	0.118	-0.140	-0.096	0.032
ORGANIZATIONAL CLIMATE - INNOVATION 38	0.229	0.162	0.826	0.098	0.006	0.049	0.049	0.017
ORGANIZATIONAL CLIMATE - INNOVATION 39	0.729	0.290	0.351	0.012	-0.130	0.047	0.146	0.287
ORGANIZATIONAL CLIMATE - INNOVATION 40	0.721	0.079	0.379	0.025	-0.019	0.134	0.306	0.276
Extraction method: principal component analysis. Rotation method: Varimax with Kaiser normalization.								
a. The rotation has converged in 7 iterations.								

Table 3 Descriptive statistics of Organizational Climate dimension, component matrix
Source: self made (2019)

The previous table shows the groupings of the different items, which measure a common objective of each variable, for example: items 6 to 10 measure the cohesion dimension, the support dimension is also integrated, as well as the trust.

Component Matrix								
	Component							
	1	2	3	4	5	6	7	8
PRODUCTIVITY - ABSENTISM 1	0.395	0.091	0.431	-0.664	-0.138	0.124	0.080	0.196
PRODUCTIVITY - ABSENTISM 2	0.780	0.233	-0.058	-0.346	0.023	-0.136	0.074	0.210
PRODUCTIVITY - ABSENTISM 3	0.801	0.378	0.030	0.170	0.156	0.064	0.007	-0.024
PRODUCTIVITY - ABSENTISM 4	0.625	0.495	-0.102	0.056	0.109	-0.258	0.306	-0.144
PRODUCTIVITY - ABSENTISM 5	0.582	-0.268	0.342	0.273	0.337	-0.045	0.123	0.026
PRODUCTIVITY - ABSENTISM 6	0.488	-0.164	0.484	0.351	-0.117	0.196	0.098	-0.207
PRODUCTIVITY - ABSENTISM 7	0.646	0.361	0.297	0.308	0.052	0.213	-0.211	0.165
PRODUCTIVITY - ABSENTISM 8	0.436	0.348	-0.387	0.396	-0.304	-0.157	0.212	0.178
PRODUCTIVITY - ABSENTISM 9	0.651	-0.189	-0.512	-0.056	-0.113	-0.021	-0.040	0.127

Table 4 Descriptive statistics of Productivity dimension, component matrix
Source: self made (2019)

Normality tests

The results of the data behaviors through kurtosis and asymmetry are shown below.

Descriptive statistics					
	N	Asymmetry		Kurtosis	
	Statistical	Statistical	Standard error	Statistical	Standard error
ORGANIZATIONAL CLIMATE - AUTONOMY 1	36	-.639	.393	.187	.768
ORGANIZATIONAL CLIMATE - AUTONOMY 2	36	-.059	.393	1.334	.768
ORGANIZATIONAL CLIMATE - AUTONOMY 3	36	-.467	.393	.895	.768
ORGANIZATIONAL CLIMATE - AUTONOMY 4	36	-.391	.393	.603	.768
ORGANIZATIONAL CLIMATE - AUTONOMY 5	36	-1.052	.393	.674	.768
Valid N (per list)	36				

Table 5 Asymmetry and kurtosis calculations of the Organizational Climate dimension
Source: self made (2019)

The results of the data behavior by means of Kolmogorov-Smirnov are shown below.

Normality tests					
	Kolmogorov-Smirnova			Shapiro-Wilk	
	Statistical	Gl	Sig.	Statistical	gl	Sig.
PRODUCTIVITY - TEAM WORK 12	.289	36	.000	.680	36	.000
PRODUCTIVITY - TEAM WORK 13	.287	36	.000	.728	36	.000
PRODUCTIVITY - TEAM WORK 14	.267	36	.000	.776	36	.000
PRODUCTIVITY - TEAM WORK 15	.298	36	.000	.764	36	.000
PRODUCTIVITY - TEAM WORK 16	.297	36	.000	.742	36	.000
PRODUCTIVITY - TEAM WORK 17	.299	36	.000	.764	36	.000
PRODUCTIVITY - TEAM WORK 18	.252	36	.000	.797	36	.000
PRODUCTIVITY - TEAM WORK 19	.367	36	.000	.686	36	.000
PRODUCTIVITY - TEAM WORK 20	.355	36	.000	.655	36	.000
a. Lilliefors significance correction						

Table 6 Kolmogorov-Smirnov calculations of the Productivity with teamwork dimension
Source: self made (2019)

NAVARRO-HERNANDEZ, Ana Rosa & CASTRO-VALENCIA, Alberto Merced. Productivity of the millennial generation in institutions of higher education. ECORFAN Journal-Republic of El Salvador. 2019

Normality tests						
Kolmogorov-Smirnova			Shapiro-Wilk			
	Statistical	gl	Sig.	Statistical	gl	Sig.
ORGANIZATIONAL CLIMATE - PRESSURE16	.264	36	.000	.865	36	.000
ORGANIZATIONAL CLIMATE - PRESSURE17	.308	36	.000	.849	36	.000
ORGANIZATIONAL CLIMATE - PRESSURE18	.265	36	.000	.815	36	.000
ORGANIZATIONAL CLIMATE - PRESSURE19	.230	36	.000	.825	36	.000
ORGANIZATIONAL CLIMATE - PRESSURE20	.169	36	.011	.891	36	.002
a. Lilliefors significance correction						

Table 7 Kolmogorov-Smirnov calculations Organizational Climate dimension – Pressure
Source: self made (2019)

Normality tests						
Kolmogorov-Smirnova			Shapiro-Wilk			
	Statistical	gl	Sig.	Statistical	gl	Sig.
ORGANIZATIONAL CLIMATE - TRUST 11	.317	36	.000	.765	36	.000
ORGANIZATIONAL CLIMATE - TRUST 12	.393	36	.000	.649	36	.000
ORGANIZATIONAL CLIMATE - TRUST 13	.291	36	.000	.758	36	.000
ORGANIZATIONAL CLIMATE - TRUST 14	.320	36	.000	.723	36	.000
ORGANIZATIONAL CLIMATE - TRUST 15	.295	36	.000	.779	36	.000
a. Lilliefors significance correction						

Table 8 Kolmogorov-Smirnov calculations of the Organizational Climate dimension – Trust
Source: self made (2019)

Normality tests						
Kolmogorov-Smirnova			Shapiro-Wilk			
	Statistical	gl	Statistical	gl	Statistical	gl
PRODUCTIVITY - ABSENTISM 1	.288	36	.000	.810	36	.000
PRODUCTIVITY - ABSENTISM 2	.313	36	.000	.762	36	.000
PRODUCTIVITY - ABSENTISM 3	.317	36	.000	.719	36	.000
PRODUCTIVITY - ABSENTISM 4	.279	36	.000	.765	36	.000
PRODUCTIVITY - ABSENTISM 5	.286	36	.000	.760	36	.000
PRODUCTIVITY - ABSENTISM 6	.285	36	.000	.790	36	.000
PRODUCTIVITY - ABSENTISM 7	.275	36	.000	.798	36	.000
PRODUCTIVITY - ABSENTISM 8	.323	36	.000	.758	36	.000
PRODUCTIVITY - ABSENTISM 9	.355	36	.000	.731	36	.000
PRODUCTIVITY - ABSENTISM 10	.267	36	.000	.762	36	.000
PRODUCTIVITY - ABSENTISM 11	.255	36	.000	.784	36	.000
a. Corrección de significación de Lilliefors						

Table 9 Kolmogorov-Smirnov calculations of the Productivity dimension – Absenteeism
Source: self made (2019)

Annexes

Next, the 40 items of the instrument applied in the Organizational Climate variable are shown.

Autonomía	1.- Tomo la mayor parte de las decisiones para que influyan en la forma en que desempeño mi trabajo.
	2.- Yo decido el modo en que ejecutaré mi trabajo.
	3.- Yo propongo mis propias actividades de trabajo.
	4.- Determino los estándares de ejecución de mi trabajo.
	5.- Organizo mi trabajo como mejor me parece.
Cohesión	6.- Las personas que trabajan en mi empresa se ayudan los unos a los otros.
	7.- Las personas que trabajan en mi empresa se llevan bien entre sí.
	6.- Las personas que trabajan en mi empresa se ayudan los unos a los otros.
	7.- Las personas que trabajan en mi empresa se llevan bien entre sí.
	8.- Las personas que trabajan en mi empresa tienen un interés personal el uno por el otro.
	9.- Existe espíritu de "trabajo en equipo" entre las personas que trabajan en mi empresa.
	10.- Siento que tengo muchas cosas en común con la gente que trabaja en mi unidad.
Confianza	11.- Puedo confiar en que mi jefe no divulgue las cosas que le cuento en forma confidencial.
	12.- Mi jefe es una persona de principios definidos.
	13.- Mi jefe es una persona con quien se puede hablar abiertamente.
	14.- Mi jefe cumple con los compromisos que adquiere conmigo.
	15.- No es probable que mi jefe me dé un mal consejo.
Presión	16.- Tengo mucho trabajo y poco tiempo para realizarlo.
	17.- Mi institución es un lugar relajado para trabajar.
	18.- En casa, a veces temo oír sonar el teléfono porque pudiera tratarse de alguien que llama sobre un problema de trabajo.
	19.- Me siento como si nunca tuviese un día libre.
	20.- Muchos de los trabajadores de mi empresa en mi nivel, sufren de un alto estrés, debido a la exigencia de trabajo.
Apoyo	21.- Puedo contar con la ayuda de mi jefe cuando lo necesito.
	22.- A mi jefe le interesa que me desarrolle profesionalmente.
	23.- Mi jefe me respalda 100%.
	24.- Es fácil hablar con mi jefe sobre problemas relacionados con el trabajo.
	25.- Mi jefe me respalda y deja que yo aprenda de mis propios errores.
Reconocimiento	26.- Puedo contar con una felicitación cuando realizo bien mi trabajo.
	27.- La única vez que se habla sobre mi rendimiento es cuando he cometido un error.
	28.- Mi jefe conoce mis puntos fuertes y me los hace notar.
	29.- Mi jefe es rápido para reconocer una buena ejecución.
	30.- Mi jefe me utiliza como ejemplo de lo que se debe hacer.
Equidad	31.- Puedo contar con un trato justo por parte de mi jefe.
	32.- Los objetivos que fija mi jefe para mi trabajo son razonables.
	33.- es poco probable que mi jefe me halague sin motivos.
	34.- Mi jefe no tiene favoritos.
	35.- Si mi jefe despide a alguien es porque probablemente esa persona se lo merece.
Innovación	37.- A mi jefe le agrada que yo intente hacer mi trabajo de distintas formas.
	38.- Mi jefe me anima a mejorar formas de hacer las cosas.
	39.- Mi jefe me anima a encontrar nuevas formas de enfrentar antiguos problemas.
	40.- Mi jefe "valora" nuevas formas de hacer las cosas.

Table 10 40 items of the instrument applied in the Organizational Climate variable
Source: self made (2019)

The 25 items of the instrument applied in the Productivity variable are shown below.

Dimensión	Indicador
Absentismo	1.- Comparte sus conocimientos laborales en beneficio de sus compañeros.
	2.- Aplica los valores institucionales en su puesto de trabajo.
	3.- Es leal con sus superiores.
	4.- Mantiene buenas relaciones interpersonales con sus compañeros.
	5.- Le gusta participar en actividades de grupo.
	6.- Evita hacer murmuraciones de sus compañeros.
	7.- Mantiene el control físico y administrativo sobre el material, equipo y enseres bajo su responsabilidad.
	8.- Es puntual con la entrega de trabajos que se le asignan.
	9.- Mantienen una actividad positiva ante los cambios que se generan en la organización.
	10.- En ausencia de su inmediato superior, asume responsabilidad.
	11.- Evita ser sancionado por realizar trabajos personales dentro del horario de trabajo.
Trabajo en equipo	12.- Acepta la ayuda de otros para superar las metas establecidas.
	13.- Posee la capacidad de atender asuntos laborales bajo presión.
	14.- Aunque no se le solicite, brinda más tiempo del requerido.
	15.- Cumple con los procedimientos administrativos establecidos en la unidad.
	16.- Posee los conocimientos adecuados para desempeñarse en el puesto que actualmente ocupa.
	17.- Se preocupa por superarse académicamente, asistiendo a cursos de capacitación.
	18.- Aplica sus conocimientos en beneficio de otros compañeros de trabajo en la realización de sus tareas.
	19.- Participa con entusiasmo y atención a las reuniones de trabajo.
	20.- Participa con entusiasmo y atención a las capacitaciones programadas.
Empatía	21.- Falta a sus labores, cuando es una verdadera emergencia.
	22.- Hace buen uso del equipo e instrumentos de trabajo.
	23.- Aplica nuevos conocimientos en su lugar de trabajo.
	24.- Efectúa aportes de carácter académico o técnico que sea de beneficio a su unidad.
	25.- Consulta e investiga manuales que tengan relación con su trabajo.

Table 11 25 items of the instrument applied in the Productivity variable
Source: self made (2019)

Acknowledgments

Conclusions and recommendations

In the present work you can see the different statistical tests that were applied, as well as their results in each one, definitely you must change some items that in each test are indicated, for example, in the Cronbach's Alpha it had to be run several times due because the final result did not increase, after one or even three times after running it the result improves, indicating that the reliability increases.

In the present work, the various statistical tests were carried out to review the instruments of each of the variables: organizational climate and productivity, in relation to the work environment in general, the statistical tests validate the reliability and normality of each of the items in a 90% and in the case of productivity, good evidence is argued from 90% to 100%, however, in the thesis from which the instrument was obtained, statistics are not argued, that is; They are not so it is decided to propose gold model to measure productivity called "EFO" in which 16 items are presented which aim to measure productivity.

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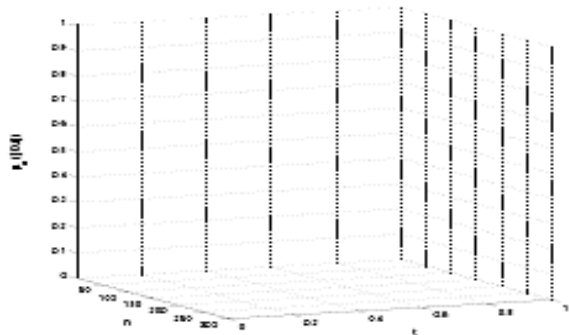
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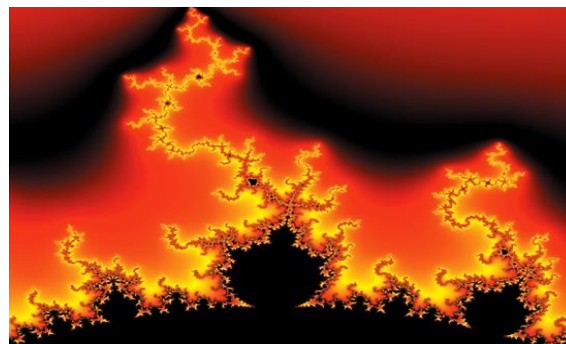
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