ASEGURAMIENTO DE LA CALIDAD DE SOFTWARE

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2021 - 2022

DESCRIPCION

En la materia se desarrolla los contenidos fundamentales acerca de la Calidad de Software en el contexto de la Ingeniería de Calidad. Se insiste en los métodos y prácticas de SQA y en la mejora continua de los procesos de desarrollo de software

CONTRIBUCION

Los contenidos de la materia aportan en la formación de los estudiantes de la Carrera con los métodos y prácticas de gestión de la calidad para el ciclo de vida del software

CALIDAD

Conjunto de propiedades y de características de un producto o servicio, que le confieren aptitud para satisfacer una necesidades explícitas o implícitas (ISO 8402)

Shewhart's DEFINITION OF QUALITY

If we are to talk intelligently about the quality of a thing or the quality of a product, we must have in mind a clear picture of what we mean by quality. Enough has been said to indicate that there are two common aspects of quality. One of these has to do with the consideration of the quality of a thing as an objective reality independent of the existence of man. The other has to do with what we think, feel or sense as a result of the objective reality.

In other words, there is a subjective side of quality. For example, we are dealing with the subjective concept of quality when we attempt to measure the goodness of a thing, for it is impossible to think of a thing as having goodness independent of some human want. In fact, this subjective concept of quality is closely tied up with the utility or value of the objective physical properties of the thing itself.

For the most part, we may think of the objective quality characteristics of a thing as being constant and measurable in the sense that physical laws are quantitatively expressible and independent in time.

When we consider quality from a subjective viewpoint, comparatively serious difficulties arise. To begin with, there are various aspects of the concept of value. We may differentiate between the following four kinds of value:

1. Use.
2. Cost
3. Esteem
4. Exchange.

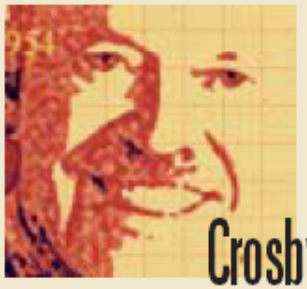
From the viewpoint of control of quality in manufacture, it is necessary to establish standards of quality in a quantitative manner. For this reason we are forced at the present time to express such standards, insofar as possible, in terms of quantitatively measurable physical properties. This does not mean, however, that the subjective measure of quality is not of interest. On the contrary, it is the subjective measure that is of commercial interest ...

Looked at broadly, there are, at a given time, certain human wants to be fulfilled through the fabrication of raw materials into finished products of different kinds. These wants are statistical in nature in that the quality of a finished product in terms of the physical characteristics wanted by one individual is not the same for all individuals.

The first step of the engineer in trying to satisfy these wants is, therefore, that of translating as nearly as possible these wants into physical characteristics of the thing manufactured to satisfy these wants. In taking this step, intuition and judgment play an important role as well as the broad knowledge of the human element involved in the wants of individuals. The second step of the engineer is to set up ways and means of obtaining a product which will differ from the arbitrarily set standards for these quality characteristics by no more than may be left to chance.

WALTER A. SHEWHART

From W.A. Shewhart, *Economic Control of Quality of Manufactured Product* (New York: D. Van Nostrand Co., 1931), pp. 53-54.



Crosby's DEFINITION OF QUALITY

The first erroneous assumption is that quality means goodness, or luxury, or shininess, or weight. The word "quality" is used to signify the relative worth of things in such phrases as "good quality," "bad quality" and that brave new statement "quality of life." "Quality of life" is a cliché because each listener assumes that the speaker means exactly what he or she, the listener, means by the phrase. That is precisely the reason we must define quality as "conformance to requirements" if we are to manage it. ...

In business the same is true. Requirements must be clearly stated so they cannot be misunderstood. Measurements are then taken continually to determine conformance to those requirements. The nonconformance detected is the absence of quality. Quality problems become nonconformance problems, and quality becomes definable.

PHILIP B. CROSBY

From Philip B. Crosby, *Quality is Free* (New York: McGraw-Hill Book Co., 1979), p. 7.

Deming's DEFINITION OF QUALITY

The problems inherent in attempts to define the quality of a product, almost any product, were stated by the master, Walter A. Shewhart. The difficulty in defining quality is to translate future needs of the user into measurable characteristics, so that a product can be designed and turned out to give satisfaction at a price that the user will pay. This is not easy, and as soon as one feels fairly successful in the endeavor, he finds that the needs of the consumer have changed, competitors have moved in, there are new materials to work with, some better than the old ones, some worse; some cheaper than the old ones, some dearer ...

What is quality? Quality can be defined only in terms of the agent. Who is the judge of quality?

In the mind of the production worker, he produces quality if he can take pride in his work. Poor quality, to him, means loss of business and perhaps of his job. Good quality, he thinks, will keep the company in business. All this is true in the service industries as it is in manufacturing.

Quality to the plant manager means to get the numbers out and to meet specifications. His job is also, whether he knows it or not, continual improvement of processes and continual improvement of leadership.

W. EDWARDS DEMING

From W. Edwards Deming, *Out of the Crisis* (Cambridge, MA: Massachusetts Institute of Technology, Center for Advanced Engineering Study, 1988).

Feigenbaum's

DEFINITION OF QUALITY

Quality is a customer determination, not an engineer's determination, not a marketing determination, [n]or a general management determination. It is based upon the customer's actual experience with the product or service, measured against his or her requirements—stated or unstated, conscious or merely sensed, technically operational or entirely subjective—and always representing a moving target in a competitive market.

Product and service quality can be defined as: The total composite product and service characteristics of marketing, engineering, manufacture and maintenance through which the product and service in use will meet the expectations of the customer.

ARMAND V. FEIGENBAUM

From A.V. Feigenbaum, *Total Quality Control*, third edition (New York: McGraw-Hill Book Co., 1983).

Juran's

DEFINITION OF QUALITY

The word quality has multiple meanings. Two of those meanings dominate the use of the word:

1. Quality consists of those product features which meet the needs of customers and thereby provide product satisfaction.
2. Quality consists of freedom from deficiencies.

It would be most convenient to have some short phrase which is universally accepted as a comprehensive definition of quality; i.e., so that it includes the product features which lead to product satisfaction and in addition includes freedom from deficiencies. Various such phrases have been proposed by practitioners but none has achieved universal acceptance.

Nevertheless, in a handbook such as this [*Juran's Quality Control Handbook*, fourth edition] it is most convenient to standardize on a short definition of the word "quality" ... as "fitness for use."

JOSEPH M. JURAN

From *Juran's Quality Control Handbook*, fourth edition. J.M. Juran, editor-in-chief, Frank M. Gryna, associate editor (New York: McGraw-Hill Book Co., 1988), pp. 2.2, 2.8.

Ishikawa's DEFINITION OF QUALITY

We engage in quality control in order to manufacture products with the quality which can satisfy the requirements of consumers. The mere fact of meeting national standards or specifications is not the answer. It is simply insufficient.

Japanese Industrial Standards (JIS) or international standards established by the International Organization for Standardization or the International Electrotechnical Commission are not perfect. They contain many shortcomings. Consumers may not be satisfied with a product which does meet JIS. We must also keep in mind that consumer requirements change from year to year. Generally even when industrial standards are modified, they cannot keep pace with consumer requirements.

We must emphasize consumer orientation. Heretofore, it has been acceptable for manufacturers to think that they are doing consumers a favor by selling their products to them. Let us call this a "product out" type of operation.

What I propose is a system of "market in," in which consumer requirements are to be of the utmost concern. In practical terms, I propose that manufacturers study the opinions and requirements of consumers and take them into account when they design, produce and sell their products. When developing a new product, a manufacturer must anticipate consumers' requirements and needs.

How one interprets the term "quality" is important. ... Narrowly interpreted, quality means quality of product. Broadly interpreted, quality means quality of work, quality of service, quality of information, quality of process, quality of division, quality of people, including workers, engineers, managers and executives, quality of system, quality of company, quality of objectives, etc.

KAORU ISHIKAWA

From Kaoru Ishikawa, *What is Total Quality Control? The Japanese Way* (Englewood Cliffs, NJ: Prentice-Hall Inc., 1985), pp. 44-45.

Pirsig's DEFINITION OF QUALITY

A few days later he [Phaedrus, the central character in Pirsig's novel] worked up a definition of his own and put it on the blackboard to be copied for posterity. The definition was: "Quality is a characteristic of thought and statement that is recognized by a nonthinking process. Because definitions are a product of rigid, formal thinking, quality cannot be defined."

The fact that this "definition" was actually a refusal to define did not draw comment. The students had no formal training that would have told them his statement was, in a formal sense, completely irrational. If you can't define something you have no formal rational way of knowing that it exists. Neither can you really tell anyone else what it is. There is, in fact, no formal difference between inability to define and stupidity. When I say, "Quality cannot be defined," I'm really saying formally, "I'm stupid about quality."

Fortunately the students didn't know this. If they'd come up with these objections he wouldn't have been able to answer them at the time.

But then, below the definition on the blackboard, he wrote, "But even though quality cannot be defined, you know what quality is!," and the storm started all over again.

"Oh, no we don't!"

"Oh, yes you do."

"Oh, no we don't!"

"Oh, yes you do!" he said, and he had some material ready to demonstrate it to them.

He had selected two samples of student composition. The first was a rambling, disconnected thing with interesting ideas that never built into anything. The second was a magnificent piece by a student who was mystified himself about why it had come out so well. Phaedrus read both, then asked for a show of hands on who thought the first was best. Two hands went up. He asked how many liked the second better. Twenty-eight hands went up.

"Whatever it is," he said, "that caused the overwhelming majority to raise their hands for the second one is what I mean by quality. So you know what it is!"

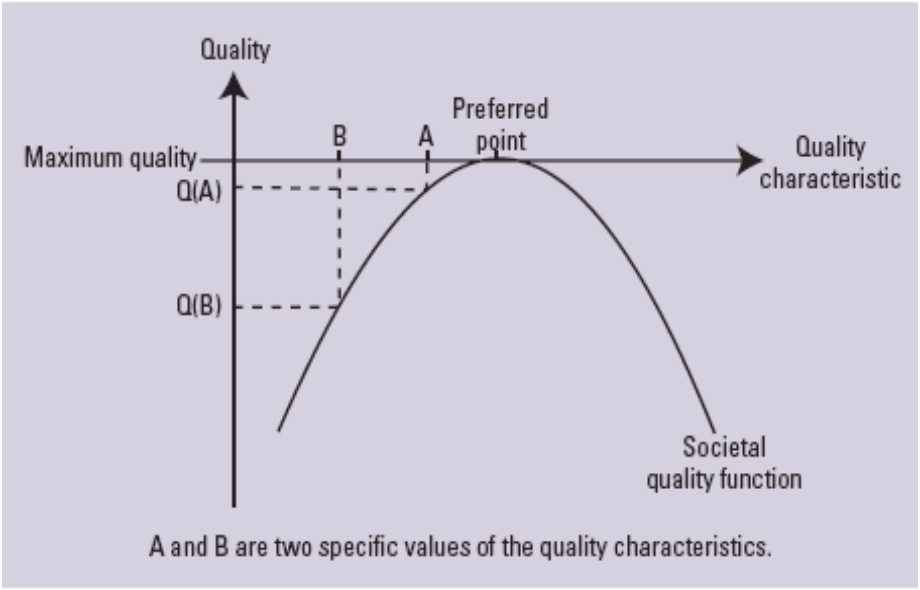
There was a long reflective silence after this, and he just let it last.

This was just intellectually outrageous, and he knew it. He wasn't teaching anymore, he was indoctrinating.

ROBERT M. PIRSIG

From Robert M. Pirsig, *Zen and the Art of Motorcycle Maintenance* (New York: William Morrow & Co., 1974), pp. 206-207.

FIGURE 1 Societal Quality Function



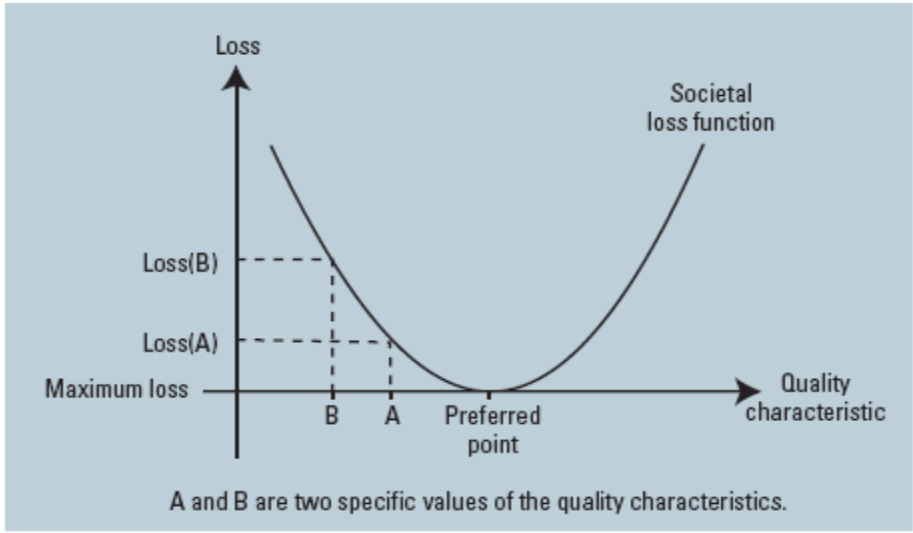
Taguchi's DEFINITION OF QUALITY

Quality is the loss a product causes to society after being shipped ... other than any losses caused by its intrinsic function.

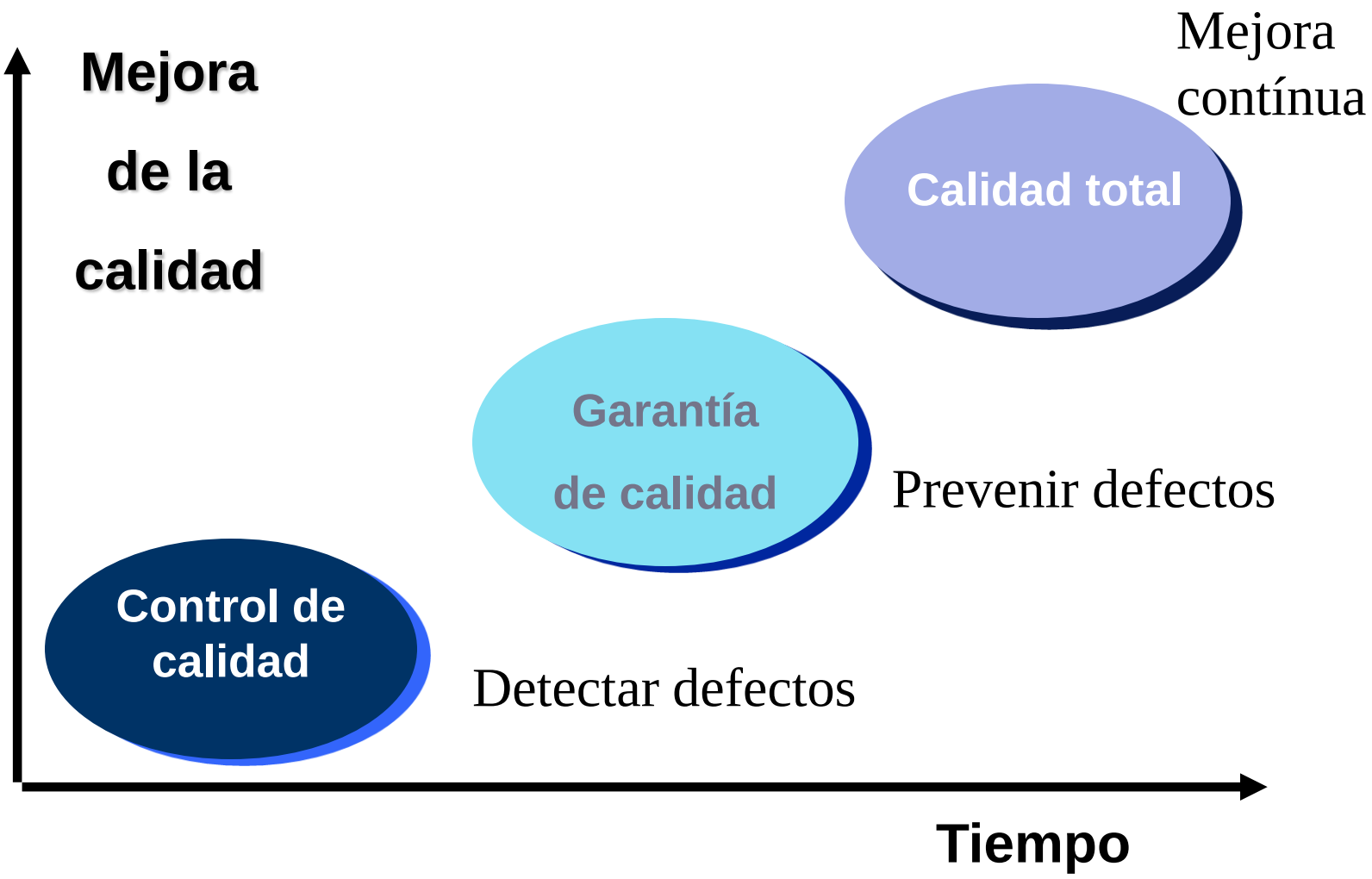
GENICHI TAGUCHI

From Genichi Taguchi and Yu-in Wu, *Introduction to Offline Quality Control* (Negaya, Japan: Central Japan Quality Control Association, 1979), p. 2.

FIGURE 2 Taguchi Societal Loss Function



EVOLUCIÓN HISTÓRICA



TERMINOLOGÍA (ISO 8402)

- **Calidad: “**Conjunto de propiedades y características de un producto o servicio que le confieren su aptitud para satisfacer unas necesidades explícitas o implícitas”
- **Control de calidad:** “Conjunto de técnicas y actividades de carácter operativo, utilizadas para verificar los requerimientos relativos a la calidad del producto o servicio”.
- **Garantía de calidad**: “Conjunto de acciones planificadas y sistemáticas necesarias para proporcionar la confianza adecuada de que un producto o servicio satisfará los requerimientos dados sobre calidad”.

TERMINOLOGÍA (ISO 8402)

Gestión de la calidad: "Aspecto de la función de gestión que determina y aplica la política de la calidad, los objetivos y las responsabilidades y que lo realiza con medios tales como la planificación de la calidad, el control de la calidad, la garantía de calidad y la mejora de la calidad".

La gestión de la calidad es responsabilidad de todos los niveles ejecutivos, pero debe estar guiada por la alta dirección. Su realización involucra a todos los miembros de la organización.

En la gestión de la calidad, se tienen en cuenta también criterios de rentabilidad.

TERMINOLOGÍA (ISO 8402)

- **Sistema de gestión de la calidad (QS):** "Conjunto de la estructura de la organización, de responsabilidades, procedimientos, procesos y recursos que se establecen para llevar a término la gestión de calidad".
  - El QS debe tener el volumen y alcance suficiente para conseguir los objetivos de calidad.
  - El QS de una organización está fundamentalmente previsto para satisfacer las necesidades internas de la organización. Es más amplio que los requerimientos de un cliente concreto que únicamente valor el QS que le interesa (directamente).
  - Para finalidades contractuales o vinculantes en la valoración de la calidad, se puede exigir que se ponga de manifiesto la realización de ciertos elementos del QS.

CALIDAD DEL SOFTWARE

“La calidad del software es el grado con el que un sistema, componente o proceso cumple los requerimientos especificados y las necesidades o expectativas del cliente o usuario”. (IEEE Std. 610-1990).

“Concordancia del software producido con los requerimientos explícitamente establecidos, con los estándares de desarrollo prefijados y con los requerimientos implícitos no establecidos formalmente, que desea el usuario” (Pressman)

“Software quality is the degree to which software possesses a desired combination of attributes (e.g., reliability, interoperability).” (IEEE Std. 1061)

CALIDAD DEL SOFTWARE

Standish Group

MODERN RESOLUTION FOR ALL PROJECTS

	2011	2012	2013	2014	2015
SUCCESSFUL	29%	27%	31%	28%	29%
CHALLENGED	49%	56%	50%	55%	52%
FAILED	22%	17%	19%	17%	19%

The Modern Resolution (OnTime, OnBudget, with a satisfactory result) of all software projects from FY2011–2015 within the new CHAOS database. Please note that for the rest of this report CHAOS Resolution will refer to the Modern Resolution definition not the Traditional Resolution definition.

CALIDAD DEL SOFTWARE

Standish Group

CHAOS RESOLUTION BY PROJECT SIZE

	SUCCESSFUL	CHALLENGED	FAILED
Grand	2%	7%	17%
Large	6%	17%	24%
Medium	9%	26%	31%
Moderate	21%	32%	17%
Small	62%	16%	11%
TOTAL	**100%**	**100%**	**100%**

The resolution of all software projects by size from FY2011–2015 within the new CHAOS database.

CALIDAD DEL SOFTWARE

Standish Group

CHAOS RESOLUTION BY AGILE VERSUS WATERFALL

SIZE	METHOD	SUCCESSFUL	CHALLENGED	FAILED
All Size Projects	Agile	39%	52%	9%
	Waterfall	11%	60%	29%
Large Size Projects	Agile	18%	59%	23%
	Waterfall	3%	55%	42%
Medium Size Projects	Agile	27%	62%	11%
	Waterfall	7%	68%	25%
Small Size Projects	Agile	58%	38%	4%
	Waterfall	44%	45%	11%

The resolution of all software projects from FY2011–2015 within the new CHAOS database, segmented by the agile process and waterfall method. The total number of software projects is over 10,000

CALIDAD DEL SOFTWARE

Standish Group

CHAOS FACTORS OF SUCCESS

FACTORS OF SUCCESS	POINTS	INVESTMENT
Executive Sponsorship	15	15%
Emotional Maturity	15	15%
User Involvement	15	15%
Optimization	15	15%
Skilled Resources	10	10%
Standard Architecture	8	8%
Agile Process	7	7%
Modest Execution	6	6%
Project Management Expertise	5	5%
Clear Business Objectives	4	4%

CALIDAD DEL SOFTWARE

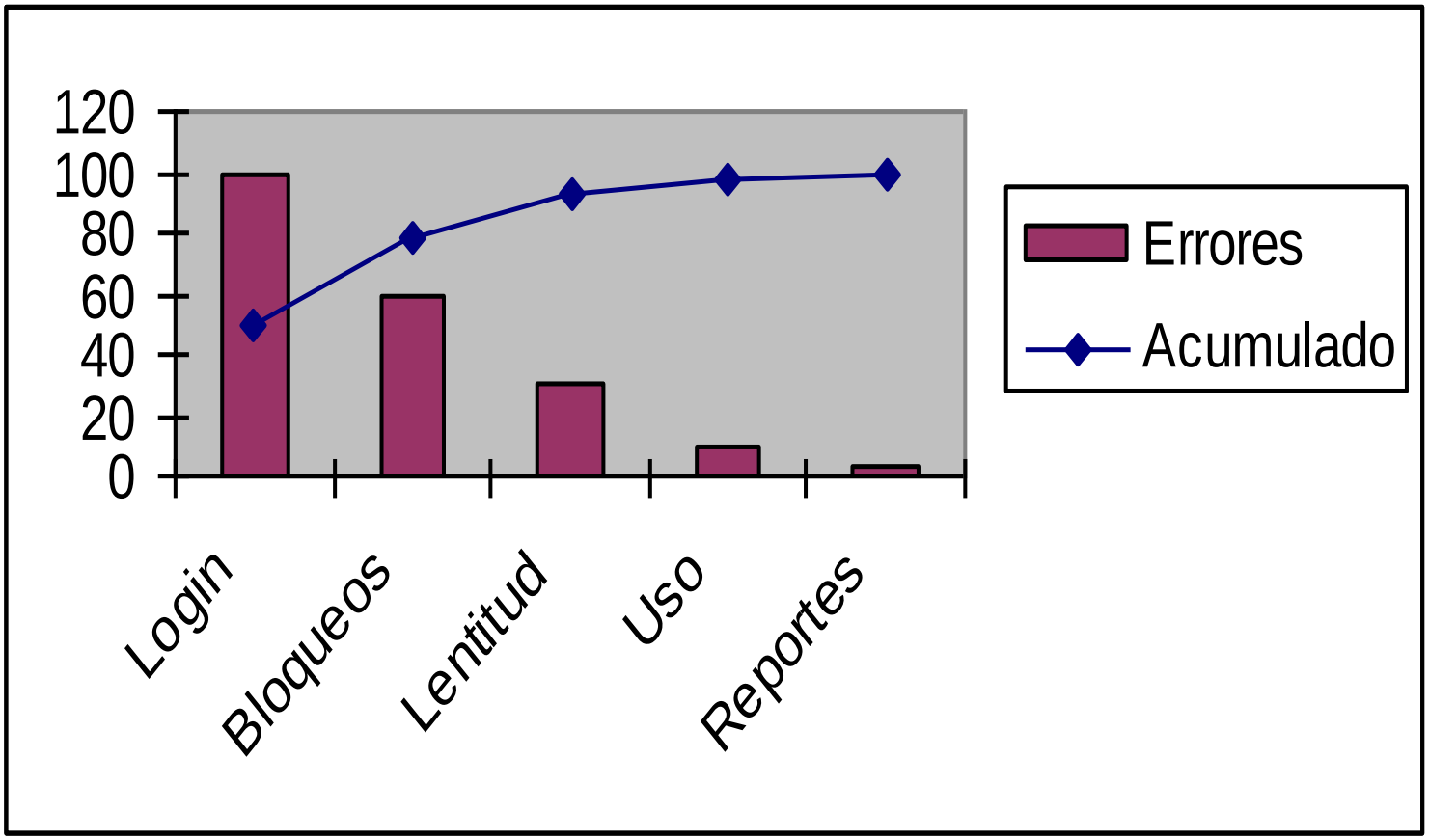
Standish Group

		COMPLEXITY				
		C1	C2	C3	C4	C5
SIZE	S1	100	250	400	550	700
	S2	175	325	475	625	775
	S3	250	400	550	700	850
	S4	325	475	625	775	625
	S5	400	550	700	850	1000

ALGUNAS HERRAMIENTAS

- Análisis de Pareto: Identifica los contribuyentes vitales en los problemas de calidad.
  - Regla 80-20
  - Diagrama de Pareto
- Muestreo estadístico y Desviación Estandar
- Cartas de Control
- Pruebas

DIAGRAMA DE PARETO

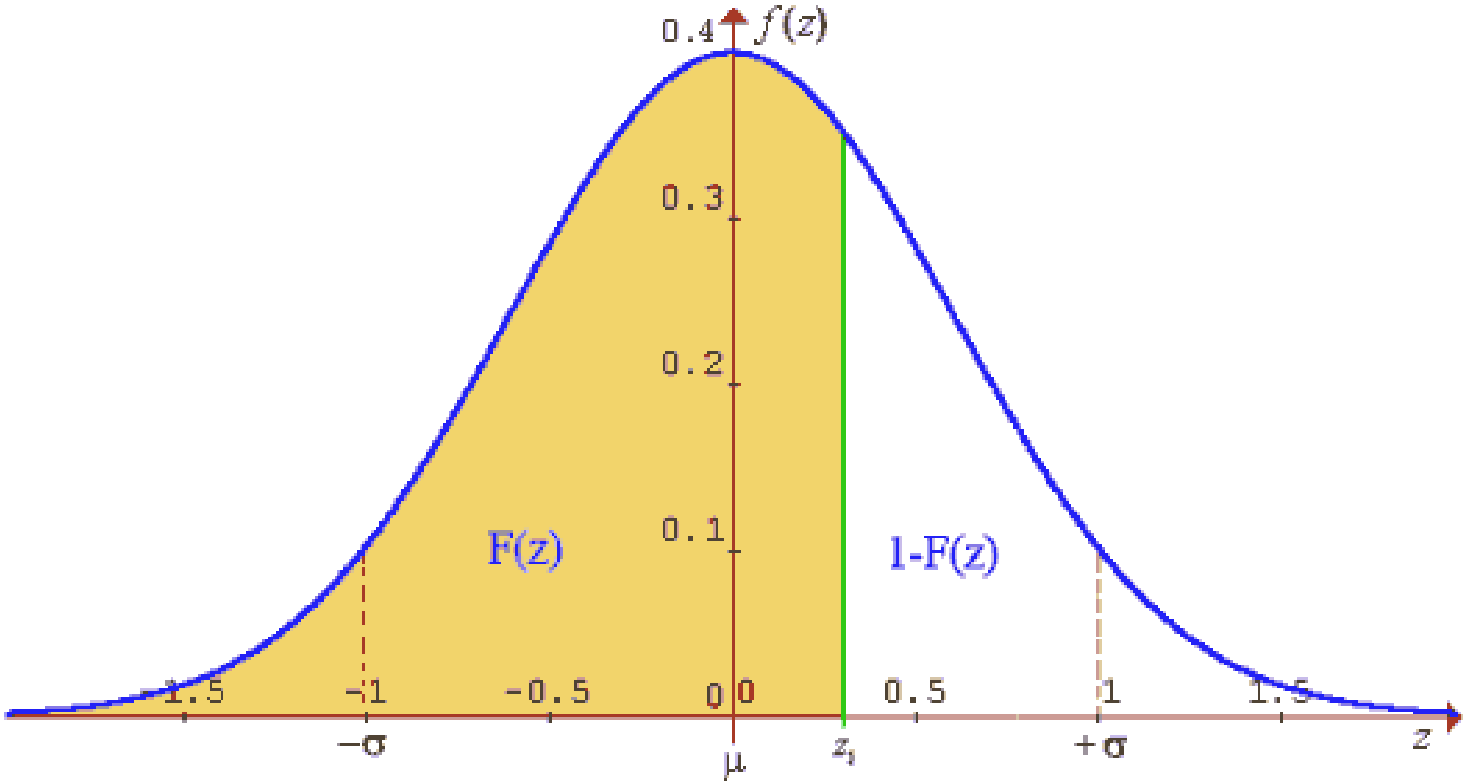


MUESTREO

- Tamaño de una población de interés para una inspección
- El tamaño depende de la representatividad
  - Ej:
    - Tamaño = 0.25 x (Factor Certeza / Error aceptable) exp(2)

Certeza	95%	90%	80%
Factor	1.96	1.645	1.281
Tamaño	384	68	10

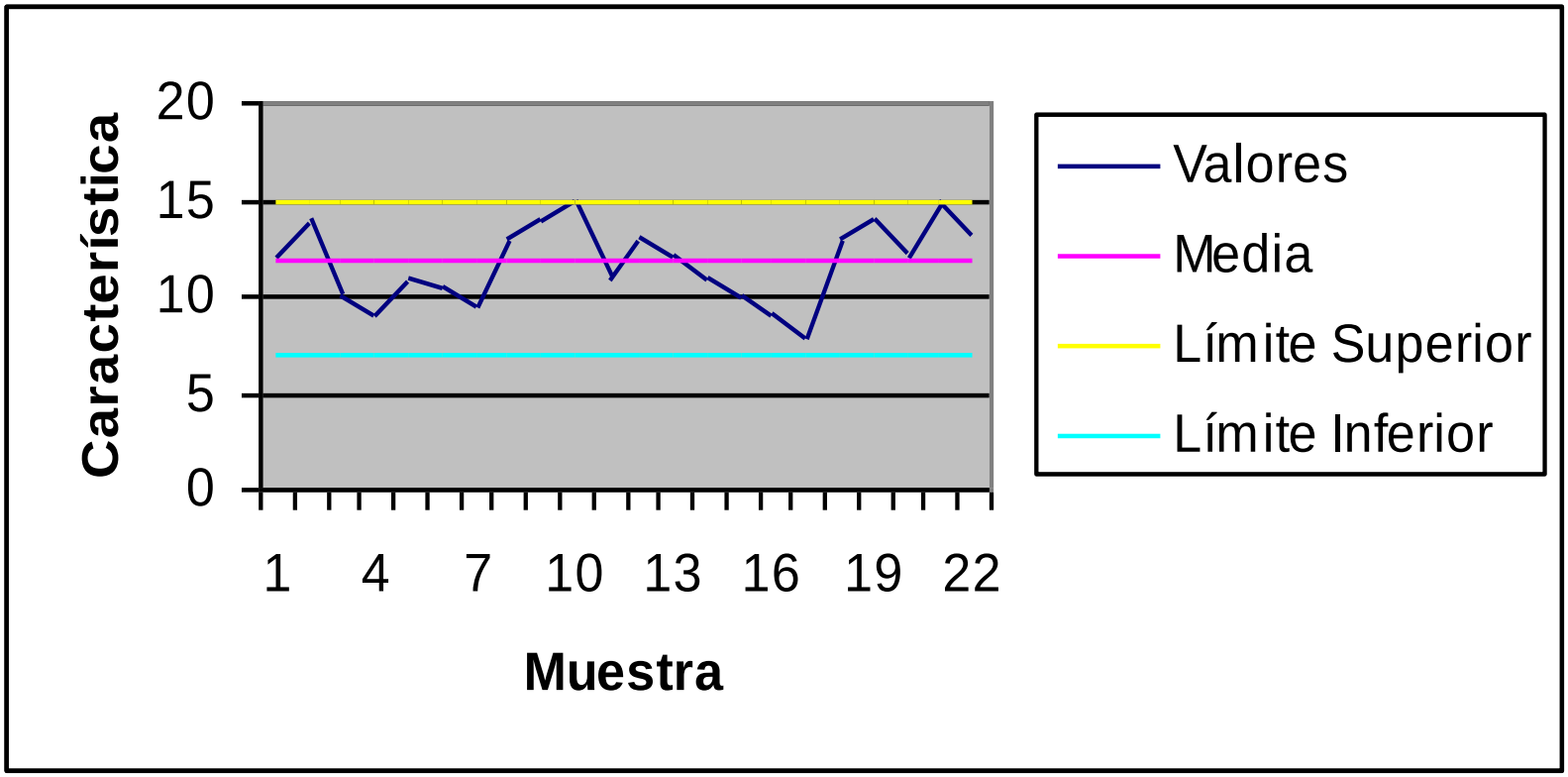
DESVIACIÓN ESTÁNDAR



Desviación Estándar (Sigma)

- La probabilidad que encierra en el intervalo media +/- Sigma es del 68.3 % aproximadamente. Es decir, es de esperar que el 68.3 % de las medidas de una magnitud estén comprendidas en ese intervalo. Dicho de otra forma, si medimos una magnitud un número grande de veces, el 68.3 % de los valores obtenidos estarán comprendidos en el entorno de una desviación estándar en torno a la media. La probabilidad se amplía al 95.4 % y al 99.7 % si consideramos los intervalos media +/- 2(Sigma) y media +/- 3(Sigma) respectivamente.

CARTAS DE CONTROL

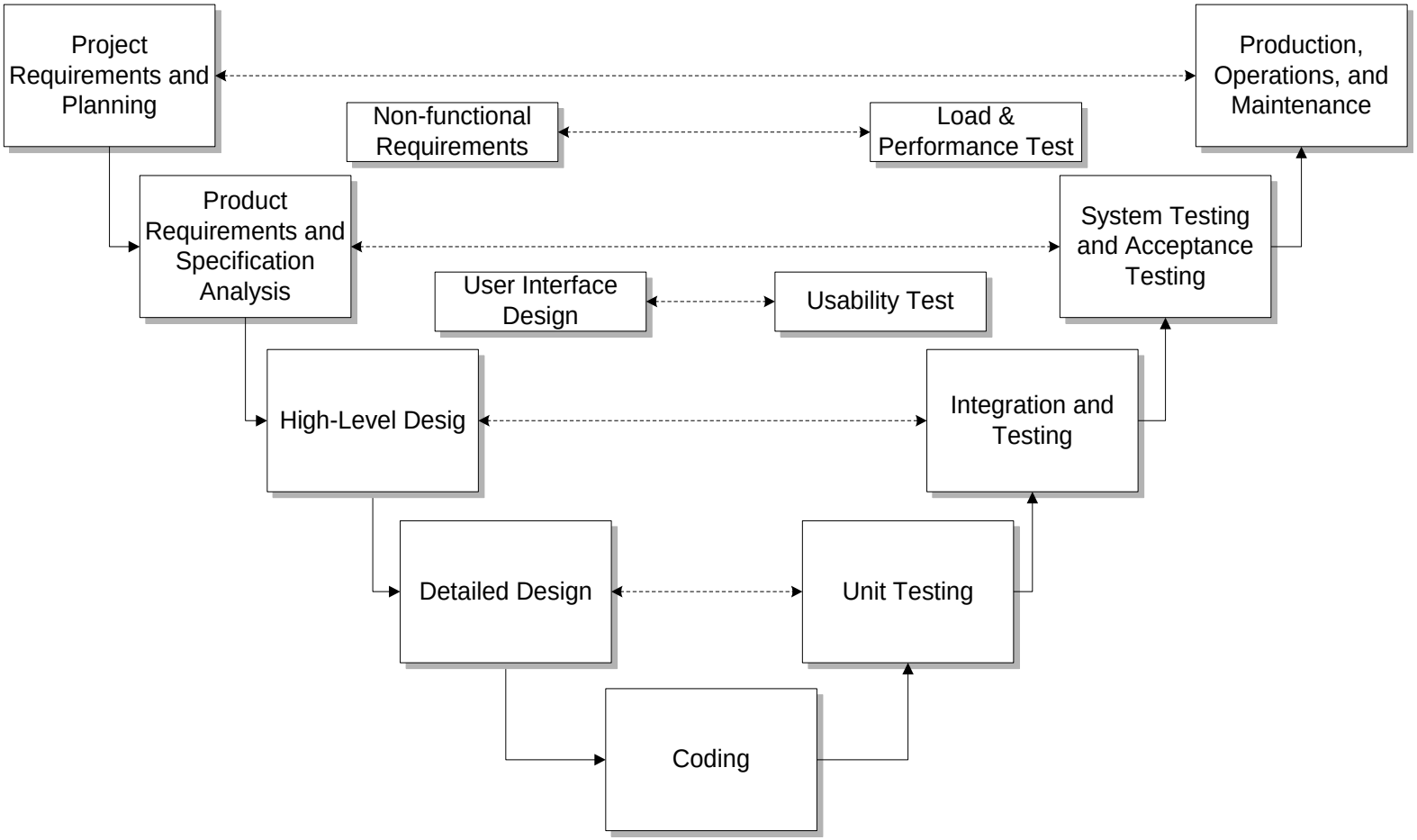


SEIS SIGMA Y SIETE CORRIDAS

- Sigma permite definir los límites inferior y superior de la Cartas de Control
  - Máximo: +/- 6(Sigma). 2.7 millones de defectos por billón
  - Común: +/- 3(Sigma). 2 defectos por billón

- La regla de las Siete Corridas establece que si al menos siete datos continuados están todos bajo la media, sobre la media, o se incrementan o decrementan regularmente, el proceso requiere examinarse para localizar errores de calidad no aleatorios

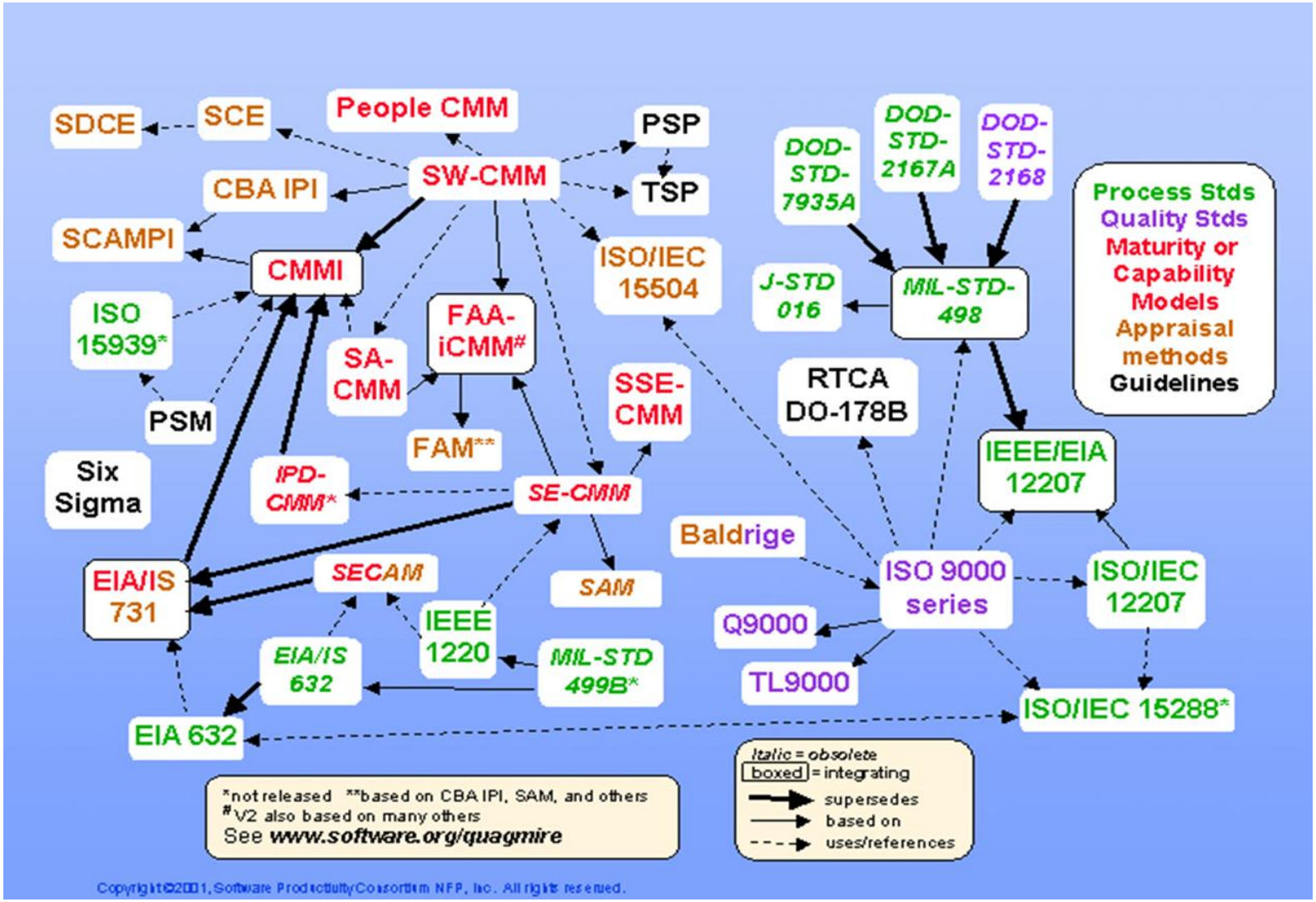
PRUEBAS


Project Requirements and Planning
Production, Operations, and Maintenance
Non-functional Requirements
Load & Performance Test
Product Requirements and Specification Analysis
System Testing and Acceptance Testing
User Interface Design
Usability Test
High-Level Desig
Integration and Testing
Detailed Design
Unit Testing
Coding

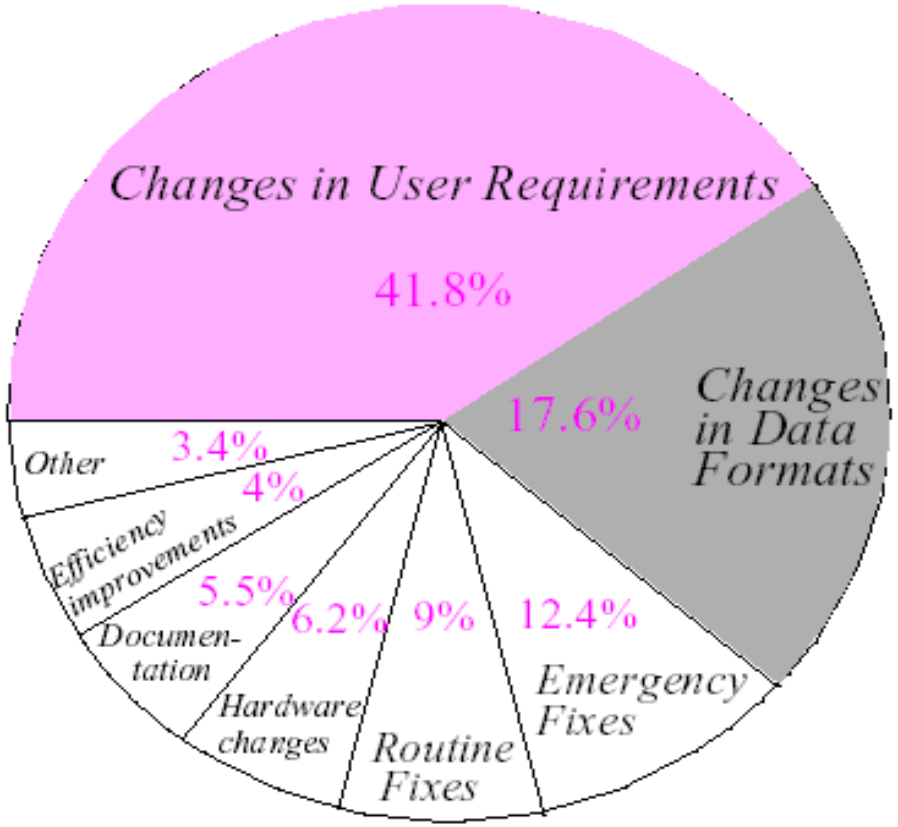
MODELOS DE CALIDAD

- Filosofías de Gestión
  - Crosby, Deming, Feigenbaum, Ishikawa, Juran, Shewhart, etc
- Modelos de Calidad
  - McCall
  - Boehm
  - FURPS
  - Dromey
  - ISO
    - 9000
    - 9126 y 25000
    - 15504 (SPICE)
    - …….
  - CMMI
  - SIG SIGMA

MODELOS DE CALIDAD



MANTENIMIENTO Y CALIDAD



COSTOS DE LA CALIDAD

COSTOS RELATIVOS

- Requisitos: 1
- Diseño: 3 – 6
- Codificación: 10
- Pruebas de desarrollo: 15 – 40
- Pruebas del Sistema: 30 – 70
- Operación: 40 -1000

PRODUCTIVIDAD Y CALIDAD

- PRODUCTIVIDAD: LDC/mes-persona

- INCREMENTO DE LA PRODUCTIVIDAD CON LA CALIDAD
  - Mejor calidad, menor trabajo (+/- 50% de ahorro)
  - Disminuyen las pruebas
  - Localización temprana de errores a menor costo
- DECREMENTO DE LA PRODUCTIVIDAD CON LA CALIDAD
  - Mejor calidad requiere inversión que se recupera en la entrega
  - La revisión de los productos de desarrollo mejora la calidad pero disminuye la productividad
  - Las técnicas de calidad insisten en detalles que pueden constituirse en obstáculos para el trabajo

SQA

- Ejecución de las actividades de control de calidad previstos y manipulación defectos descubiertos. Además de realizar actividades de aseguramiento de calidad seleccionados, una parte importante de esta ejecución normal es hacer frente a los problemas descubiertos.
- Definición de IEEE : "patrón planificado y sistemático de todas las acciones necesarias para proporcionar la confianza adecuada de que el software realiza a los requisitos técnicos establecidos "
- Responsabilidades clave:
  - Promueve la calidad en la organización
  - Defensor del Cliente
  - Lleva a cabo auditorías para verificar el cumplimiento
  - Generación de informes de auditoría a la administración
  - Proporciona visibilidad a la gestión de los procesos realizados
  - Facilita la mejora de procesos de software

EVALUACION Y MEJORA

- Actividades posteriores a la garantía de la calidad: medición, evaluación y mejora. Estas son las actividades que se llevan a cabo después que las actividades normales de aseguramiento de calidad han comenzado; no como parte de ellas. El propósito principal de estas actividades es proporcionar evaluación de la calidad y la retroalimentación de manera que se pueden tomar decisiones de gestión y se lleven a cabo posibles iniciativas de mejora.
- Las actividades principales son:
  - Medición
  - Análisis y modelización
  - Proporcionar información y la identificación de los potenciales de mejora
  - Seguimiento de las actividades

TALLER 1

(Adaptado de Myers, 1979)

Desarrollar una pequeña aplicación con un nivel de calidad aceptable, que lea tres valores enteros representativos de las longitudes de los lados de un triángulo. Obtener como salida el tipo de triángulo: Equilátero, Isósceles, Escaleno, de acuerdo a la *Historia de Usuario* correspondiente

Tomar en cuenta los siguientes criterios generales a ser validados y/o verificados:

1. La aplicación hace lo que debe hacer
2. La aplicación no hace lo que no debe hacer