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Meta Modeling and alignment between a quality system and a company system

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Abstract

When we consider that quality concerns all the areas that can be improved, we do not limit ourselves to the quality of products or services, but we extend the horizon to the quality of the management of men, the financial results, the 'environment… and in general to everything that concerns us. This naturally leads to the research for quality being similar to the research for progress, better situations, which tend towards an ultimate state of excellence; it is a dynamic of uninterrupted actions of progress. The word quality itself reduces the concept that it must represent.

As it is the case in our current community and for a given society, there are several actors that influence the way the company operates. In this paper, we wanted to define quality in all its prospects approach and process as well as the structure of a quality system and a quality management system, without forgetting, of course, the process approach that characterizes the most the establishment of quality approach.

Keywords: *Quality, Quality approach, Process approach, Quality system, Company.*

1. Introduction

The Quality is an important goal since consumer needs have been integrated into the decision-making loop and it is becoming a real strategic and offensive tool to face the new challenges of the company [Cartan 2006] [1]. It is currently considered one of the main levers with which a company can increase its overall competitive position.

The quality has become essential to ensure that a company's products and services meet the needs of customers regardless of their field of activity or size.This observation requires companies to master and improve their processes almost continuously in order to guarantee the expected performance and satisfaction of their customers in order to ensure their sustainability and competitiveness.

In this sense, quality is to be considered as a key business process that is integrated with other processes such as the maintenance process, the production process …

It should not be limited to a particular function or department of the company.

2. General Context

The quality objectives depend on where you stand to analyze quality. For this, quality experts distinguish "partners for quality". These partners are: the company and the customers. The objectives of each party therefore differ, depending on the status of each party.

2.1 The objectives of the company:

The company is a set of facilities and people with responsibilities, powers and relationships. It is an economic actor producing goods and services for other actors in order to get benefits [36].

Its objectives are related to its obligations to the outside world (customers and society) and to itself. It also has commitments to honor towards its composing parts.

The company must satisfy the customer. She is led to espouse the point of view of this one as to the quality.
It must provide him with the desired quality and the elements of trust in that quality. Also, towards the customers linked to it by contract, the company must respect the clauses in terms of quality, price and time. This constitutes for her "external" objectives to be achieved.
The objectives "In-house" come from the company's obligations towards its employees and shareholders; or in a general way, to those who put the means at his disposal. It seeks profitability, competitiveness, sustainability, progress.
Improving the quality of its supplies and services, gained through better process control, is an essential factor in profitability and competitiveness. For, according to the « chain reaction» taught by Deming7 to the Japanese since 1950, this improvement in quality makes it possible, with the reaction of the costs of non-quality and cost prices, to « gain market share, thanks to better quality and lower prices».

2.2. The Customer objectives:

The customer is a person or group of people who receives, for payment, a product or service and benefits from the benefits of that product or service [37]. The term "customer" applies to the business, the consumer, the end user of a product, the retailer, the recipient or the buyer.
The customer is the most important player in the business because it significantly determines the survival and development of the business. Its objective, in terms of the quality of the products or services offered to it by the company is very delicate.
The customer wants to have, in advance, a probability as high as possible, if not the absolute certainty, that the product or service he will have will meet his needs. He is very attentive to the quality of what he acquires.
The objectives of the customer, facing the products and services of a company, come together under the name "customer requirements". His relations with the company are most often limited to the satisfaction of his requirements, and therefore of his needs or expectations formulated, implicitly and, if not, imposed.
Nowadays, the impact of quality has been profoundly expanded, since it affects not only the product, but also the manufacturing processes, equipment and people, the organization and all the working procedures within the company. of the structure. Beyond the quality of the product, it is necessary to glimpse all the aspects and factors contributing to the finished product. It is therefore important to become familiar with quality management.

3. State Of The Art Of Quality Management

The quality approach offers a wide range of support tools (method, analysis, statistics, monitoring and control). These tools, created and / or disseminated by the main founders of the quality approach in the context of their consulting activities with companies, are educational.
It is useful to divide quality tools into two categories:

3.1. The complex tools :

Used in the fields of engineering, logistics, metrology, statistics, planning and method services ... These tools were often created at the beginning of the last century. Most of them are already included in Joseph Juran's (1951) [2] book « Quality Control Handbook » a booklet by Mc Graw-Hill Book Company that collects concepts, tools, and approaches to quality improvement.

3.2. The simple tools:

The simple tools to help reflection, analysis, method, usable by any public without special training. It is the JUSE (Japanese Union of Scientists and Engineers) who will make the first systematic broadcast in 1977, 7 tools "all public" selected for the simplicity of their use. These tools have been referred to as the "7M" (1-Pareto Diagram, 2-cause-effect diagram, 3-layering, 4-check-list, 5-histogram, 6-scatter diagram, 7-graph / control chart).

❖ To analyze a performance :

- It is possible to check the performance from a control chart. (United States) (Author: Walter A. Shewart) (Variants: Dashboard Monitoring, Statistical Process Control (PSC): A Quality Management Approach in Which Statistics Are Measured Using Statistical Techniques process to determine if changes need to be made or maintained as is).
- The Benchmarking: is a marketing or quality management technique that consists of studying and analyzing the management techniques and organizational methods of other companies in order to draw inspiration and obtain the best from

them. It is an ongoing process of researching, benchmarking, adapting and implementing best practices to improve the performance of processes in an organization.

- Comparative analysis :

	Advantages	Disadvantages
Control card	• An improvement of quality and productivity • Their use by operators to control a process • Promoting the prevention of defects • Process stabilization • The contribution of a common language • The separation of the causes of variation.	The Shewhart control chart is relatively insensitive to small disadjustments (less than a sigma): It often happens that the disadjustement of the process is slow and progressive. On continuous processes in particular. It is then necessary to detect very early this disadjustment to act before the process deviates from the target value.
Benchmarking	**Internal Benchmarking:** Quickly leverage the best known processes internally. **Competitive benchmarking**: Identifies the measures or performance indicators of the most successful organizations or competitors. **Functional Benchmarking**: Brings new standard examples. Identifies and documents performance related processes.	**Internal Benchmarking:** We stay within the same values "we always did it like that". **Competitive Benchmarking**: Does not take into account the business context and does not document the processes that are driving performance. **Functional Benchmarking:** Limited to universal and comparable processes. It Represents an investment in time and money.

Table 1: Comparative analysis to analyze a performance

❖ To frame the piloting :

- It is possible to use the Deming wheel: (US) steps to set up quality control. Another denomination: the PDCA (Plan - Do - Check - Act: design, implement, control, react), the "wheel of quality". This method was initiated by the Juran [2] and Shewhart [3] quality experts at Bell Telephone in 1925. W. Deming, a statistician who had been a student trainee with Shewhart [3] at that time will discuss this tool in Japan in 1950 when he was in charge of giving series of courses on statistics for two months. In 1954, Japanese industry will call upon Juran [2] to expose the managerial aspects and methods of quality deployment. Nevertheless, the name of Deming remained attached to this tool.

- The Six Segma Method: (USA) management method based on a process of continuous improvement of quality. Equivalent: PDCA, of which it is an improved version.

- Comparative analysis :

	Advantages	Disadvantages
Six Segma	• Adapts naturally to sectors whose operation is based on the 'Process' mode. • By measuring and analyzing the causes of process drift, makes the organization of a company more reliable and better meets the needs of the end customer. • A decrease in rejects, retouching and more generally non-quality costs; • Improved machine availability and synthetic rate of return1 (TRS); • Better market share as a result of improved product quality.	• There are many different tools that need to be used • It is important to have the highest level of accurate data and business participation. • Everyone in a society should be ready to help with data collection and assessment processes. If companies are not ready to negotiate business changes, then the program does not work. When data and detailed business statistics are not available the results of the data collection are not accurate. In some cases, the evaluation can be very expensive if the data are not available or if the process takes longer than expected.
Deming wheel	• Help self-employed workers and consultants to solve problems in a concrete way. • This organizational technique is particularly suitable for major decision-making, requiring strong investments, or for a strategic market position. • provides a foundation for the sustainability of any activity where expertise is required	Being a basic tool, Deming's wheel quickly reaches its limits. For example, it does not provide for solutions to unforeseen situations or emergency management requiring radical and rapid alternatives. It also remains very closed to creative and innovative approaches. If one wishes to use such an approach, it seems good to combine it with more advanced methods.

Table 2: Comparative analysis to frame the piloting

❖ To analyze a functioning :

- "The flow chart (synonym: flow chart)." Codified diagram representing the successive and logical steps of a path and showing the interactions of a

procedure, a process or a system using a set of figures interrelated geometries (eg rectangles or lozenges).

- The PERT tool : Project Evaluation and Review Technique (PERT), a project management method for defining the tasks and deadlines of a project and ensuring its followed.

❖ To investigate the causes of defects and describe their impact :

- The Cause and Effect Diagram or diagram d'Ishikawa Kaoru Ishikawa [4] (synonym: fishbone diagram). Diagram to examine the root causes of problems. By continually asking the question "Why? You end up discovering the real cause of the problem. Usually used to highlight the causes of a problem and group them into separate categories (eg method, labor, material, machinery, materials).
- Pareto Diagram. Author: Joseph Juran [2] (synonym: 80-20) (variant: the curve A-B-C Pareto diagram cut into three segments delimiting the treatment effort to be performed). Simple bar graph, used after data collection to classify causes of problems and set priorities for action. It identifies the causes of problems by the extent of their effects and helps to define improvement activities in their order of priority. The use of this kind of graph gives rise to the rule of 80-20, that is, 80% of the problems stem from 20% of the causes.
- The Histogram. A bar graph showing the distribution of a variance. It also shows the deviations from the norm, in the form of selective analysis for example. It measures the frequency with which something happens.

Comparative analysis :

	Advantages	Disadvantages
Ishikawa Diagram	• Allow the decomposition of a situation or problem into several dimensions (or types of causal factors); • "Decenter" the point of view of those who make the diagnosis; • Constitute a dialog tool or diagnosis shared between actors.	• Difficulty in adapting terms to education; • Static representation of complex and therefore evolving situations; • Focus on what does not work.
Pareto Diagram	• Optimize inventory management • Rational analysis	• The quantitative aspect (generally financial) conceals the qualitative aspects: an inexpensive but strategic stock in the production will not be identified by the method. • They do not provide knowledge about root causes
Histogram	• illustrates the shape of the distribution • easy to clear trends • indicated frequency	• impossible to read exact data • it is more difficult to compare two sets of data • only for continuous data.

Table 3: Comparative analysis to investigate the causes of defects and describe their impact

❖ To choose the appropriate solution :

- The compatibility matrix: allows you to select among several solutions, those that are best suited to a context and based on some predefined criteria.In other words, it is a question of measuring to what degree each of the proposed solutions is compatible with the determining criteria of a project.
- The 8D approach (to ensure the complete resolution of a problem).
- Decision tree : Representation in a tree structure that allows from a starting point to decline all intermediate objectives and means to implement.

Comparative analysis :

	Advantages	Disadvantages
The compatibility matrix	• All solutions are checked. • Each solution is studied according to all the criteria. • The need to fill each box requires everyone to agree. • The ideal solution, when existing, is immediate. • The limits of the optimal solutions studied are also highlighted. • The formalization of the answers allows a quick reference.	• Disregard any interactions that may occur ...
The 8D approach	• Method is to be participative or even collaborative. That is, it can be used to manage inter-service problems, customer / supplier relationships or even inter-process issues. • Effective approach to identifying a root cause, developing appropriate actions to eliminate root causes, and implementing the final corrective action.	• 8D training can be long and difficult to develop. • Requires training in the 8D problem-solving process as tools for collecting and analyzing data such as the Pareto chart, and flowcharts to name just a few.
Decision tree	• "intelligible" knowledge - expert validation (if not too big tree) • direct translation of the tree to a rule base • automatic selection of relevant variables • non-parametric • undifferentiated treatment according to the type of predictor variables • robust against outliers, solutions for missing data • robust against redundant variables • speed and ability to deal with very large bases • enrich rule interpretation with unselected variables • Possibility for the practitioner to intervene in the construction of the tree.	• stability problem on small databases (very small sheets) • "step-by-step" search: difficulty in finding certain interactions (eg xor) • poorly adapted to scoring • poorer performance in general compared to other methods (in reality, performance strongly dependent on the size of the learning base)

Table 4: Comparative analysis to choose the appropriate solution :

❖ To optimize - secure a process :

- AMDEC or Analysis of Failure Modes, their Effects and Criticality.
- Gantt Diagram. The Gantt chart is a tool for modeling the planning of tasks needed to complete a project. This is a tool invented in 1917 by Henry L. Gantt. It serves as a support for setting up and managing a project.
- The matrix "QFD" (Quality Function Deployment), also referred to as the "house of quality". This is a double-entry table that cross-checks the process steps and customer requirements. A system of notation makes it possible to specify the critical points in the matrix and even to follow its evolution (= figurative scoreboard).
- The Kanban, label system for production monitoring (used in just-in-time).
- The Pokayoke : warning system to avoid (yoke) errors (poka) at the operator level (use of simple means such as sight and hearing to prevent operational incidents). Invented by a Japanese engineer named Shigeo Shingo (SMED system designer).

Comparative analysis :

	Advantages	Disadvantages
AMDEC	• Customer satisfaction. • The management of continuous improvement. • Improved communication. • Improved stability of products, processes, services and machines. • Cost reduction. • Optimization of controls. • Elimination of failure's causes.	• Requires tremendous work. • Not adapt to projects in real time. • Optimization of effort between cost and AMDEC analysis and the cost of improvement.
Gantt Diagram	• It allows to visualize the complexity. • It organizes our thoughts. • It shows that we know what we are doing. • It should help us to define a realistic schedule. • It is a good communication tool on the progress of the project.	• They can become extraordinarily complex. • The bar's size does not indicate the amount of work. • They must be constantly updated. • Difficult to print on a sheet of A4 or even A3 paper.
Matrix « QFD »	• The DFQ looks for the customer's 'stated' and 'unspoken' requirements and maximizes the 'positive' quality (such as ease of use, fun, luxury) that creates value. Traditional quality systems aim to minimize negative quality (such as defects, poor service). • The DFQ makes invisible requirements and strategic advantages visible. This allows a company to prioritize and provide relying on them. • Design and manufacturing cost decreased. • Improved quality. • Increased customer satisfaction.	• Customer perceptions are identified by market study. If the study is of poor quality, then the entire analysis can have negative consequences for society. • The needs and requirements of customers can change quickly nowadays. Systemic and methodical thinking can make adaptation to the changing needs of the market more complex.
KANBAN	Inventory management using the Kanban method has many advantages: • Quick implementation that does not require large financial investments. • Reduced manufacturing and delivery times. • Reduction of production and storage costs. • Optimization of the traceability of orders.	For the KANBAN method to work properly, it must be ensured: • the responsiveness and reliability of the production team, but also suppliers; • the quality of the organization; • that the method can be implemented in the company without taking too many risks.
POKAYOKE	• A process in which all (humans as well as machines) does well the first time is more profitable and more enjoyable: ⇨ More profitable because we do not waste time correcting anomalies; ⇨ More enjoyable because everyone is less afraid to make a mistake or to let one go. • Of course, quality is also improved by reducing the risk of delivering a non-compliant product to customers (internal and external). • The brains of all can be mobilized on improvement instead of spending energy to avoid mistakes.	• A poka-yoke is most often single-task, it answers one problem at the time. • A poka-yoke detection can be ignored ⇨ the operator overrides the alert, voluntarily or not

Table 5: Comparative analysis to optimize - secure a process:

❖ To manage the first steps of an analysis:

- Diagram KJ. It is part of the 7 quality tools broadcast by the Japanese. Originally referred to as Affinity Diagram, it is frequently identified by the initials of its designer KawakitaJiro [5]. Very frequently used in the animation of the working groups, this diagram serves to gather ideas, opinions related to various problems and to create links between them in order to bring them closer by categories.
- The QQOQCCP ("Five Ws" or "5W2H"): A very effective quality tool to identify as completely as possible a problem, a cause, a given situation. Very useful also in the work of writing procedures. His name comes from the questions that must be answered:
  - What? : What is it about? (Object, operation, nature, ..)
  - Who? : Who is concerned? (Performers, qualification)
  - Where? Where does this happen?
  - When? : When does it happen? (Duration, frequency ....)
  - How? : How should we proceed? (Tools, materials, method ...)
  - How many? : How often does this happen?
  - Why? : Why is this happening this way?

- Analysis of strengths and weaknesses. The tool can simply consist of a table distinguishing the two categories. The origin of this method is attributed to Kurt Lewin.
- The Brainstorming: Collective method of collecting ideas on a given problem in order to facilitate the search for its causes and / or solutions.
- The QRQC (Quick Response, Quality Control) method developed in Japan and then taken over in France and Europe by the automotive supplier Valeo in 2002. First used in the automotive industry the QRQC method is now more widely used. The QRQC is a visual problem solving method, closer to the field, involving the person who detected the anomaly. Each detected problem must be immediately identified, characterized and analyzed in the field by the people concerned using the incriminated documents; Corrective action must be defined and implemented within 24 hours. The analysis of the problem must make it possible to identify the factor or factors causing the occurrence and non-detection of the problem. Once the influence of the factors on the problem is demonstrated, a five-fold analysis must make it possible to arrive at the root cause which is at the origin of the defect. Finally this root cause must be the subject of a learning card or a "LessonLearnedCard" in English in order to capitalize and share this experience in the company.

Comparative analysis :

	Advantages	Disadvantages
QQOQCCP	• Easy to use. • The versatility of the tool. • Can be used in groups or individually. • Avoid forgetting an important element to the success of a project. • Allows the making of an exhaustive list of ideas.	• The disadvantage is that one sometimes tries to absolutely "fill all the boxes". However, it is quite possible that a question (for example: where?) Has no interest.
KJ Diagram	• Clarification of a problem by extracting verbal data from a chaotic situation. • Natural grouping of data. Framework for ordering ideas. • Make it easy to come up with new ideas "BREAKTROUGH". • Precise targeting of the problem • Clear recognition by everyone. • Involvement of the members, thus improving the cohesion of the team. • Awareness of the problem	• It is helpful to get help from an experienced facilitator, as there are some difficulties with the tool. A delicate aspect is knowing how to handle the levels of abstraction, because it is necessary to bring the elementary ideas together and give them a title of higher level of abstraction.
Analysis of strengths and weaknesses	• Allows linking internal and external elements within a single analysis • Quick visual representation of a strategy • Can be done internally	• Often subjective, weaknesses may be underestimated • Internal / external differentiation can be difficult • Should be supplemented by other tools of strategic analysis (PESTEL, Matrix of Porter, ...)
QRQC	• Dynamic method that allows the participation of several levels of the hierarchy. • Very visual tool, where the information is arranged in a practical way (visual management). • Low application costs. • Uses tools that are easy to learn. • Continuous improvement.	• The transcription of problems is done manually, which can cause some problems of comprehension. • If the company does not have a culture of continuous improvement and quality, the implementation of the method may seem "sinuous". • The success of the method goes with a serious involvement of all the staff.
Brainstorming	• Allows you find a lot of ideas. • Allows everyone to express themselves. It's a way of motivating a team.	• The ideas found do not always correspond to solutions and those that are already in the form of a solution do not necessarily answer. It is necessary to criticize the ideas found by transforming them into useful solutions, that is to say adapted to the problem.

Table 6: Comparative analysis to manage the first steps of an analysis

4. Research Problem

The quality process should be seen as one of the processes of the company [Vernadat 1996] [6], [Dessinoz 2000] [7]. The quality process involved in obtaining a high-performance product only makes sense when considered as part of the company. Integration is, in general, a destruction of the company's organizational barriers in order to improve its synergy so that all activities can be carried out in a more productive and efficient way [Vernadat 2002] [8]. In this sense, system engineering (IS), through ISO / IEC 15288, classifies the quality management process as one of the business processes that coexists with project processes, contractual processes and technical processes [ISO / IEC15288 2002] [9]

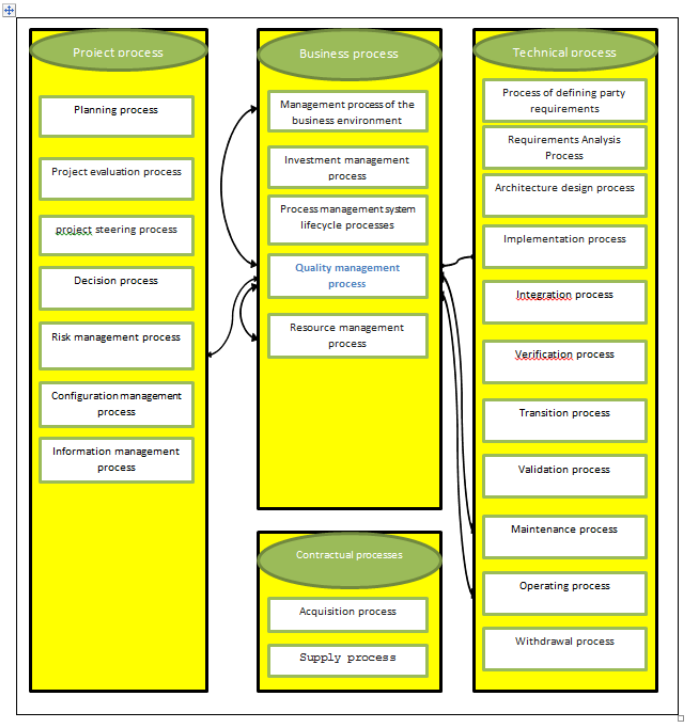

Fig. 1 Positioning of the quality process according to the ISO / IEC 15288 system engineering standard [ISO/IEC15288 2002]

In Systems Engineering, the goal of this process is, first, to ensure that the products, services, and lifecycle processes of a system meet quality objectives, and second, to improve the overall performance of the company. by integrating this process with others.

The quality process is so defined in relation to other types of processes and cannot be located either in a particular function of the company or even in a single structural level [Lopez 2006] [10].

4.1. The quality process in the different structural levels of the company:

"The quality process is not exercised by a single department in the company, all departments and all its employees have a role to play in obtaining the quality of products and services in the company" [Gogue 2000] [11]. Thus, the quality process is usable in the different structural levels of the company with the objective of realizing precise quality activities. In this sense, this process can be broken down into the different levels : strategic, tactical and operational [Marcotte 1995] [12] , [Gentil 2001] [13] , [Pujo 2002] [14].

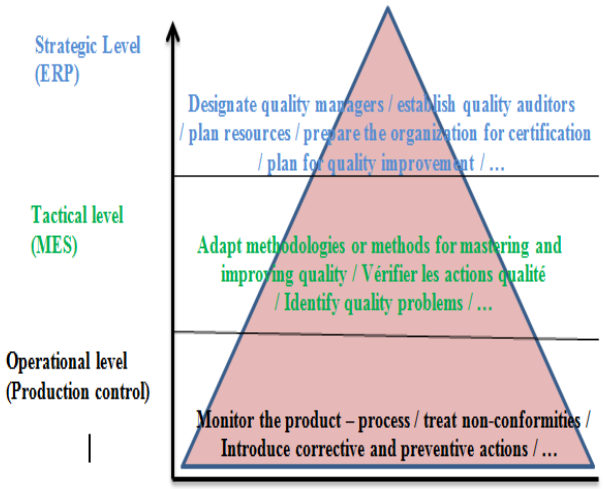

Fig. 2 Quality activities in the different structural levels of the company [Marcotte 1995], [Gentil 2001], [Pujo 2002]

- At the strategic level :

This structural level of the company integrates quality activities related to the notions of quality planning, policy and quality objectives in the company. It also contains all quality activities related to ISO9000 certification. The Quality management at this level must therefore define a general quality policy containing internal requirements relating to product quality and a plan for improving quality. The purpose of the plan is, on the one hand, to specify the control points of the processes, according to the importance in relation to the risks incurred, in particular for the quality of the product or service, and, on the other hand, to make choices regarding methods and quality tools to use and support their deployment in the company at the

tactical and operational levels. This quality plan is carried out in collaboration (in parallel) with the production plan, the maintenance plan, ... which will integrate the constraints resulting from this activity.

In the same vein, the IEC62264 standard, in parts 1 and 2 [IEC62264-1 2003] [15] , [IEC62264-2 2004] [16], shows that the role of the quality process at the (strategic) ERP management level is to define the "good" steps to maintain quality in relation to customer requirements from product design to marketing and delivery.

- At the tactical level:

The quality process operates at this level more specifically on technical type processes such as production and maintenance. This process encompasses quality activities related to the concepts of mastering and improving quality. The purpose of the quality process at this level is to control the quality of the products and the quality of the production processes in the broad sense. The attached activities ensure the satisfaction of the requirements for quality, identification of quality problems, verification of quality actions, etc.
Depending on the objectives defined at the strategic level, the implementation of the means, among the methodologies or the approaches used, is to plan the actions that will make it possible to forecast the quality activities according to the quality improvement plan defined at the higher level, and the planned quality control activities on lower level processes. The management of products and resources of the notion of quality can be adjusted according to this quality plan. This planning of quality activities must be carried out in coherence with the production process.
For its part, the IEC62264 standard, in parts 3 and 4 [IEC62264-3 2007] [17], shows that the role of the quality process at the Manufacturing Execution System (MES) level is also to check the quality actions in order to guarantee the respect of the performances expected from the production system and the product. Indeed, the quality process at this level (tactical) realizes the link between the strategic level and the operational level in order to follow, in real time, the progress of all the production activities.

- At the operational level:

The objective of the quality process at this level is to put in place the activities and means to verify that the results of the technical processes comply with the specified requirements in terms of quality. It is about achieving quality control and dealing with nonconformities related to the process or the product itself. So, quality activities at this level are supported by the implementation of quality methods and tools. These methods and tools enable the implementation of corrective and preventive actions that are launched in accordance with the quality plan defined above. These actions lead to activities related to the notion of improving the quality of manufactured products and their production processes. Some of these activities are integrated into the production range, so of course they need to be coordinated with the production activities. In the same way, the IEC62264 standard, in parts 3 and 4 [IEC62264-3 2007] [17], shows that the quality process is theoretically integrated into the production control system. The role of quality at this level of the business is to monitor the product / process, execute the control and act on the non-compliance.

In conclusion, quality is understood as a process integrated with the different structural levels of the company. At each structural level, this process brings together a set of quality activities that occur either in the design phase of this process or in its operational phase. These quality activities are supported by the implementation of approaches, methodologies and quality methods which represent, in general, means to exploit the activities.

4.2. Development of the quality process:

All processes to be integrated and coordinated in-house need to be modeled to some extent [Vernadat 1996] [6]. Enterprise modeling is clearly a prerequisite for integration. In this sense, the integration and development of the quality process is based on a modeling of this process through the deployment of tools, methods, methodologies and quality approaches that are defined by [Foulquie 1982] [18], [Defourny 1996] [19] , [Dale 1998] [20], [Bechard 2001] [21] as:

- The quality tool: is a means or instrument designed to perform a specific task efficiently. It helps to target and support improvement and change activities. In this category, we find amongst others the control charts, the Pareto analysis ...
- The quality method: is a set of rules and principles designed to support specific quality activities. However, it can logically group and structure a set of tools. In this category, we find among others SPC, AMDEC ...
- The quality (technical) methodology: is a set of activities carried out in a certain order to achieve a well-defined objective. It often consists of several ordered and structured methods according to a set

of operating rules. In this category, we find among others the QFD, the Six Sigma ...

- The quality approach: is a set of reasoned quality approaches to achieve a result in a specific context relating to quality. It does not necessarily require a rigorous implementation algorithm (TQM, ...).

The various approaches, methodologies, methods / quality tools support all or part of the quality process (quality activities) inherent to a level or the interconnection between levels. In addition, some of these approaches, methodologies and methods / tools are oriented to support activities used more in the design phase than in the exploitation phase and vice versa.

4.3. Business Modeling Techniques:

The Enterprise modeling is an essential process for studying organizations in order to improve their performance; it allows to represent society, according to a multi-view abstraction [34]. It is a practice that guarantees the company to self-inform and intelligently drive the alignment of its objectives in coherence with its environment and listening to its customers. The Business modeling remains at the heart of the study topics for the ISO TC184 SC5 WG1 standardization group called "Industrial Automation and Systems Integration, Architecture, Communications, and Integration Framework, Modeling and Architecture" [35]. This community of work proposes standards and Meta-models according to a vision multi-view: "Process mapping, integration infrastructure and representation of human involvement", Hence this character of business modeling that is both informational, organizational and human [22] [23] [24]:

In the next section, we present a literature review of different enterprise modeling approaches.

- **IDEF language:**

During the 1970s, the US Air Force launched a project called ICAM (Integrated Computer Aided Manufacturing) structured in three formalisms IDEF0, IDEF1, IDEF2 / IDEF3 having a point respectively functional, informational and dynamic [32] [33]:

 IDEF0 « functional view »: Also called SADT (Structured Analysis Design Technique), is a graphical technique consisting of a sequence of diagrams transforming the input of a subject system of modeling into "output", by means of control mechanisms. Such representation is likely to distinguish between missions, operations, processes and activities related to the system under study.

 IDEF1 « informational view »: This modeling language is based on graphs representing the rules and procedures relating to the functional view, in order to constitute an informational database called whenever information on any element of the model is needed.

 IDEF2 « dynamic view »: Allows the modeling of the behavior of a production system based on the concept of queues. It is based on four models related to the physical system, entity flow, system control and resource management;

 IDEF3 « dynamic view »: Also defines the behavioral characteristics of the model. It enriches the process modeling provided by IDEF0 via logical connectors useful to represent any relationship activity / activity of the system.

- **The GRAI model :**

The GRAI model, acronym for "Graphs with Results and Interrelated Activities" was developed by Breuil, Doumeingts and Pun at the GRAI laboratory, University of Bordeaux, in the early 1980s [25]. It allows to represent and analyze the functioning of all or part of a production activity of a company by focusing on the decisional and information subsystems. It defines an appropriate management structure by integrating the operating hypotheses and correcting the inconsistencies and malfunctions detected [26].

The GRAI model is a hierarchical system broken down into three subsystems: physical, decisional and informational. This technique is a two-step process for detecting inconsistencies in structure, information, or resources [27]:

 An analysis step: composed of a downward phase to identify the hierarchical structure of the steering system, and an ascending phase based on a survey of the managers of each of the identified centers;

 A design step: determines the overall architecture of the future system by integrating the new relationships between decision centers and the specification of functionalities.
The GRAI method uses two main tools: the GRAI grid and GRAI networks [28].

GRAI is well suited for a global analysis of the production system; a synthetic representation; a hierarchy of functions; extended validation of specifications and simple implementation and operation. On the other hand the GRAI method presents some limitations which can be summarized by a complexity of the GRAI network in case of diversified analysis on several activities; difficulties of detection of operating, decision-making and information systems for industrial systems. The Horizon-period hierarchical representation is not generalizable for some organizations; weak links to the information system specification.

- **GIM-GRAI Method :**

The GIM method "GRAI Integrated Methodology" was created in the GRAI laboratory of the University of Bordeaux within the framework of the European projects ESPRIT "European Strategic Program on Research in Information Technology" Open CAM and IMPCAS. It is a technique that describes the information view of the system using the MERISE method and defines the physical and functional aspects of the model via the IDEF0 / SADT formalism [29].

This approach gives the business model a decision-making aspect based on decision centers resulting from the cross-fertilization of the company's functions with couples (horizon, decision period). It is based on the GRAI technique with its different modeling languages, which offers a user-oriented approach, transforming the user needs into specifications in terms of functions, information, decisions and resources and a second technology-oriented approach to transform the specifications as well as generated in other purely technical specifications. GRAI's GIM conceptual model for business modeling focused on the informational, organizational and decision-making aspects. A decision center can hold all the decision-making functions at a certain hierarchical level. Internal information from the physical system and external information from the surrounding system is filtered, integrated, and provided for use at this hierarchical level. The control system, which consists of the decision-making system and the information system, controls the physical system and enables the entire production system to achieve the expected objectives. In a GRAI-GIM model, a business consists of a physical system, a decision-making system, and an information system. A company can be described using four points of view: functional, physical, decisional and informational.

- **CIMOSA model :**

In 1985, the ESPRIT consortium "European Strategic Program on Research in Information Technology" began work on the definition and specification of CIM "Computed Integrated Manufacturing" architecture for enterprise integration. In 1996, these efforts led to the development of a pre-modeling solution called CIMOSA "Computed Integrated Manufacturing, Open System Architecture", which provides a framework based on the system lifecycle [31]. This method guarantees a process-oriented modeling of industrial companies, making it possible to represent the operations that flow from them in a specific environment. This model is a reference architecture that constitutes [30]:

 A business modeling « framework »;

 An enterprise modeling language;

 An issue for infrastructure integration to provide a set of service entities for model engineering and business operations control.

The modeling framework provides a structure of the CIMOSA reference architecture in a generic and partial modeling, each level housing different views relating to the particular model of the enterprise [56]. The concept of points of view allows you to work on your area of interest. CIMOSA defines four different models of points of view: function, information, resources and organization. However, this set of views can be extended if necessary. The CIMOSA reference architecture supports three levels of complete business life cycle modeling (requirements definition, design, specifications, and implementation description). Again, the modeling sequence is optional. Modeling can begin at any phase of the life cycle and can be iterative as much as possible.

In keeping with the specificities of model engineering, only a few of the phases of the life cycle can be covered [31]. The business modeling approach.

⇨ Drawing on existing approaches to enterprise modeling, almost all of the standards evoked for modeling a particular area of the business offer an organized set of relevant concepts of modeling and integration, as well as their relationships. Consequently, the determination of the positioning and potentialities of any approach in relation to this set is appropriate, because of its strong participation in bringing existing methods closer together with a view to highly hoped integration. The table below shows all of these

techniques with the advantages and limits detected.

Approach /Model	Contributions	limitations
IDEF	Good understanding and communication between problems studied and results obtained;	Confusion when interpreting the model Lack of precision on the input / output;
GRAI	Global system analysis; Synthetic representation; Hierarchy of functions; Extension of specifications; Simple implementation.	Limited performance in case of complexity; Very limited interoperability;
GIM/GRAI	Integration of the decision view; Taking into account resources human.	Limited operation; Modeling the level of definition of requirements not clearly defined.
CIMOSA	Possibility of an infrastructure integral; Consistent modeling of the company.	No distinction of modeling boundaries; Lack of a clear vision on the behavior of processes; Heaviness of formalisms of description based on forms.

Table 7: Comparative analysis of Business Modeling Techniques

5. Research Topic And Outlook:

The quality management is the set of organizational techniques that contribute to obtaining quality in the context of managing the production of goods or services at the enterprise level.

The concept of quality is a subjective notion that finds in the company certain objectivity in a compliance with standards (norms). The concept of quality management is a concept of management at the heart of production whose object is the management of material flows (called logistics) and immaterial (called management of information system). A quality service or research and development is therefore a production support service that may or may not take this name. In a certain way quality management, whatever its name, is co-responsible for the staff of the company carrying a certain intangible capital to value with the management of human resources.

In future work, we will try to bring the two systems closer together; the quality management system and the company structure while addressing, categorizing quality methods and trying to improve them to better cover the components of a company.

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