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The New Forms of the Industrial Maintenance: Which Impact in the Performance of the Industrial Companies? (Case study)

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Abstract*— for a long time the industrial Maintenance is regarded as a vital action in the industrial companies, this classical design of Maintenance saw a radical evolution according to the technological development as well as the integration of the New Information and Communication Technologies (N.I.C.T.), the globalization and the word competitiveness which involve the assurance of the total quality of products and the cutting cost, that is it on their immaterial resources(human, system, process…), or in the materiel resources (Tools, equipment…).

However, it is unanimously recognized that N.I.C.T. play a key role for the support and the assistance of the majority of the activities of Maintenance and whose the Computerized Mechanical Management System (C.M.M.S.) constitutes a significant portion. These multiple evolutions have created a new requirement as regards of competences and versatility of the operators of Maintenance, the latter must know as well permanently about the last developments in the developments in the technologies of the generating stations automated as of the new method and tools for Maintenance.

Our word fellows two ways; the first one consists in describing the successive changes of the Maintenance function and its impact on the competence of the operators of Maintenance. The second aims to modeling the positioning of the Maintenance function starting form a diagnosis based on the concept of audit which is carried in the Tangier Free Zone (T.F.Z.), according to three branches of industry, the textile, leather and clothing sector, the construction, manufacturing and aeronautical sector, and finally the wiring, electronics and electricity sector, while locating the impact of the N.I.C.T. in the industrial Maintenance.

***Index Terms*—C.M.M.S., Competence, Evolution, Impact, Industrial Maintenance, Modeling, N.I.C.T., TFZ.**

I. INTRODUCTION

The whole of all technical, administrative and management action carried out during the life cycle of a good and intended to maintain it or to restore it in the condition which it can achieve the necessary function is the definition of the Maintenance which is granted by the AFNOR standard. [2] This Classical design saw a radical evolution according to the new methods of diagnosis and control as well as the technological development and that of the N.I.C.T., the globalization and the world competitiveness which involve the assurance of the total quality of products and cost cutting…, which allows such a change in the entrepreneurial resources, that it is on the immaterial resources (human, system, process…), or material resources (tools, equipment…).The advance of the New Information and Communication Technologies (N.I.C.T.) changed the traditional structure of the features of the company towards structures more interactive, and flexible, including the Maintenance function. In this article we will describe the changes of the Maintenance function, and their impact on the development of competences of the operators of maintenance, then we will present a study aims to model the positioning of the Maintenance function in Tangier Free Zones T.F.Z., this modeling segments three industrial sectors, the wiring, electronics and electricity sector, the construction, manufacturing and aeronautical sector , and finally the textile, leather and clothing sector, and while locating the impact of the N.I.C.T. on the performance of the industrial companies.

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II. THE SUCCESSIVE CHANGE OF THE INDUSTRIAL MAINTENANCE: FROM THE CLASSIC TOWARDS THE MODERN ONE

A. History:

For a long time the industrial maintenance played the corrective part whose objective was to reduce the duration of immobilization of the machines by the replacement of equipment (palliative or curative), without giving an account the problems involved in degradations of this last. The place of the companies in world competitive encourages them to search total quality and especially cost cutting, which changed the positioning of the Maintenance function towards a major function in the company. It thus aims less at giving in work the tools that to anticipate its dysfunctions, the company in this case should not undergo the events, but it must envisage them and analyze their effects on the long run. Formerly curative, the Maintenance function becomes preventive and contributes to improve the reliability of the equipment and the quality of the product, this form results in the definition of the action plans and of interventions on the equipment, by the replacement of certain parts in the process of degradation in order to limit wear of it, by the greasing or the regular cleaning of certain installations…, these actions were initially carried out in a systematic way according to calendars preset, maintenance remains not limited has this level there, thanks to the evolution of the method of diagnosis and of control, maintenance was evolved to the concept of conditional preventive maintenance, it uses techniques of forecasts of the breakdowns as the vibratory analysis or of oil, this form of maintenance makes it

possible to replace parts right before their rupture, the following figure presents the various aspects of the Maintenance function [11]:

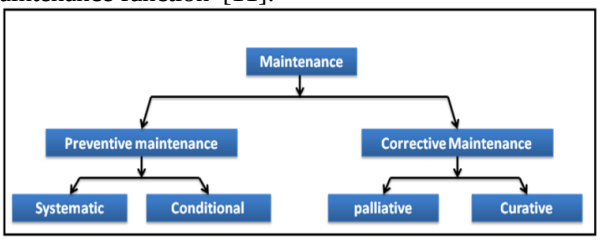

Fig.1: The different aspects of maintenance

The birth of the concept of expert system (E.S.) like tools of resolution of the problems and decision-making aid, support industrialists to improve the maintainability of their production sites, to facilitate the diagnosis of the breakdowns and to decrease the downtimes. The expert systems are a computer application able to make decisions or to solve problems in a precise field.

The Expert System is a program which calls on the artificial intelligence. A database is conceived starting from the knowledge of an expert before being integrated into the program [5].

The expert systems used in maintenance allow to:

- Treat the various aspects of maintenance for a family of equipment given.
- Guide step by step the speaker according to an advance of lower costs by a judicious integration of know-how corresponding and the remarks.
- Easily take into account the adaptations which appear important.
- Begin again if required and reinforce "the flow chart of breakdown service" which can be developed while making it more accessible.

Concepts like the Total productive of Maintenance T.P.M. or the Reliability Centered Maintenance R.C.M. are essential for goal of improvement, of modification and of maintenance of the machines and equipment, [6][7], with these concepts maintenance is not only anymore regarded a not-generator activity of added-value, but as an important process of improvement of the total productivity of which the goal to reduce as much as possible the stops of activity due to maintenance, like improving the total productivity by implying all staff.

The application of the T.P.M involves the reduction the causes from the losses in order to improve the performance of the resources of production and to thus obtain the maximum effectiveness of the people and equipment.

The objective of the R.C.M. is to work out an optimized program of preventive maintenance, aims to do, the reliability and the security of the tools of production, by taking account of the economic aspects, as well as the improvement of the organization of maintenance. [7]

These visions of maintenance function known as classical since they are not connected with the leading-edge technologies, the vision today is to develop these classical visions towards modern and flexible visions.

B. Modern Maintenance:

In the way of competition development and the race to competitiveness that drives the search for total quality, and especially the reduction of costs as well as complexity and automation of production processes, maintenance has become one of the strategic functions of the company. Far from being stabilized today, maintenance has been evolving with the latest information and communication technologies I.C.T., the introduction of new methods of management, the technological development of the tools of production, particularly in the areas of the measurement and control of operation and the systematization of progressive of the use of standards and procedures.

From a classical management of maintenance passing by a Computerized Mechanical Management System (C.M.M.S.) towards a vision of the maintenance remote based on the concept of Remote maintenance and E-Maintenance.

1) The technology of C.M.M.S. :

The information used in different applications of the field of maintenance has been changing according to the evolution of information technologies and in function of the increasing complexity of the industrial environment. In the past, this information has been entered manually on paper (plans, schematics, manuals) and exchanged verbally between operators.

The information was not formal enough in order to share the paper form, because the need was not to be considered. Today, however, the information has become totally different. It is structured and formalized in order to be manipulated by the computer systems.

The existence of the C.M.M.S. package (Computerized Maintenance Management System) will meet the needs of businesses with regard to the exchange of information and procedures and the analysis of maintenance activities and archive them. [1]

The C.M.M.S. is characterized by four standard features (fig2):

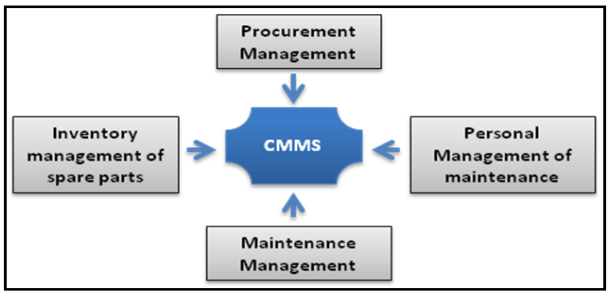

Fig.2: The characteristics of the C.M.M.S.

- Maintenance management concerning the preventive or curative interventions on the industrial plants.
- Personal Management of Maintenance relating to planning, assignments, and with the management of the formation.
- Inventory management of spare parts, control of the reserve stocks, alerts on the threshold, reception of the parts.
- Procurement Management concerns the addition of commands, the management of suppliers and their price, and the billing.

2) The remote Maintenance:

Businesses are looking to improve the current system of maintenance through two strategic levels:

- The first level is aiming to strengthen the service of maintenance in the company itself, i.e. at the level of internal resources (internalization of the maintenance function.)

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- The second level appeal to external resources of the enterprise through a sub-contractor (reduction of maintenance service) - we are talking here about the outsourcing of the maintenance function.

The current trend is to outsource, in part, the maintenance function. The Outsourcing process brings us to evolve in a domain which is distributed and has changed the information systems as well as the practices of the company. The new information and communication technologies (N.I.C.T.) have helped establishing these new practices and making them to change. Thanks to the N.I.C.T., to the emergence of Web technology and the Internet, the tasks of maintenance services and controls can be performed automatically to distance and with the aid of various appropriate devices implanted within the firms.

The birth of the remote maintenance on the technologies of access, treatment of data, information or of knowledge and exchange between actors at a distance, appears to solve the problem of the limited number of service personnel with the skills, the versatility and the know-how in the business. Hence, the new forms of maintenance tend to expose the staff to a rapid access to information.

They also allow you to directly benefit from the assistance of experts to distance in case of need. In remote maintenance, the states of devices are discovered on the spot thanks to sensors or local operators, and then routed via a network and forwarded to the intended recipient. As such, two main architectures of remote maintenance exist:

➢ ***The remote Maintenance:***

A.F.N.O.R. according to [2], the remote Maintenance is defined as "Maintenance of a goods implemented item without physical access of personnel to the working tool."
The remote maintenance therefore aims to allow the staff performs, quickly and at a distance, a large number of operations. The main component of a system of remote Maintenance is the network on which it relies for the flow of information. A system of remote maintenance is usually consisted of at least two distinct parts:

- The center of expert maintenance, also called the center of competence.
- The sites of maintenance.

ZERHOUNI presents the architecture of the remote Maintenance shown in the figure.3 [13]:

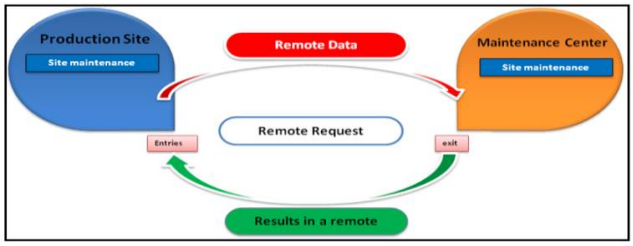

Fig.3: The architecture of the remote maintenance.

➢ ***The E-Maintenance:***

The e-maintenance is also an evolved form of maintenance with the advent of the Internet and of the new information and communication technologies (N.I.C.T.), and which allows for the sharing of knowledge and work with actors. The e-maintenance is associated with the concept of intelligent service since it allows access to knowledge outsourced, of e-service (electronic service via the Internet). [12]

It allows you to make available for remote resources; these resources can be hardware (spare parts, tools …) or intangible (human or computer…). The outsourced resources are accessible through the Internet network, to tools for communication, exchange and access to information that can be grouped under the term of e-service.
The architecture of e-maintenance is done via a web-based network which allows you to cooperate, to exchange, share and distribute this information to the different systems partners in this network. [13]

The principle is to integrate all of the different maintenance systems into one information system .The systems offer different formats of information which are not always compatible for sharing data which requires the coordination and cooperation between the systems to make them interoperable. ZERHOUNI presents the architecture for E-maintenance:

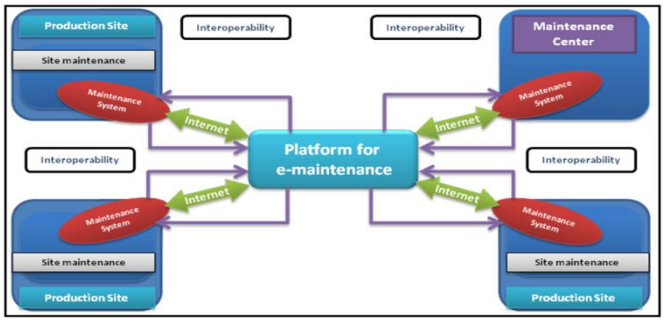

Fig.4: The architecture of the E-maintenance

III. IMPACT OF THE NEW FORMS OF THE INDUSTRIAL MAINTENANCE ON THE COMPETENCE OF THE OPERATORS OF MAINTENANCE

A. History:

A long time ago, maintenance had been an aspect for repair and maintenance, this function is entrusted to a person called "agent of maintenance", the latter focuses on the tasks of curative maintenance and repairs failures or malfunctions that occur unexpectedly. He must be able to identify the origin of the failures, find and implement quickly troubleshooting solutions. With the development of "preventive maintenance", he also brings me to participate in the improvement of the performance of facilities by performing the actions planned (cleaning, adjustment, lubrication, replacement of parts ...) and identifying any anomalies on the equipment.

With the evolution of preventive maintenance, the maintenance agent has been suffering the urgent developments at the profile level which is mainly organized into two profiles, that of "the service technician" and "Technician of methods". We usually find in the profile of the "technician of intervention" all the skills implemented by the agent of maintenance in accordance with a level of requirement higher in the technical areas such as: the mechanical, electrical, electronic and the hydraulic… In addition, his role can always be oriented more toward the research and the implementation of technical solutions aimed at addressing the deficiencies and improving the performance of the facilities.

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However, more fundamentally, what distinguishes the technician of intervention from the agent is his ability to organize, plan and coordinate the response, to ensure their proper execution in the enforcement of safety rules, the deadlines and the existing procedures. [9], [10]
He has the responsibility of define “operational ranges”, i.e. specific actions for each type of intervention and equipment. Moreover, he seeks new technical solutions, to ensure optimization of the output and an anticipation constant worry of the failures of the installations.

One also finds the same overlap between the two profiles of technician: the “technician of methods” plans most of the activities carried out by the technician of intervention. Nevertheless, its principal activity is well the method: in a constant worry to improve the methods of intervention, it defines the specifications i.e. the rules of actions related on the technical specifications, the deadlines, the costs, the supply; it takes care of the respect of their application by the staff of his company or the subcontractors; it identifies and optimizes the costs of the activities of maintenance [9], [10]

The developments of maintenance are not confined to this level with the birth of the T.P.M. or the R.C.M. "Total Productive Maintenance, Reliability Centered Maintenance ", the two profiles have evolved to the level skills. With the birth of the notions of maintainability, availability, reliability "maintenance indicator", the service technician must be able to analyze the activity of the production equipment, to operate a machine history and to maneuver the maintenance indicators with regard to the M.T.B.F. (Mean Time Between Failures) and M.T.T.R. (Mean Time To Repair.)

The technician must master certain concepts in mathematics allowing him to obtain an estimate on the availability and reliability of his production tools. Also, he must be able to calculate the yield of the plant, to acquire the knowledge and know-how related to activities of corrective maintenance, preventive maintenance, improvement and integration of new machines.

B. Evolution:

The birth of packages of C.M.M.S. (Computerized Maintenance Management System) has changed the structure of information between the agents of maintenance. The service technician must know how to guide this tool with its different tabs. In effect, he must be able to manage his work (type of preventive intervention or curative), manage his schedules of periodic inspection and check the stock at a store. He must have the basics on the management of the maintenance as regards the procurement of parts, the addition of commands, and the management of suppliers as well as the management of the billing. Therefore the concept of the versatility is needed in any significant fashion.

In accordance with the integration of new information and communication technologies (N.I.C.T) in the field of maintenance, and the emergence of the web technology and networks, a new maintenance image has emerged; it is ultimately the remote maintenance. The degree of knowledge and know-how is in more and more demand regarding especially the knowledge in the areas of mechanical, electrical, and the automatic tools. The maintenance agent must have an extreme interoperability, he must have a depth of knowledge in the field of computer science, that is to say, he must be able to manipulate a computer or a phone, know the main concepts of telecommunications in regard to the drafting of a query (problematic) and send it by a phone network (W.A.P.) or by a computer (local loop radio) WIRELESS LAN ") with the help of a local server or from a remote server in the service of central maintenance to correct the anomaly to distance. Some concepts of the programming are required in this the management of the documentation and management of the planning. The autonomy, the reflection and the control of the risks are also required.

IV. APPLICATION

We carried out a study on the positioning of the plant Maintenance in the TFZ (Tangier Free Zones) [8], this study aims to present the state of place of the Maintenance function according to three categories of industrial companies, the first category concerning the specialized companies in Wiring, Electronics and Electricity, the second concerning the specialized companies in Construction, Manufacturing and Aeronautics, and finally the third category concerning the specialized companies in Textile, Leather, and Clothing

A. Presentation of the problems:

The optimization of the costs and the performance of the Maintenance function passes regularly by an analysis of existing (diagnosis) in order to being able to compare itself with others, it is the approach of Benchmarking, or to be made evaluate by experts starting from series of questions.

The diagnosis of the effectiveness of the Maintenance function comprises a set of phases which are used to evaluate the level of realization of the activities of Maintenance.

The approach consists to introduce the opinion of the company on the degree of realization of the functions analyzed of the total organization of Maintenance in the company on a scale of frequency. (See tab.1)

Tab.1: Criterion of each of frequency

Frequency	Criterion
0%	The function or/and the action are not filled or the means does not exist
25%	The function or/and the action are filled partially where are in phase of installation. The means has just been acquired and is in phase of commissioning
50%	The function or/and the action or/and the means are operational but do not give satisfaction yet
75%	The function or/and the action or/and the means are operational give apparently satisfaction but are not evaluated (indication activity)
100%	The function or/and the action or/and the means are operational; they give satisfaction and are controlled by indicators of effectiveness

B. Methodology of the study

The evaluation of the Maintenance function is carried out on eight phases; each phase contains a series of questions defining the state of place. The following figure presents a design of the stages of evaluation.

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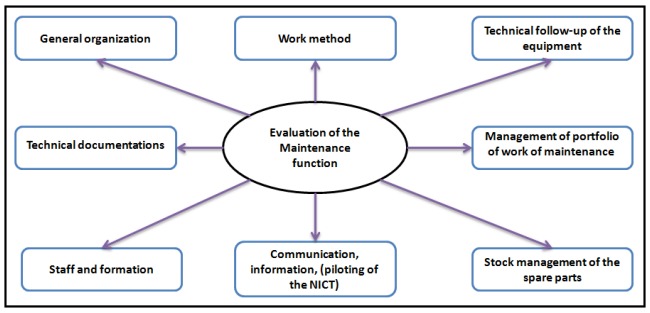

Fig.5: Various phases for the evaluation of the Maintenance function

The following table illustrates the various phases for the evaluation of the Maintenance function with the specification of each phase.

Tab.2: specifications of each phase of evaluation of the function Maintenance

Phase	*Specification*
General organization	This phase contains general features of maintenance, the policy which it adopts in the company (internalization, partial outsourcing, total outsourcing), the place which it occupies in the company i.e. a service relative or independent with the production function, the number of staff in charge to the mission of maintenance, the policy of routine checking of work of maintenance, while locating the losses due to work of maintenance and the stops of production.
Work method:	This phase illustrates the working method of maintenance, passing by the preparation of programs of work and the interventions of maintenance, the classification and the accessibility of the files of preparation…
Technical Follow-up of the equipment	This phase contains the relative information for each equipment, coding, existence of technical dossier, history of work, report and inspection, analyzes histories of work…
Management of portfolio of work of maintenance	This phase adopts a general vision on the management of portfolio of work of maintenance, i.e. the existence of a program for the preventive maintenance for equipments, the scheduling of work, planning of launching of work…
Stock management of spare part:	This phase consists of giving a point of view on the stock management of spare part, with regard to the relative information with the updating of the cards of stock, the follow-up of the consumption of the articles (parts) for equipments, the availability with regard to the cost of each spare part…
Technical documentation	This phase aims to define the relative information in the technical documentation of the equipment of production (plan, diagram, note…), the accessibility and the use of these documents, thus the recording of work of modification for the equipment (put up to date of documentation)…
Staff and formation	This phase contains information concerning the staff of maintenance, the working conditions, the methodology of work, the evaluation of its know-how, and training for staffs…
Communication, information (piloting of the N.I.C.T.)	This phase relates to the use of the means of communication and the circulation of information during a detection of an anomaly or a breakdown, passing by the means of communication and the exchange of information between staffs of maintenance, the existence of Computer Supported Cooperative Work C.S.C.W., the archival medium for the call reports…

In order to collect information in the whole of the companies concerned, we used the software Sphinx plus^2 V5 like a numerical tool of modeling of this study.

- Modeling under sphinx plus2 V5:

After having designed our questionnaire, we used the software Sphinx Plus2 V5 like a numerical model and the data analysis [14] of our study, it makes it possible to assist us in each of the three great stages of realization of an investigation, and the following figure presents the process of analysis under V5 Sphinx.

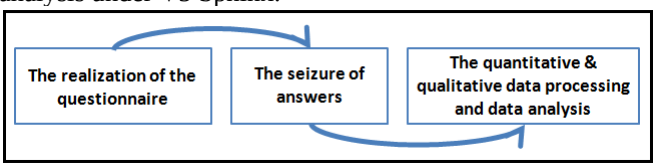

Fig.6: Process of analysis under Sphinx

The first phase (design of the questionnaire) aims to define the data which have wants to analyze according to the questionnaire, with regard to the seizure of the variables, the means of answer (answers closed, multiple answers…).
Once the digital questionnaire was designed, the second phase aims to seize the answers coming from the companies concerned.

The third stage it is the most important phase of this tool. It aims to treat the quantitative information and to give statistics for all the questions concerned with our study in the form of a detailed instrument panel, thus to carry out qualitative analyses of the data, and the relations of interaction between the studied variables.

C. Analysis of the results:

The graph (radar) illustrates the positioning of the function Maintenance in the TFZ according to the three studied sectors.

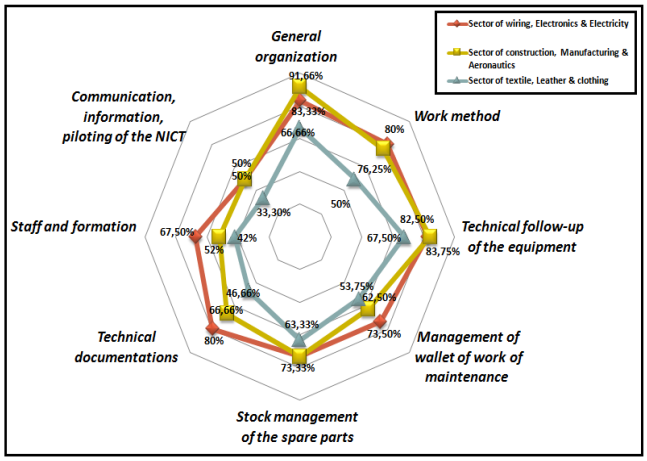

Fig.7: Modeling of the positioning of the function Maintenance in the free zone according to the three studied sectors

We notice that the maintenance function specific to the Sector of (Textile, Leather, Clothing…) occupy a reduced position by a percentage of 58.21% compared to another two, knowing that the sector of (Wiring, Electronics, Electricity…) is located at the head with a rate of 78.75%, as for the sector of (Construction, Manufacturing, Aeronautics…), it occupies the second rank with a rate of 68.25%.

On the level of this same graph, we can notice that phases concerning the general organization, the work method, the technical follow-up of equipment, management stock of spare parts as well as the phase of communication, information and piloting of the N.I.C.T. overlap for the sectors of (Wiring, Electronics and Electricity…) and of (Construction, Manufacturing and Aeronautics…)

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what shows that the quality of work as well as the control of the processes are practically identical even if there are differences between some phases such as technical documentation and management of portfolio of work in Maintenance. (See the fig.7)

In contrary, various phases of positioning of the Maintenance function for the sector of (Textile, Leather, and Clothing…), are less developed in regards to quality of work and the control of the processes.

With regard to our study and more particularly, the phase of communication, information and piloting of the N.I.C.T., one notices that the latter is marginalized compared to the other phases of positioning with percentages not exceeding the 50%. (Sector of (Textile, Leather, and Clothing…) 33%, and the two other sectors show a rate of 50%), this is a potential handicap which can slow down and block the development of the companies as regards productivity in each sectors of industry. As we saw that the N.I.C.T. present technologies of the information flow and the tools of the communication. The cause of this handicap lies in the fact that the companies do not invest enough in the modernization of the communications tools and information for the Maintenance function already taking place.

With regard to the tools for storage of relative information to work of maintenance, more than 50% of the companies use the format paper; This last influence on the productivity of the company with regard to the information retrieval stored on hundreds of paper at end to inform itself with the anomaly correction, which causes a waste of time during the time of repair. (See fig.8)

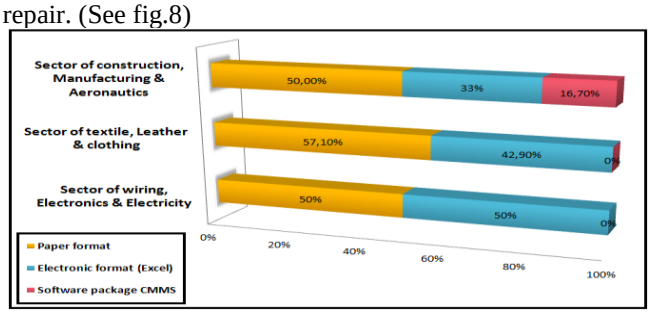

Fig.8: The tools for filing of the relative information to work of Maintenance

The second support used as tools for storage of the relative information to work of Maintenance function is the digital support (Excel format) with a rate varied between 33% to 50% of the companies according to the branch of industry (figure.8) while the exploitation of a software package C.M.M.S. is used very little in the zone, and which does not exceed the rate of 16.70%, it is used exclusively in the Construction, Manufacturing, and Aeronautical sector.

The persons in charge within companies making use of interviewed Software package C.M.M.S., stated us to save money in time and to constitute a knowledge base their offering a very important experience feedback when it is a question of evaluating the quality of the process of maintenance.

The recourse to a software package C.M.M.S. will meet the needs for the companies with regard to the information exchanges and the procedures, and analyzes it activities of maintenance and filed.

With regard to the circulation and the exchange of information and the communication between the staff of maintenance, one notices according to the survey that the tool more used, it is the classical tool i.e. the exchange in a verbal way with a rate from 37.5% to 50% following the branch of industry of each company.

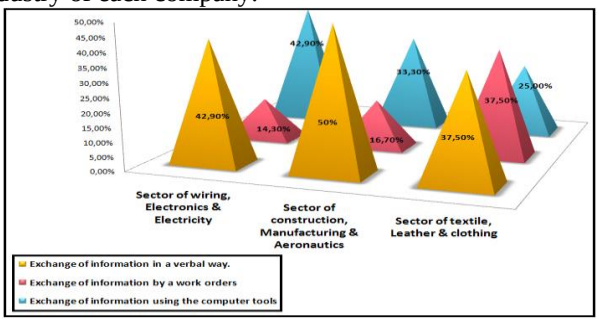

Fig.9: Various methods of communication enters the operators of Maintenance

The use of the physical supports in the transmission of information between the various operators (exchange by a good of intervention) present of the rates which vary between 14.3% and 37.5% according to the branch of industry of each company of the zone; This tool blocks the realization of the tasks to which they are assigned and the respect of the imposed times.

The access to the computer systems to facilitate the flow and the information flow between the operators of Maintenance shows a rate which varies between 25% and 42.9%. These tools are divided into two: the telephone and the computer. The figure.10 presents the distribution of the computer tools according to the branch of industry of each company.

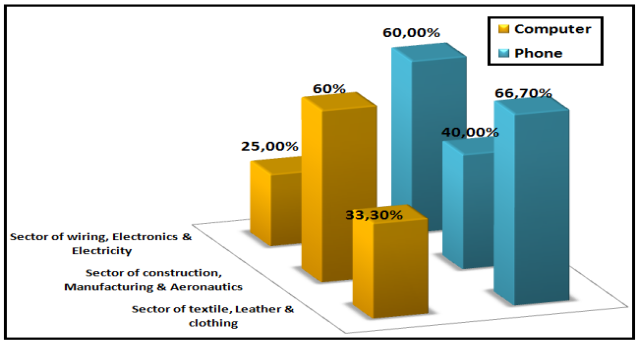

Fig.10: Various computer tools used for the information exchange and the communication enters the operators of Maintenance

The use of the methods to share information and to communicate between the operators of Maintenance remains an archaic global way of work.

The N.I.C.T. presents new tools in the environment of the agents of Maintenance; we can conclude that the phase staff and formation can influence on the handicap of the positioning presented by the phase of communication/ information and piloting of the N.I.C.T.

The N.I.C.T. presents a positive impact on the change of competences of the operators of Maintenance. Indeed the presence of the N.I.C.T. in a service influences in a continuous way on competence of the operators of this last.

If one speaks about the Maintenance function, the degree of knowing and know-how of the operators of Maintenance must be required, having more and more knowledge in the technical fields of mechanics, electricity, and the automatics…

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These operators of Maintenance must have an interworking with these new technological tools which do not cease being established, which requires constants trainings, like formations concerning the remote working, of the formations related to the fields of telecommunication, and the teleworking. A certain method of the successful change makes it possible to change the spirit of the operators and to improve their know-how, in order to get along with this new virtual and technological world.

A recent study was conducted using a questionnaire sent to the various sectors of industry in France [4]. This study aimed to define the various functions of the agent of maintenance which are related to the field of the N.I.C.T. We could note that competences summarize in four functions strategic cities in the previous table and gathered in the following figure:

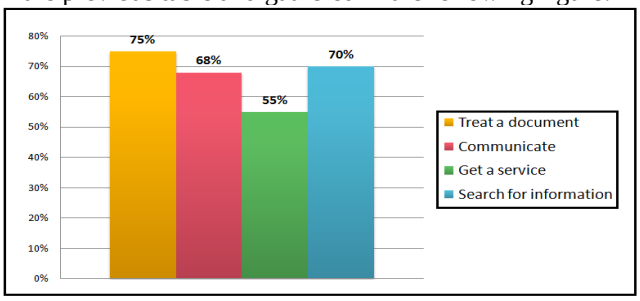

Fig.11: The classification of the principal functions for the use of the N.I.C.T. in the maintenance function [4]

The agent of maintenance must have initially like necessary meadows of the concepts of bases in the various fields of technologies such as data processing, telecommunication and gathered in the level 1.

Following the survey which we could make, each strategic function has two levels:

- Level 2: Have the extensive knowledge
- Level 3: Mastering his knowledge.

- *Treating a document:*

For the second level, the maintenance agent must be able to produce a simple textual digital document to describe the type of anomaly and the archive (document management).

While in the third level, the maintenance agent must realize and manage functional documents; in the same vein, he must be able to archive and manage his files, use a sheet of simple calculation (summons, product, …) or complex a text (rate of malfunction of a machine, M.T.B.F., M.T.T.R; for example).

So he is ready to edit a document (report) complex text based on mathematical calculations and graphs narratives.

- *Searching for the information:*

For the second level, the maintenance agent must find information in a context; which means, he must be able to know the use, the interest, and the limits of the internet, discover the architecture of a graphical user interface (web site, C.M.M.S. software or other) and identify the invariants of the graphical interfaces and the specificities of presentation.

The third level leads the maintenance agent to find and manage information tailored to his needs. Equally, he must be able to develop a critical aspect vis-à-vis the internet, use of search engines, filter and extract the information suited to his needs and finally download a file (document, video…).

- *Communicating:*

For the second level, the maintenance agent must send and receive messages with a known device. Likewise, he must know (the use, the interest, the limits of e-mails, discussion forum…), exchange and share information on a forum or a network.

For the third level (masters), he must be able to create a box mail to facilitate the sharing of information, manage his contacted, send and receive messages developed with a complex procedure and finally archive his messages.

- *Getting a service:*

For the second level, the maintenance agent must be able to obtain a desired service of a communication device (phone, fax, computer…) or an application of industrial maintenance (C.M.M.S. or of more intelligent software diagnostic).

For the third level (masters), he must be able to use any type of device that is providing all the preferred services to diagnose the anomaly to distance, starting goods from a distance, archive all information...

V. CONCLUSION

In this article we presented the evolution of the plant Maintenance and its impact on competences of the agents, while making a diagnosis on the positioning of the plant maintenance in the free zone of Tangier on which we modeled the positioning of the function Maintenance in three distinct industrial sectors, this modeling enables us to have the vision of the change towards the virtual one [3] that one must face the intensive integration of the N.I.C.T.in the various services of the company.

The N.I.C.T. present influences on the plant maintenance that is in their material resources (equipment, intelligent sensor…) or in their immaterial resources (competence, Process…).

The integration of the N.I.C.T. in a medium which is far from technological development poses a problem on its output in the process what requires a quite clear management leading to a successful change. The change of staff is often one of the experiments more stressing our life and this proves quite as true for the organizational changes.

A approach of E-Learning or K.M. (Knowledge Management) can help the operators to be within a standard framework of development, in order to apply one of the methods which can ensure a change of process, technology, of structure, and finally of staffs.

REFERENCES

[1] Association Française des ingénieurs et responsables de maintenance, « production maintenance » guide GMAO – seconde édition- revue de l'AFIM, paris septembre 2004.

[2] Association Française de Normalisation, AFNOR : NF EN 13-306, « Terminologie de la maintenance », Ed. Afnor, Paris, 2001.

[3] A.Rachidi, A. Talbi & A.Khatory, « L'entreprise virtuelle, une stratégie pour le développement des entreprises. », Colloque de Recherche Appliquée et de Transfer de Technologie (CRATT'12), ISET Radés, Tunisie, 2012.

[4] A.Rachidi, A.Talbi & A.Khatory, « The industrial maintenance: a function by mutation and the skills in evolution » International Journal of Research and Reviews in Mechatronic Design and Simulation (IJRRMDS), Vol. 2, No. 2, June 2012, ISSN: 2046-6234, Science Academy Publisher, United Kingdom.

[5] Blanc M., Charron E., Freyssenet M., Le « développement » des systèmes-experts en entreprise, Cahiers de recherche du GIP « Mutations Industrielles », n° 35, novembre 1989, 84 p. Édition numérique, freyssenet.com, 2007, 800 ko.

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and Sciences Publication (BEIESP)

[6] Jean BUFFERNE « la TPM : un système de production », Technologie (SCEREN - CNDP) – Revue Française de gestion Industrielle, Paris, avril 2008.
[7] Eugène Désiré EFAGA, « Analyse des données du retour d'expérience pour l'organisation de la maintenance des équipements de production des PME/PMI dans le cadre de la MBF (Maintenance Basée sur la Fiabilité), thèse doctorat, université Luis Pasteur Strasbourg, 2004 .
[8] Foreign Direct investment, Magazine, « Global Free Zones of the Future 2010/11Winners,http://www.scspa.com/Cargo/Logistics/ftzs/documents/Free_Zones_of_the_Future_2010.pdf, June/July 2010.
[9] Catherine FRENOT « Référentiel des métiers et des compétences », direction de la protection judiciaire de la jeunesse DPJJ/SDRHRS ministère de la justice, mise à jour juillet 2008.
[10] Ministère de l'économie des finances et de l'industrie « les métiers de la maintenance industrielle » mode d'emploi, édition de l'industrie, Paris 2001.
[11] Monchy F., « Maintenance, Méthodes et Organisations » Ed. DUNOD, Coll. L'Usine Nouvelle Série Gestion Industrielle (2e édition), Paris, ISBN 2-10-007816-5, 2003
[12] Muller A., « On the concept of e-maintenance review and current research», reliability Engineering and System Safety, 93 (8), p. 1165-1187, 2008.
[13] Noureddine Zerhouni « classification des différentes architectures de maintenance » 7ème Congrès international de Génie Industriel – 5-8 juin 2007 – Trois-Rivières, Québec (CANADA).
[14] Logiciel Sphinx plus2 V5, « Repère méthodologique pour logiciel Sphinx plus 2 V5»,http://www.lesphinxdeveloppement.fr/Publicc/uPLoad/_FRANCE/pdf/Support/Declic/ReperesMethodologiques.pdf,2009.
[15] Marion PERSONNE, « Contribution à la méthodologie d'intégration de l'environnement dans les PME-PMI: Évaluation des performances environnementales. » thèse doctorat, INSA Lyon, 1998.

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