

## Statistical analysis system to support the quality department

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### Abstract

In this article, a system is designed and developed which, through statistical analysis, allows the quality department of a maquiladora company to take into account the main activity carried out by the quality engineer, to take measurements of the critical characteristics of five groups of twenty-five pieces each of the manufactured product. This is done for every shift, and it is intended that through a statistical analysis using graphs it is clearer and easier to understand the behavior of the data, to detect measurements out of specification and to be possible to anticipate failures in order to comply with the main activity mentioned above. As a result we have a system that graphs the data and shows the results of a system that graphs the data and shows the alerts of Nelson's rules applied to the set. Alerts of the Nelson rules applied to the set. The system was designed and developed with Visual Studio 2012, ASP.NET (MVC 4, JavaScript, HTML5, Razor, Bootstrap) and C # (Entity Framework, Linq, Lambda Expressions). The database used to store the information is MS SQL Server 2008.

**Quality, System, ASP.NET, C#**

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**Introduction**

Frequently in maquila companies, measurements of characteristics considered critical are made manually, due to the absence of a computer tool.

In the study of this article, it has to be according to an established procedure, based on the rules of 6 Sigma, the quality engineer is responsible for taking measurements of the critical characteristics of five different groups of twenty-five pieces each, The previous one is carried out during the assigned shifts, and by means of a statistical analysis, it must detect out-of-spec measurements and, if possible, anticipate failures.

**Justification**

The development and use of computer systems can facilitate the process to detect failures in time and form, considering the critical characteristics of the different groups that exist, through a statistical analysis.

**Problem**

At the moment of performing a detailed analysis of the activity (as mentioned at the beginning) that the quality engineer performs, it was detected that the lack of understanding of the behavior of the data, as well as the time invested, is the cause of these activities are not completed.

**Hypothesis**

The use of a system that through statistical analysis, will allow support in the area or department of quality, with the aim of facilitating decision-making, when detecting measurements outside of specification and anticipating possible failures.

**Objectives****General Objective**

Design and develop a system that through a statistical analysis can be used to support the quality department of a manufacturing company.

**Specific Objectives**

- Identify the elements involved in the statistical analysis.
- Design and develop a system using Visual Studio 2012, ASP.NET (MVC 4, JavaScript, HTML5, Razor, Bootstrap) and C # (Entity Framework, Linq, Lambda Expressions), which indicate as a result a graph of the data and sample Nelson rules alerts applied to the set.
- Design a database in MS SQL Server 2008 to store the records the values taken by the quality engineers.

**Theoretical framework**

Visual Studio is part of the family of integrated development environments (IDE). It supports numerous activities linked to the development of applications, such as the creation of graphical interfaces, assisted code inclusion, etc. (Guérin, 2016).

The .NET framework has two main components: the Common Language Runtime CLR and the .NET Framework class library, which includes ADO.NET, ASP.NET and Windows Forms. (Arias, 2015). Applications for the .NET platform can be written in the C # language, which is an Object Oriented language.

The ASP.NET MVC is an architecture pattern that provides an alternative to ASP.NET Web Forms, for the creation of Web applications based on the MVC (Model View Controller). (Arias, 2015).

The ASP.NET MVC is a pattern where the model, the visualization and the controllers are separated in layers. (Arias, 2015).

Razor is one of the two default view engines that ASP.NET has, introduced for the first time in MVC 3. (González, 2015).

JavaScript is a programming language, interpreted, oriented to objects, based on prototypes and first-class functions, better known as the Web's scripting language. It is the programming language that Netscape created to give life to your browser. (Ayoze, 2017).

HTML (Hyper Text Markup Language) is a language of labels (Van Lancher, 2012). HTML 5 is the fifth revision of the standard markup language used for the web. It is one of the most used languages for this purpose, since with it it is possible to create the structure of a web page. Text, images and multimedia material can be displayed correctly.

Bootstrap is a framework or set of open source tools for designing web sites and applications. It contains design templates with typography, forms, buttons, boxes, navigation menus and other HTML-based design elements, as well as additional optional JavaScript extensions.

SQL Server 2008 is Microsoft's enterprise-class database server, designed to compete with products such as Oracle and IBM DB2. Allows you to store, retrieve and manipulate data to meet your organization's business goals. (Chapple, 2008).

## Research Methodology

### Software Development Methodology

The system was developed with Visual Studio 2012, ASP.NET (MVC 4, JavaScript, HTML5, Razor, Bootstrap) and C # (Entity Framework, Linq, Lambda Expressions).

A system was designed and developed that serves as support for statistical analysis, which facilitates the activity of the area engineer or quality department.

The system was developed with Visual Studio 2012, ASP.NET (MVC 4, JavaScript, HTML5, Razor, Bootstrap) and C # (Entity Framework, Linq, Lambda Expressions).

The following figure shows the main page in which you can enter the area to which you want to apply the analysis or enter a new feature.



**Figure 1** System start screen

*Source: own elaboration*

The following figure shows the window in which a critical characteristic can be registered. Data are requested such as the description of the characteristic, the model of the product, the field in which the value is recorded (if there is equipment that makes and record the measurements automatically), the operation of the characteristic and the limits of Top specification (USL) and lower (LSL).

**Figure 2** Entry of critical features  
*Source: own elaboration*

Once the critical features are entered, they are displayed in the main window, when the line is entered.

From this screen, data can be entered manually into the system database or can be plotted either from an external database (when the data is read through a PLC and entered into a database), it can be read the data entered manually or you can plot data from a text file.

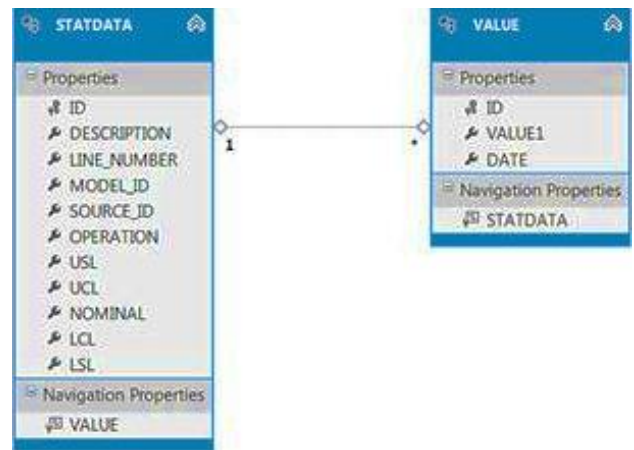
KEY IN	DESCRIPTION	LINE	MODEL	USL	LSL	CHART/EDIT
	CLAMPING STRENGTH#1	127	S4241172_110_01	3900	3600	
	CLAMPING STRENGTH#2	127	S4241172_110_01	3900	3600	
	CLAMPING STRENGTH#1	127	S4241172_110_01	3900	3600	
	CLAMPING STRENGTH#2	127	S4241172_110_01	3900	3600	
	DISTANCE FROM CENTER OF INFLATOR TO RIGHT EDGE	127	#	145	135	
	DISTANCE FROM CENTER OF INFLATOR TO LEFT EDGE	127	#	40	30	
	EDGE OF CHAIN STITCH TO BAG EDGE LEFT SIDE	127	#	5	0	
	EDGE OF CHAIN STITCH TO BAG EDGE RIGHT	127	#	5	0	

**Figure 3** High critical characteristics  
*Source: own elaboration*

The following figure shows the manual data entry window to the system.

**Figure 4** Data entry to the system  
*Source: own elaboration*

The database used to store the information is MS SQL Server 2008. The following figure shows the tables that are used to store the records of the lines as well as the values registered by the quality engineers.



**Figure 5** Tables used by the system  
*Source: own elaboration*

**Results**

Once the information collection form has been selected, the system graphs the data and shows the alerts of the Nelson rules applied to the set. Nelson's rules are a set of methods that detect trends in the analyzed data. The system also shows the following values: Upper and Lower Specification Limit as well as the following values, which are calculated automatically: Upper and Lower Control Limits, average and standard deviation.



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