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Title: Application of Dmaic Methodology in the production process of artisan brick making

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INTRODUCTION

BACKGROUND

▶ The history of the brick is the history of civilization, the architecture began when 2 bricks were joined. Brick is an older man-made building material. (W. P. Campbell, 2004 and Sánchez, 2013).

▶ The importance of evaluating the parameters that affect the productivity of a company determines a process of change that will bring significant benefits to the company.

•   Internal factors such as:

1.   Availability of raw materials,

2.   Skilled labor, state policies regarding taxation and

tariffs and existing infrastructure

CIUDAD JUÁREZ LOCATION

Juárez city. Mexico City, located in the north of the country, in the state of Chihuahua, on the banks of the Rio Bravo. Across the river, in US territory, is the city of El Paso (Texas). Due to its population of 1,332,131 in 2010, it is the largest city in the State of Chihuahua and the eighth largest metropolitan area in Mexico.(Inegi,2010)
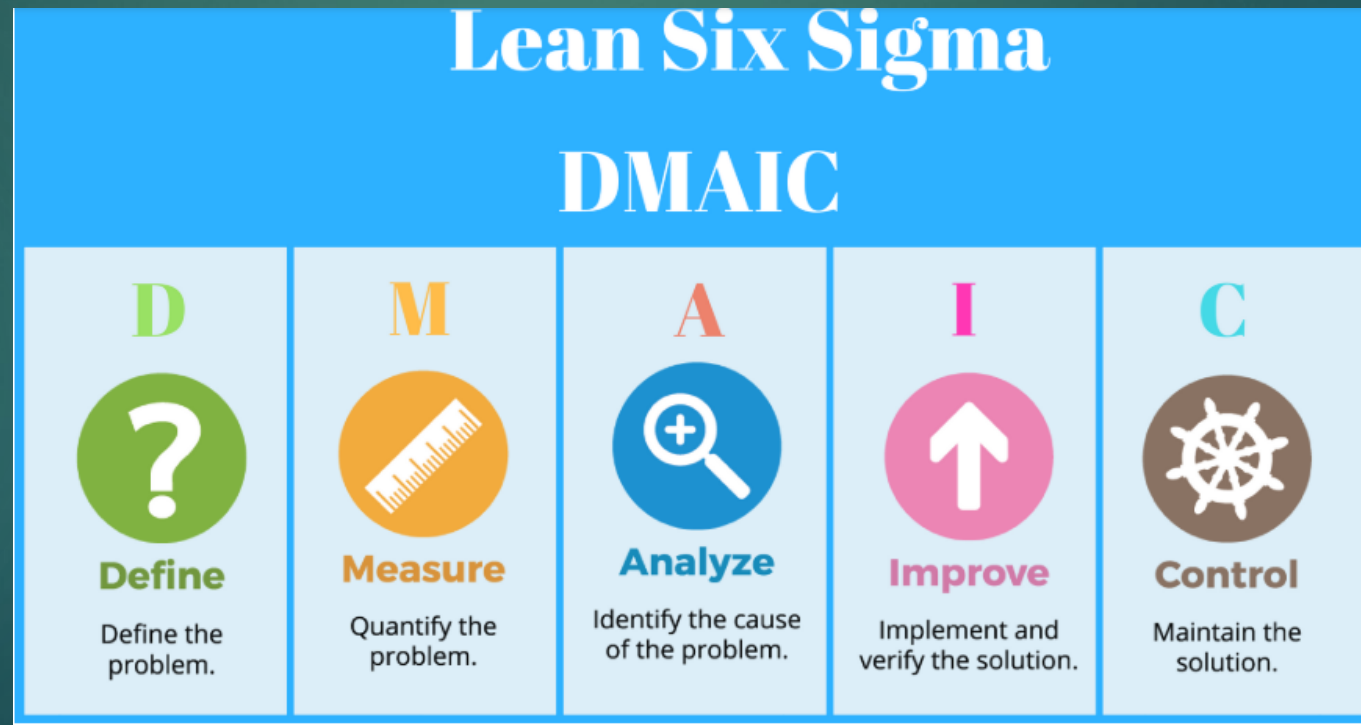
Table 2. Population and Education of workers in the brickyards of Juárez, Chih.

Temática: Education		
Corte: Municipality or delegation		
Indicator	Absoluto	Porcentual
Population aged 15 and over without schooling	25,816	3 %
Male population aged 15 years and over without schooling	12,135	2.8 %
Population aged 15 and over with incomplete basic education	308,340	35.5 %

In relation to Table 2, it can be said that most of the population in brickyards and specifically those at kilometer 20, the majority of workers have an average age of 50 years and are those who carry out these activities of making bricks and all of them do not have schooling.

ANALYSIS FROM THE METHOD

▶ The study of the DMAIC methodology in the brick manufacturing process allows us to attack improvement projects or to solve problems.

Lean Six Sigma
DMAIC

D	**M**	**A**	**I**	**C**
Define	**Measure**	**Analyze**	**Improve**	**Control**
Define the problem.	Quantify the problem.	Identify the cause of the problem.	Implement and verify the solution.	Maintain the solution.

ANALYSIS FROM THE METHOD

First step of DMAIC method:

▶ Define the Project

The problem to be solved lies in the manufacture of bricks (partitions) of 30 cm x 10 cm width x 5 cm height, nominal measurements according to standard N-CMT-2-01-001-02 which have been found to have variability in the process affecting product quality.

Currently it has been found that the wooden mold only allows to obtain 3 bricks and the mold could be improved to double the production, in addition a table could be adapted that makes it easier for the worker to place the mold without having to bend down.
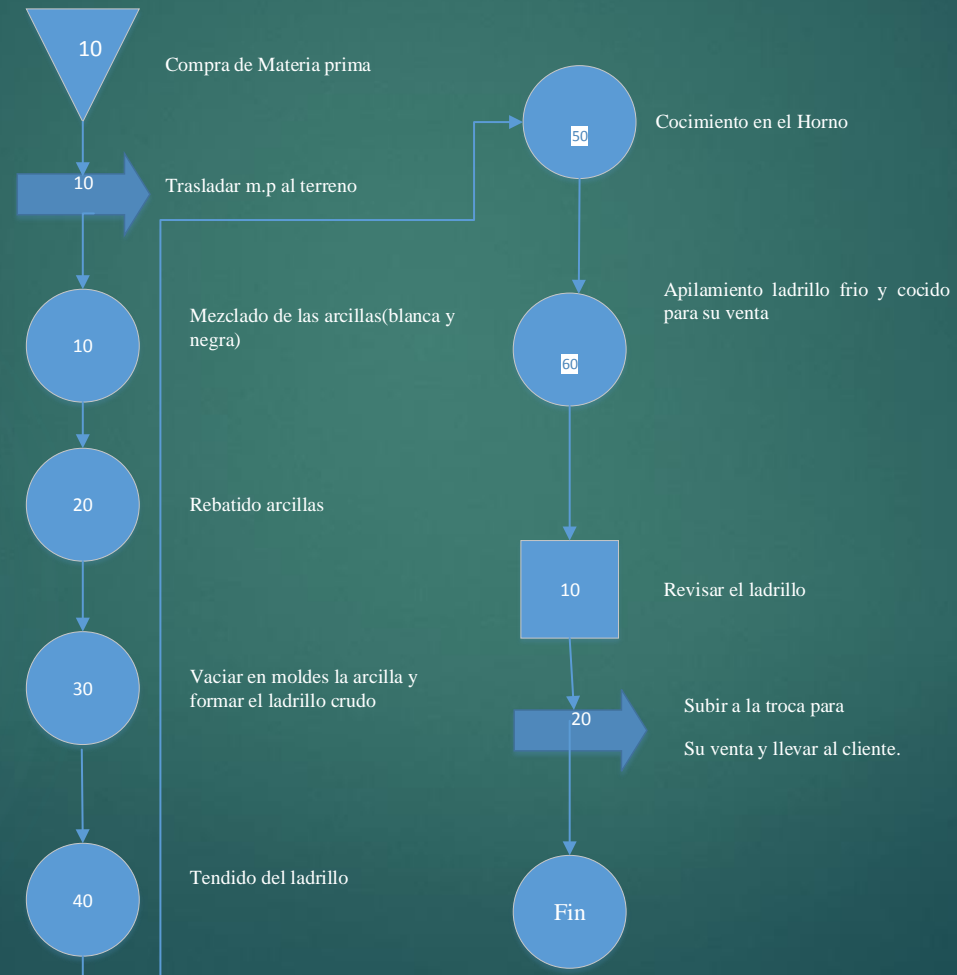
CURRENT MOLD TO MAKE BRICKS

BRICK WITH BAD QUALITY

BRICK WITH GOOD QUALITY

Flow diagram of the process Brick making.

10	Compra de Materia prima
10	Trasladar m.p al terreno
10	Mezclado de las arcillas(blanca y negra)
20	Rebatido arcillas
30	Vaciar en moldes la arcilla y formar el ladrillo crudo
40	Tendido del ladrillo
50	Cocimiento en el Horno
60	Apilamiento ladrillo frio y cocido para su venta
10	Revisar el ladrillo
20	Subir a la troca para Su venta y llevar al cliente.
Fin	

Pour clay into the mold.

Brick laying

Stack the brick

MEASURE

Sub grupo	Observaciones Ancho		
	1	2	3
1	6	5.5	5.6
2	6.3	6.4	6
3	6.8	6	6.2
4	6	6	5.5
5	5.5	5.4	5.5
6	5.5	5.4	5.5
7	5.4	5.5	5.6
8	5.6	6	6.4
9	6.5	6.4	6.5
10	6.5	6	6

Table 8. Observations of the width of the Bricks

Sub grupo	Observaciones Largo		
	1	2	3
1	18	20	18
2	20	20	17.5
3	18	19	18
4	18	18	18.3
5	18	18.1	18.2
6	18	18.4	18
7	18	17.5	20
8	20	21	20
9	21.5	22	19.5
10	19.5	20	19.5

Table 9. Brick Length Observations.
Source: self made

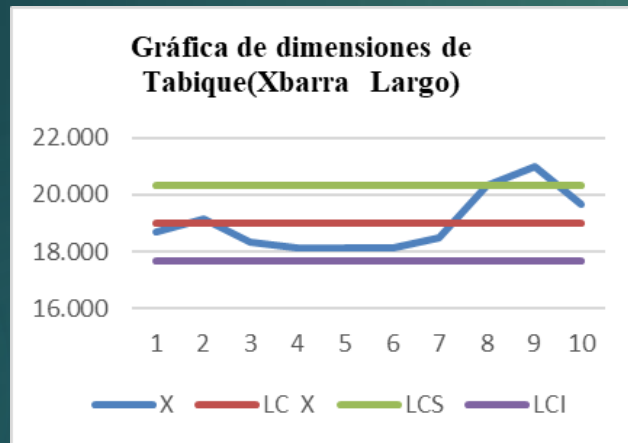| Sub grupo	Observaciones Ancho		
	1	2	3
1	3.5	4	3.7
2	3.8	3.6	3.9
3	3.7	3.8	3.6
4	3.5	3.5	3.5
5	3.5	4	4
6	4	4	4
7	3.5	3.5	3
8	3.2	3	3
9	3	3.2	3
10	3	3	3

Table 10. Height of the Bricks Observations.

Table 6. Taking time of the brick molding. Source: self made.

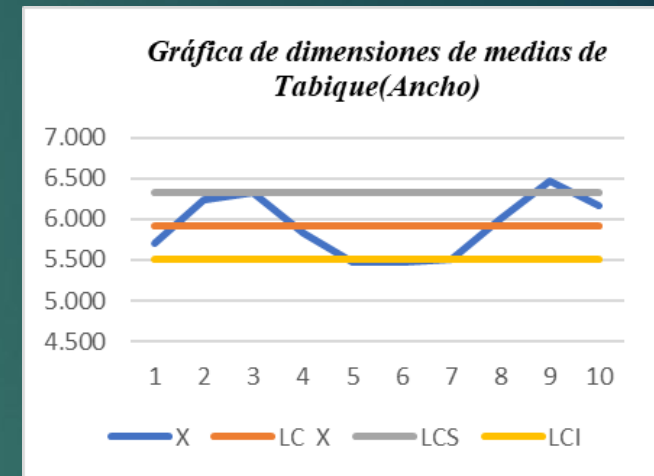| Toma de tiempos del moldeo del ladrillo (tiempo en segundos)										
Numero de proceso y descripción	Limpieza y colocación del molde	Llenado del molde con arcilla	Acomodo de la arcilla	Retiro del exceso	Alinear la mezcla con agua	Retiro del molde				Tiempo final
Tiempos del molde de 3 slots	3.98	8	6.37	11.02	13.29	2.27				44.93
Tiempo del nuevo modelo de molde	4.02	2	13	2	8	3	9.09	3	12	56.11
Numero de proceso y descripción en el nuevo modelo de molde	Limpieza con agua de todo el molde	Se baja el molde principal	llenado del molde con arcilla	Se cierra la tapa con la ranura	Retiro de exceso	Se levanta el molde	Se baja a la altura de la mesa	Se retira el plástico con los ladrillos	Se levanta la mesa nuevamente	

ANALYSE

▶ It can be seen that not all points are within statistical limits, both in width, length and height. For which a stable production system is not considered, it is probable that there is a special cause that could be studied
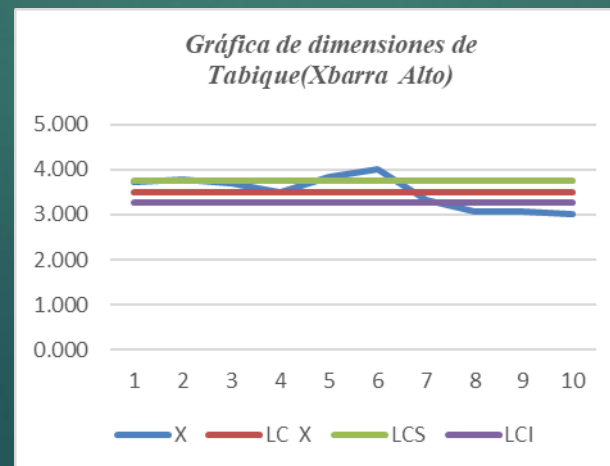
Observation chart of brick averages (Width)

Brick Range Observations Chart (Length)

Gráfica de dimensiones de Tabique(Xbarra Largo)

Gráfica de dimensiones de medias de Tabique(Ancho)

Half-brick dimensions chart (Height)

Gráfica de dimensiones de Tabique(Xbarra Alto)

RESULTS

Quote of the material to make a mold proposal

Cotización y datos del material						
Material	Empresa	Descripción	Medidas	Cantidad	Datos adicionales	Costos
Llantas	Hágalo	Rotatorias	3 pulgadas	2		450.00
Tubo	Hágalo	Fierro	610 cm x 3.5cm	1		450.00
Tornillos	Home Depot	Fierro	2" 1/4 pulgada	50	Buscarrosca negro	54.50
Bisagra	Home Depot	Fierro	3" x 3"	4		342.00
Madera	Home Depot	Madera	4"x 45"x 40"	4	Personalizada	1680.00
Barra	Home Depot	Fierro	4cm x 200cm x 4cm	2	Personalizada	294.00
Construcción y corte	Carpintería Hernández	Madera			Se cortaran las piezas para darle forma al molde	600.00
Corte y soldado de metal	Carpintería Hernández	Fierro			Se cortaran las piezas para darle forma al molde	300.00
Costo del material						3270.50
Costo de mano de obra						900.00
Costo de producción						4170.50

IMPROVE

It is worth mentioning that the material cost is $ 3,270.50 pesos, the material cost will be $ 900.00 pesos and the production cost of $ 4,170.00 pesos.

CONCLUSION

▶ The success of using the DMAIC methodology depends not only on knowledge of statistical methods, but also on the commitment of the owners to lead this change. The situation found in this type of business is that the necessary ergonomic and infrastructure requirements were not met in order to increase productivity, and it did not have effective quality management. It is intended that productivity increases from 40% to 80% and that the worker is not injured by the use of anti-ergonomic molds and has a better quality of life.

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