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Tesqual: A Microthesaurus for Use in Quality Management in European Higher Education

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1. Introduction

Nowadays, the demand for quality has become an essential issue of concern within university education. The widespread introduction of systems of quality assessment for higher education makes necessary a controlled specific language for users who work in this field. This "normalized" vocabulary is designed so as to improve the processes which are to be evaluated. In this sense, there exists widespread agreement regarding the usefulness of these standardised languages which normalize certain words and vocabulary, and later will facilitate access to information.

The objective is to solve a growing problem in the areas of quality assessment and management in higher education, namely lexical dispersion and the limited control of specialized vocabulary within this subject field. Consequently, a document tool is created in order to help solve problems, such as the difficulties associated with the presentation of and access to information, or the processing and transfer of specialized information in this field. This tool is in the form of a microthesaurus, developed to cover the needs and expectations of those users who are involved in university education.

Microthesaurus Tesqual is a controlled vocabulary with a structure based on hierarchical, associative and equivalence relationships. It is aimed at scientists, researchers, education professionals, students and the general users who use a "key" vocabulary to conceptualize and define the content of specific documents. The final aim is to help experts store and recover these documents coming from a particular information system.

2. Tesqual design

For the design and production of the Microthesaurus, certain phases were followed. These were mainly established in the ISO 2788: 1986 norm, and they also observed Aitchinson's et al. (2000) guidelines, contained within his practical manual *Thesaurus Construction and Use*. The stages are the following: subject field, collection of terms, vocabulary control, organization into categories and subcategories, conceptual structure, relational structure and technological implementation.

2.1 Subject field

The subjects covered by the Microthesaurus are grouped under nine subject categories, known as semantic fields. In fact, there is a list of semantic fields, ordered according to the number code assigned to each of them, which shows a set of hierarchical chains contained in each of the different fields.

The following descriptors have been established as series headings of the hierarchical systematisation of the Microthesaurus: University Administration, University Quality, Quality Management, Information and Communication, Integration in the Labour Market, University Policy, Results in Society and University System. The broadest semantic field is that of University Quality, which covers Accreditation, Certification, European Space for Higher Education and Institutional Assessment.

One of the characteristics of the thesauri in general and of the Microthesaurus Tesqual in particular, is that the division of the set of descriptors into subject fields is, to some extent, flexible. This is due to the fact that a few descriptors could actually belong to two or more subject fields. To solve this problem, it was determined to include these in just one of the fields, which is normally the one considered most natural by users.

2.2 Collection of terms

The second phase consisted of the collection of vocabulary through the simultaneous combination of the deductive or synthetic method and the inductive or analytical method. This task was based mainly on collecting the entire lexicon that was found within the consulted literature and also the terms derived from conversations maintained with experts on the subject matter.

On one hand, the deductive or analytical method involves indexing the most recent articles and monographs in order to obtain an updated lexicon. On the other hand, through the inductive or synthetic method, the number of descriptors is increased, taking them from other reference sources, such as technical dictionaries, glossaries, etc. For this purpose, users and specialists were also asked to give their opinions on the subject-matter.

Both procedures were combined in a single method of mixed-collection, which adds the advantages of the analytical method to the advantages of the synthetic one. This made it possible to create a solid term-base.

After this phase, checks were carried out to ensure that the pre-descriptors did not have several meanings so as to avoid ambiguity. In this stage, the list was reduced, since obvious repetitions were removed. This was considered a good moment to compare the lexicon we had to the vocabulary of other thesauri.

For the collection of terms, a database was based in which different files were created. These contained the words referring to each semantic field. Firstly, a file was created containing all the glossaries considered of interest for the design of the Tesqual. Secondly, another file was designed containing the pre-existing thesauri which were useful for the introduction and contrast of the terms of the Microthesaurus. Thirdly, specific files for each semantic field were also created. For example, for the semantic field 'University Quality' the following descriptor files were created: accreditation, certification, documentation of the ANECA - *National Agency of Quality and Accreditation Assessment*, documentation of the *Council for University Coordination*, the European Space for Higher Education and Institutional Assessment.

2.3 Term control

It is important to consider that, in order for a thesaurus to be able to fulfill the functions for which it has been designed, it must serve primarily as a tool for vocabulary control. In other words, the specific terms of a thesaurus and their particular form must necessarily go through a previous process of normalization so as to be used as controlled-vocabulary in the users' information search. To be more precise, a particular term has been chosen from a group of synonyms which express the same concept; polysemic words; the grammatical form: noun, adjective, adverb and verb; the choice between the singular and plural form, and compounds or abbreviations of the specific terms.

Each descriptor which is part of the Microthesaurus refers to one single concept, without the several different meanings assigned to a term in dictionaries. The hierarchical structure or hierarchical relationships of the Microthesarus will make clear the exact sense of the words. If this should not be enough to clarify the meaning, a specific explanatory note to the term would be added. When the lexicon is selected, the aim is to achieve a univocal concept among the different terms, that is to say, that linguistic expressions have one single form and represent one single concept. Given that in a thesaurus, terms cannot have different senses, the meaning which best fits the requirements of the system was selected, responding to the chosen indexing field. The other definitions were rejected, since they do not belong to the subject domain that concerns us here.

When we create a thesaurus, it is necessary to avoid synonymy and polysemy. Synonymy is produced when a single concept is represented by different signifiers. The most common thing is to choose an expression as a descriptor, maintaining its synonyms as non-descriptors (Gil, 1996).

Polysemy is defined as the existence of several meanings attributed to one single significant. This is considered detrimental to the thesaurus and has to be controlled.

In the case where a concept can be expressed by two or more synonyms, one of them will be selected as the preferred term (normally the most commonly used) and the rest will remain as non-preferred terms. These latter ones will direct the user to their corresponding preferred terms. The most representative synonyms have been chosen for the non-descriptor terms. These represent concepts related to the descriptors.

There are term categories that can be considered pure synonyms. The most obvious ones are abbreviations and acronyms. In general, the full term is preferred, whereas the abbreviation appears as a non-descriptor entry term. However, there are some cases in which an acronym or abbreviation is so common that we forget about the origin of the word it actually comes from. In these cases, it is recommended to use the acronym or abbreviation as preferred terms, considering the full term as an entry-term (Lancaster, 1995). There are also other cases in which the choice will be determined by the type of users to whom the thesaurus is addressed.

The infinitive verb must not be used as an indexing term. Actions must be expressed as noun forms.

Noun, adjectival and adverbial phrases must be expressed in the order of the natural language and not in the inverted form. The inverted form can result in being redirected towards the direct form.

According to the UNESCO recommendations, most of the indexing terms can be divided into a nucleus and a difference. This refers simply to the distinction between a generic term and a term which identifies one of its subclasses.

This was one of the most laborious phases in the development of the Microthesaurus, as a huge number of terms within University Quality correspond to the same concept. All this vocabulary is included in the Microthesaurus, since the user will carry out the search and retrieve the information through the descriptors that he/she knows. In order to achieve this, the most representative sense is selected from amongst the different meanings: according to its frequency of occurrence and/or because it is the most commonly used. The term accepted as the most representative of a concept assumes the role of descriptor or main term, whilst those words which are not the most representative will be non-descriptors or secondary terms. The non-preferred terms will show different entry categories which will direct the user to the preferred term.

2.4 Grouping into categories, subcategories

This was the most important and difficult part in the process of the design of the Microthesaurus. It involved creating a single hierarchical structure, which presented all the information contained in the system in a systematic and synthetic way.

It consisted of dividing the whole future list of descriptors into subject areas which were proved to have similar meaning. At the same time, we provided each subject field with a name, doing the same with each subfield, and so on. This constituted the basic structure through which all descriptors were subsequently arranged.

In the following list, the relevant descriptors are assigned to each semantic field. Each of these subject categories is, in turn, subdivided into more specific areas:

C1 University Administration		
	C11	University Autonomy
	C12	Legislation
	C13	Institutional Levels
	C14	International Institutions
	C15	University Administrative Bodies
	C16	European Union
C2 University Quality		
	C21	Accreditation
	C22	Higher Education Accreditation
	C23	European Space for Higher Education
	C24	Institutional Assessment
C3 Quality Management		
	C31	Total Quality Costs
	C32	Quality Specialists
	C33	Quality Evolution
	C34	Quality Models
	C35	Quality Rules
	C36	Quality Organizations
	C37	Quality Management Principles
	C38	Recognition for Management Excellence
	C39	Quality Techniques
C4 University Management		
	C41	Academic Management

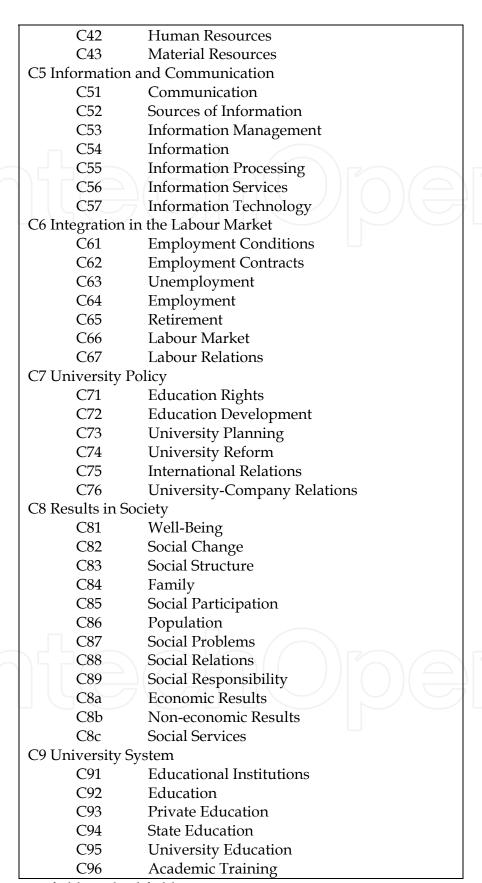|		
	C42	Human Resources
	C43	Material Resources
C5 Information and Communication		
	C51	Communication
	C52	Sources of Information
	C53	Information Management
	C54	Information
	C55	Information Processing
	C56	Information Services
	C57	Information Technology
C6 Integration in the Labour Market		
	C61	Employment Conditions
	C62	Employment Contracts
	C63	Unemployment
	C64	Employment
	C65	Retirement
	C66	Labour Market
	C67	Labour Relations
C7 University Policy		
	C71	Education Rights
	C72	Education Development
	C73	University Planning
	C74	University Reform
	C75	International Relations
	C76	University-Company Relations
C8 Results in Society		
	C81	Well-Being
	C82	Social Change
	C83	Social Structure
	C84	Family
	C85	Social Participation
	C86	Population
	C87	Social Problems
	C88	Social Relations
	C89	Social Responsibility
	C8a	Economic Results
	C8b	Non-economic Results
	C8c	Social Services
C9 University System		
	C91	Educational Institutions
	C92	Education
	C93	Private Education
	C94	State Education
	C95	University Education
	C96	Academic Training

Table 1. Semantic fields and subfields

2.5 Conceptual structure

The Microthesaurus is made up of a set of descriptor and non-descriptor terms, and a system of relationships which defines its semantic content.

A thesaurus is by definition a structured vocabulary that represents the relationships between concepts by means of the existing relations between the terms which are used to express these concepts.

The web of relationships that each descriptor establishes with the rest provides a particular definition for it. This is achieved by placing the descriptor in a specific semantic field. In fact, there are three types of semantic relationships in Microthesaurus Tesqual: equivalence, hierarchical and associative relationships.

It comprises nine general families which do not correspond to a normalized classification. In turn, these nine families are subdivided into more and more specific subjects or topics, finally reaching the degree of specificity required to understand the conceptual tree of the issue concerned.

The different constituent elements which make up the Microthesaurus, namely, the subject fields, the descriptors, the non-descriptors and the scope notes, are described below.

2.5.1 Subject fields

Descriptors are structured within semantic fields according to subject areas, which are intended to reflect the interdisciplinarity of the Tesqual. In this case, it is divided into nine semantic fields. The name of each field is preceded by the letter C and a number, used to identify each descriptor, sending it from the alphabetic list of the Microthesaurus to the semantic field to which it belongs.

C1	University Administration
C2	University Quality
C3	Quality Management
C4	University Management
C5	Information and Communication
C6	Integration in the Labour Market
C7	University Policy
C8	Results in Society
C9	University System

Table 2. Subject fields

2.5.2 Descriptors

Descriptors are words or expressions that denote the concepts which make up the area covered by the Microthesaurus without ambiguity. They can be composed of one word (simple descriptor or 'uniterm') or include several (compound descriptor or plural terms).

Example:

National Agency of Assessment
UF: ANECA

Table 3. Descriptor

2.5.3 Non-descriptors

The non-descriptors are words or expressions which, in the natural language, refer to the same concept or to a concept considered equivalent to that of the descriptor. In this way, a relationship of equivalence, within the Microthesarus language, is established between them.

Example:

ANECA
USE: National Agency of Assessment

Table 4. Non-descriptor

2.5.4 Scope notes

The scope notes guide the users, by specifying or narrowing the use of certain descriptors which may be slightly ambiguous in terms of meaning, or simply require a particular explanation in the user's search or in the document indexing.
The scope notes are introduced through the symbol SN (Scope Note), situated between the descriptor and its application note.

Example:

National Agency of Assessment
SN: National Agency of Quality and Accreditation Assessment

Table 5. Scope note

2.6 Relational structure

The relationships established between the terms which comprise the Microthesaurus, equivalence, hierarchical and associative are described as follows:

2.6.1 Equivalence relationships

Equivalence relationships connect to each other all the terms expressing the same concept, but also all those words which could be considered equivalent. These are treated as synonyms in the language of the system, even if they are not strictly so in the natural language.
These relationships of synonymy are very important, since the more synonyms a thesaurus contains, the more it is able to take into account the different ways of denoting a concept in the natural language. In fact, this makes the thesaurus a tool which can be more effectively used by a wider variety of users.
The relationships of semantic equivalence between descriptors are indicated by the following symbols:

- USE (Use), situated between a non-descriptor and the corresponding descriptor. A non-descriptor must direct to a single descriptor.
- UF (Use for), situated between a descriptor and the non-descriptor (s) which it represents. There may be zero, one, two or more non-descriptors attributed to each descriptor.

Example:

QC
USE: Quality Cost
Quality Costs
UF: QC

Table 6. Equivalence relationships

2.6.2 Hierachical relationships

The hierarchical relationship links those descriptors which are either more generic or more specific, thus placing them in their exact context and avoiding ambiguity. The hierarchical relationship between descriptors is marked using the following symbols: BT (Broader Term), situated between a specific descriptor and a generic descriptor. NT (Narrower Term), situated between a generic descriptor and a specific descriptor.

The generic term is defined as that descriptor which denotes a broader notion including other narrower notions which are represented by their specific terms. Example:

Example:

Quality Costs
BT: Total Quality Costs

Table 7. Generic term

The specific term refers to that descriptor which denotes a notion included within a broader notion. This is represented by a generic term. Example:

Example:

Quality Costs
NT: Evaluation Costs
Prevention Costs

Table 8. Specific term

In Microthesarus Tesqual, there may be up to eight levels of hierarchy. Alphabetical order is used to arrange descriptors of the same hierarchical level depending on the same term. This is commonly used in most thesauri.

Example:

C	Thesarus about quality in Higher Education
C2	University Quality
C21	Higher Education Accreditation
C211	ANECA Accreditation Programme
C2111	Accreditation Pilot Projects
C21111	Accreditation Agents
C211111	ANECA Auditors
C211112	Internal Assessment Committee
C211113	National Accreditation Committee
C211114	Sub-Committee coordinators
C2111141	Sub-Committee on Health Sciences coordinators

Table 9. Levels of hierarchy

2.6.3 Associative relationships

Associative relationships are established between terms which are not considered equivalent and cannot be connected by a hierarchical relationship. Their function is to provide information about further possibilities for indexing or information searching.

The associative relationship between descriptors is marked using the symbol RT (Related Term), which is situated between two associated descriptors.

The related term refers to one or more descriptors which, due to their meaning or use, maintain an associative or horizontal relationship with the main term.

Example:

Quality Costs
RT: Service Delivery Costs

Table 10. Related term

2.7 Technological implementation

Before deciding about the software which was to be used for the digital version of the Microthesaurus, several experts in thesaurus design were contacted in order to learn about their own experiences in this regard.

For the electronic version of the Microthesarus, the software *Multites* was used, as this allows conversion of files and generation of HTML files, as well as facilitating the introduction of the thesaurus in the web. Moreover, it is developed on the Windows operating system and it is not necessary to type terms when semantic relationships are established.

3. Tesqual presentation

At the beginning of the Microthesaurus, the main semantic categories and subcategories are presented to facilitate the task of looking up vocabulary. The written version of the Tesqual contains four parts: alphabetical presentation, hierarchical presentation, conceptual presentation, and KWOC permutation presentation. In addition, Microthesaurus Tesqual is available in digital and written formats. Each of these four parts is described below.

3.1 Alphabetical presentation

The alphabetical presentation describes the equivalence relationships considering the classification number of the descriptor. It contains the following information: descriptor, classification number and non-descriptor. They are alphabetically ordered.

Example:

Cost of poor quality	
USE: Poor Quality Costs	
Evaluation Costs C3111	
Failure Costs	C3121
External Failure Costs	C31211
Internal Failure Costs	C31212
Higher Education Costs	C7314
Poor Quality Costs	C312
Quality Costs	C311

Table 11. Alphabetical presentation

3.2 Hierarchical presentation

In the hierarchical presentation, the terms are ordered by categories or classes organized according to their meanings and logical interrelations. The hierarchical presentation contains nine semantic fields, established as the major series headings of the subject areas. These are, in turn, subdivided into semantic subfields.

In the hierarchical part, the descriptors appear according to main subject areas into which the Microthesarus has been divided, following the previously described method of classification. Therefore, each subject area contains only the descriptors which belong to its domain and their corresponding hierarchical relationships. Following this structure, each descriptor is placed in its own semantic context in a very precise way.

Under each descriptor entry, the user finds the descending hierarchy of the descriptors which constitute the tree-like structure of the upper term's descriptor. The specific descriptors are classified following a descending hierarchical order, and within each level of hierarchy, they are arranged in alphabetical order.
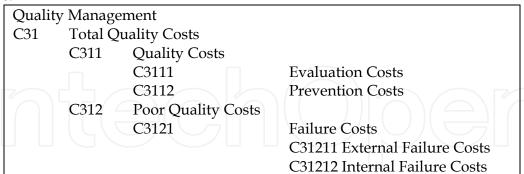
Example:

Quality Management			
C31	Total Quality Costs		
	C311	Quality Costs	
		C3111	Evaluation Costs
		C3112	Prevention Costs
	C312	Poor Quality Costs	
		C3121	Failure Costs
			C31211 External Failure Costs
			C31212 Internal Failure Costs

Table 12. Hierarchical presentation

3.3 Conceptual presentation

The conceptual presentation is the main part of the Microthesarus. It is developed in a systematic way, indicating which descriptors are the broadest. It allows the users to find the descriptors and non-descriptors in their alphabetical order and shows all hierarchical levels to which each descriptor belongs. In fact, each descriptor is shown as follows:

<u>Descriptor entry</u>
- The text of the descriptor.
- The non-descriptor (or several), corresponding to the descriptor entry. They are classified in alphabetical order, preceded by 'UF' (Use For).
- The generic descriptor of the descriptor entry, preceded by 'BT' (Broader Term).
- Specific descriptors of the descriptor entry, preceded by 'NT' (Narrower Term). The specific descriptors are also arranged in alphabetical order.
- Terms associated with the entry term, preceded by 'RT' (Related Term) and classified in alphabetical order.
- Scope Note, where relevant, preceded by 'SN' (Scope Note).
- Classification number of the descriptor.

Example:

Quality Costs
UF: QC
BT: Total Quality Costs
NT: Evaluation Costs
Prevention Costs
RT: Service Delivery Costs
SC: C311

Table 13. Conceptual presentation (descriptor)

<u>Non-descriptor entry</u>
- The text of the non-descriptor.
- The text of the corresponding descriptor, preceded by 'USE'.

Example:

PQC	
USE: Poor Quality Costs	
QC	
USE: Quality Costs	
PQC	
USE: Poor Quality Costs	
Quality Costs	C311
Poor Quality Costs	C312

Table 14. Conceptual presentation (non-descriptor)

3.4 KWOC permutation presentation
The KWOC permutation presentation comprises two types of entry terms: descriptor and non-descriptor, which are ordered alphabetically using all the significant vocabulary they contain.

Example:

Cost	
	Poor Quality Costs
Costs	
	Evaluation Costs
	External Failure Costs
	Failure Costs
	Internal Failure Costs
	Higher Education Costs
	Poor Quality Costs
	Prevention Costs
	Service Delivery Costs
	Total Costs of Quality

Table 15. KWOC permutation presentation

4. General statistics of the Tesqual

The structure of the Tesqual is divided into nine general semantic fields, which are presented with no standardised or normalized classification. These fields include 2.425 terms, out of which 2.013 are descriptors and 412 are non-descriptors. The nine semantic fields are also subdivided into more specific sub-fields, within which we find particular words and terms with their respective equivalence, hierarchical and associative relationships. 2.012 hierarchical relationships and 441 associative relationships were established. Finally, 261 scope notes were also introduced.

Terms	2.425
Descriptors	2.013
Non- descriptors	412
Semantic fields	9
Hierarchical relationships	2.012
Associative relationships	441
Scope notes	261

Table 16. Statistics of the Tesqual

5. Microthesaurus test

In order to test the Microthesaurus, a sample of documents was indexed in order to find out about the degree of coherence of the Tesqual's structure and its capacity of real application. In this stage, the frequency of the terms used in the indexing and the information retrieval processes were compared to the lexical entries which constituted the provisional version of the Microthesaurus. In this respect, it was detected that there were certain words which were present in the Microthesaurus, but not in the indexing or the information retrieval processes and vice versa; there were also terms from the document indexing and the information recovery process that were not collected within the Tesqual vocabulary.

For this reason, some words were incorporated to the corpus; while others, which were not effective in the indexing process, were eliminated. This led to some changes in the hierarchical order, which had to be re-structured.

6. Tesqual update

Due to the long time that it takes to produce, the Microthesaurus must be frequently updated. This occurs because an indexing language can be out of date even before it gets published. As an example, the semantic field C2, University Quality, had to be re-structured two months after being completed because of the creation of the ANECA organization (*National Agency of Quality and Accreditation Assessment*). Before its creation, it was the CCU (*Council of University Coordination*) that was in charge of university quality management. One of the most relevant characteristics of a Microthesarus is its flexibility, which allows us to increase its vocabulary regularly.

A thesaurus must be revised on a continuous basis. Normally, a newly created thesaurus is updated approximately every six months, while in the case of those which have been in use for a longer period, this revision is done every two or three years (Gil, 1996).

The thesaurus has to be updated with a view to introducing the new terminology derived from the process of development of the subject concerned, but also to correct faults and errors detected from the real application of the thesaurus within a particular field of knowledge.

It is necessary to check the actual use of the terms which are part of the indexing language so as to evaluate each of the entry words. In the indexing process, there may be concepts that appear in the documents, but which are not covered in the vocabulary of the thesaurus. Therefore, when the indexer misses a concept, it notes the need for a new descriptor. This word is recorded, stored on a waiting list or filed as a candidate to become a descriptor. These terms will be revised and analysed in the updating process.

The introduction of the new descriptors cannot be done daily, since this would lead to confusion, breaking the characteristic structure of the thesaurus. We have to take into account that every time a term is modified, all the relationships established between them must be also altered within the whole indexing language.

The presence of synonyms and quasi-synonyms must also be considered in word-searching, including these terms necessarily, as this facilitates user access to information. This is due to the fact that a concept may be denoted by different names.

Chaumier (1986) notes the discordance existing between the use of terms when the documents are introduced into the system and their actual use in the search equations. For this reason, it is important to analyse the terminology used by most people, which is commonly reduced to a limited amount of vocabulary. To evaluate this aspect, statistical analysis is suggested in order to study the frequency of use of descriptors.

To conclude, the Tesqual updating is an ongoing process, which allows us to be aware of the real use of terms both in the indexing process and in information retrieval. This occurs because as happens with entry operations, consultations carried out by users in the natural language provide the actual terminology of the documental system or documentation centre. The search equations give us the percentage of accuracy and response achieved with descriptors.

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Quality Management and Six Sigma

Edited by Abdurrahman Coskun

If you do not measure, you do not know, and if you do not know, you cannot manage. Modern Quality Management and Six Sigma shows us how to measure and, consequently, how to manage the companies in business and industries. Six Sigma provides principles and tools that can be applied to any process as a means used to measure defects and/or error rates. In the new millennium thousands of people work in various companies that use Modern Quality Management and Six Sigma to reduce the cost of products and eliminate the defects. This book provides the necessary guidance for selecting, performing and evaluating various procedures of Quality Management and particularly Six Sigma. In the book you will see how to use data, i.e. plot, interpret and validate it for Six Sigma projects in business, industry and even in medical laboratories.

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