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RESEARCH ARTICLE

HIGHLIGHTING QUALITY TOOLS FOR EFFICIENT SOLID WASTE MANAGEMENT IN CONAKRY

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Abstract

This study addresses the problem of the management of urban services in charge of solid waste management in African cities and particularly focuses on the role of quality management in solving the problems of solid waste management in Conakry. The hypothesis is that the absence of a quality management system contributes to unsanitary problems. The objective of this study aims to propose an adapted solid waste management model for Conakry. The results obtained following the empirical research method (observation, documentary exploitation and semi-structured interview), are aligned with other research on an African and global scale; suggest solutions for better urban environmental governance. Indeed, a new management model, the MKT-LIMSO (Maningbè Kaba TRAORE-Integrated Strategic and Operational Management Logigram), has been proposed, integrating various tools for more effective management. The recommendations include continued research on waste flows, strengthening environmental education, integrating new public management, training actors in the solid waste sector, and promoting innovation towards an economic circular. The establishment of taxes, standards and the sharing of management between municipalities are also proposed to improve the situation.

Introduction:-

The history of Conakry begins in 1890, when it was designated as the residence of the Lieutenant Governor of the Colony of the "Rivers of the South". Since then, the city has developed considerably, with major infrastructure such as the installation of water pipes and the construction of roads and railways. Located on the Kaloum peninsula, Conakry is surrounded by the Atlantic Ocean to the west, the islands of Kaback, Kakossa and Matakang to the south, the prefecture of Dubréka to the north and that of Coyah to the east. The city's relief is essentially made up of a coastal plain and gently sloping hills, with vegetation dominated by mangroves. The climate is tropical, with temperatures ranging from 24.6°C in August to 37.5°C in April, and an average annual rainfall of 4300.7 mm. Conakry's topography strongly influences solid waste management, often limiting accessibility to neighborhoods and complicating waste collection, especially during the months of July and August when flooding makes roads impassable. Conakry's population is growing rapidly, from 1.67 million in 2014 to a projected 2.33 million in 2020, although recent estimates indicate a slight decline in 2022 and 2023 (RGPH 2014, Statistical Yearbook 2013). The demographic is predominantly young, with approximately 40% of the population under the age of 15, and composed primarily of the Soussou people, known for fishing and their rich folklore. Economically, Conakry is the political

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and economic center of Guinea, with the Autonomous Port of Conakry and Ahmed SékouTouré International Airport generating significant revenue for the state. The private sector, particularly in telecommunications and finance, is dominated by foreign companies, while trade remains the main activity. Agriculture, concentrated on rice growing and market gardening on the outskirts, is threatened by increasing urbanization and industrialization. In Guinea, as in many countries, the adequacy of human resources to service projects and objectives is not a priority, leading to weaknesses in the functioning of public administrations. However, these are now subject to public management rules, inspired by the private sector, which require the setting of objectives, the evaluation of work, and the monitoring of human resource performance. Thus, a managerial approach oriented towards the performance of results becomes essential. Personnel management is fundamental to the performance of an administration, as highlighted by the Centre de Gestion de la Fonction Publique Territoriale de Loire-Atlantique (2019): "conducting good human resource management is essential today, regardless of the size of the community".The quality of the staff also depends on the skills of the manager in managing this staff. The method used in this research combines qualitative analysis and direct observation, based mainly on documentary sources and semi-directed interviews.

Materials and Methods:-

The method used for this research is based on documentary exploitation and semi-directed interviews. It is inspired in particular by the integrative management system of Maes (2012) and the strategic foresight of Godet (2007), but especially by the ISO 9001 quality management system version 2015, using tools such as the SWOT matrix, the Ichikawa diagram, the Quintilian hexameter and the Deming wheel. These resources, combined with semi-directed interviews, made it possible to develop a strategic and operational management model called the "MKT-LIMSO Model". The innovation of this model lies in the coherent integration of strategic and operational management tools. The model integrates both the tools and the actors involved in solid waste management in Conakry, but it is also applicable to other urban service management contexts. The objective is to bring together, according to a precise process, all of these management tools to define an innovative solid waste management system. This system aims to improve the waste management strategies already tested in Conakry, after an evaluation of the latter. The data collected was subject to computer processing through World, Excel and the map of the city of Conakry was produced using QGIS software.

Results:-

Results of semi-directed interviews on the production and management of solid waste in Conakry

This section presents the results of the semi-directed interviews carried out with public and private service stakeholders involved in solid waste management in Conakry, namely: ANASP, the Governorate of Conakry, the Municipalities of Matoto, Dixinn, Matam and Ratoma (the respondent indicated from the municipality of Kaloum could not be met), the Albayrak company responsible for the collection and transfer of solid waste to the mining landfill.

To do this, the summary of the results of the interviews is presented in Table No. 1, followed by the proposal of the model entitled “MKT model, integrated strategic and operational management flowchart (MKT-LIMSO), inspired by quality management tools (MK Traoré, 2022), its description, and its application.

Table 1:-Summary of the results of the semi-directed interviews carried out with the actors of solid wastemanagement in Conakry.

No	Activities	Administrative and privateentities								Observation/Specificities
		YEAR[1]	GVC[2]	Mto	Bye	Mta	Ra	Ka	Albk[3]	
1	Pre-collection			X	X	X	X	nd		

[1]ANASP is responsible for the implementation of solid waste management policies and monitoring, development of plans and programs, mobilization of technical and financial partners
Exclusivity of solid waste management without contravening the skills of local authorities while ensuring regulation (ANASP, 2020)

[2]In the current sanitation system of the city of Conakry, the Governorate is only responsible for street sweeping and monitoring (Governorate of Conakry, 2020)

[3]Albayrak is only responsible for the transfer of solid waste to the mine dump

2	Collection			Nd	Nd	Nd	X	nd		
3	Storage/Grouping point			X	X	X	Nd	nd		
4	Transfer			X	Nd	X	Nd	nd		
5	Sorting			0	Nd	0	X	nd		
6	Treatment			0	Nd	0	X	nd		
7	Communal management scheme/plan			0	0	0	0	nd		
8	Equipment/Infrastructure			Nd	Xi	Xi	Xi	nd		
9	Approach improvement in sight or in perspective			Xi	Xi	Xi	Xi	nd		Steps taken but need to be improved and no results
10	Innovation			Nd	Nd	Nd	Nd	nd		
11	Proposal for improvement of the overall system (pre-collection, collection, transfer, storage, processing and others)			Nd	Nd	Nd	Nd	nd		Unanimity on the need to improve the entire supply chain management, the whole system
12	Reasonable monthly collection fee for households			X	Nd	X	X	nd		The subscription fee gap proposed by three communes out of 5 is quite important
13	Pickup tracking			0	X	0	0	nd		

Source: MK Traoré, 2022

Legend: x: existing, nd: not determined; xi: exists but unavailable; 0: not practiced

Description of the MKT-LIMSO model: Integrated Strategic and Operational ManagementFlowchart

"The entire movement towards public management is driven by the idea that administrative activity should be refocused on the service provided and the beneficiary public, on results to the detriment of a logic of use and renewal of resources" (CPA, 2016). It emerges from this statement that the goal of management is oriented towards the search for quality. To address the weaknesses of the management system of services in charge of the solid waste issue in Conakry, it is important to focus on the principles of the quality management system as outlined by the International Organization for Standardization (ISO) and on the tools of the quality approach with a view to developing a coherent diagram to serve as an integrated strategic and operational flowchart of the quality approach. This diagram thus developed (see Figure 1) constitutes the model entitled: MKT-LIMSO (Strategic Management and Integrated Operational) whose acronym is preceded by the initials of the author's name.

Let us recall that "quality management is a set of coordinated activities to guide and control an organization in terms of quality" (CPA, 2016). It is about obtaining the smallest gap between, on the one hand, the service promised by and the service actually provided and, on the other hand, the service expected by the user and the service perceived. According to ISO 9000 (2015), "quality management aims to increase the awareness of the organization's management of its obligations and its commitment to meet the needs and expectations of its customers and interested parties and to satisfy them with its products and services". To make this meaning a reality in solid waste management, the application of the proposed MKT-LIMSO model, due to its innovative nature, is a sure path to performance because its managerial approach systematically integrates strategic and operational management tools. It is thus designed to serve as a solid basis for a quality management system. Also, it results from the analysis of the weaknesses of solid waste management strategies that have failed on the one hand, and on the other hand, from the harmonious combination of a set of tools, pre-established universal principles and which takes into account the working environment but also the global environment in relation to the problem of solid waste management. It is thus a tool for optimizing solid waste management actions applicable to any strategic and operational management situation. At the strategic level, the MKT-LIMSO approach combines the aforementioned elements (figure 1). It involves the following tools in the model: the Deming wheel, the Ishikawa diagram and the Quintilian hexameter. These three tools or sets of tools are supplemented by a summary table.

This table, although used in the overall approach to solving piloting problems, does not appear explicitly in the MKT-LIMSO model; but is used to summarize the causes and the solutions recommended in relation to the different causes (see illustration in Table 3). One of the tools of the quality approach, the Deming wheel is used for planning, action, verification in order to act for continuous improvement.

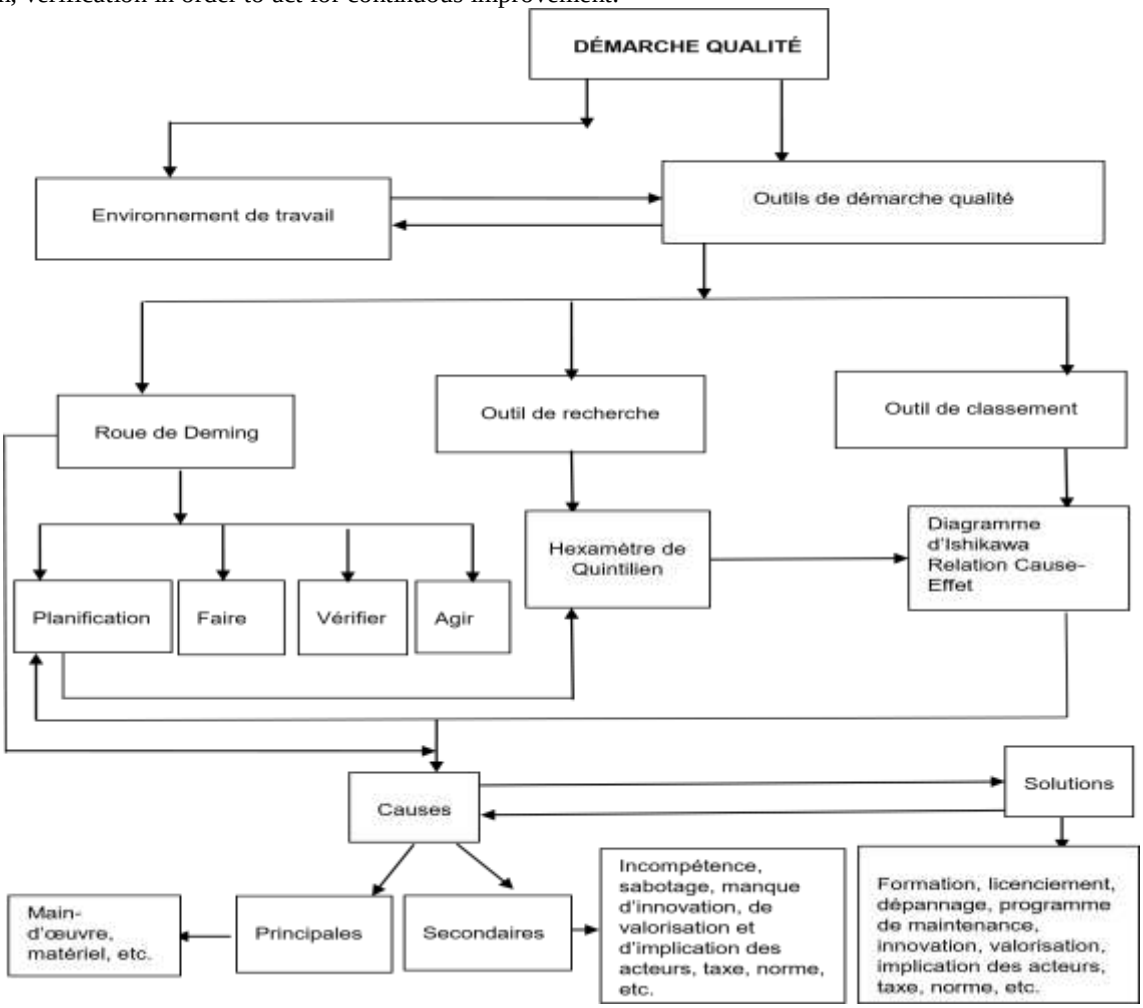

Figure 1:-Model - integrated strategic and operational management flowchart (MKTLIMSO).

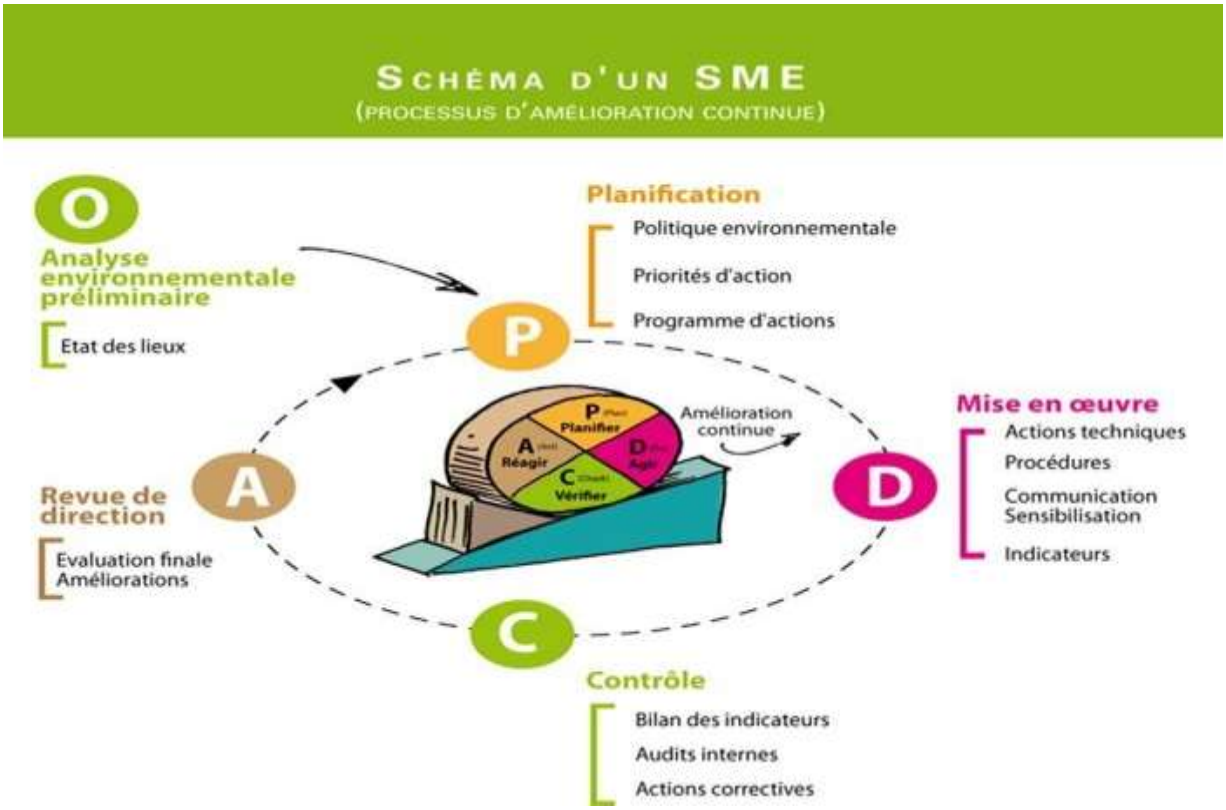

Figure 2:- Application of the Deming wheel to the environmental management system.

For Darbon (2014), "the Deming wheel is the most systematically used tool when talking about quality approaches, proposing a method built around a moving situation and five stages (four + one), linked to each other" supported by a wedge. We can therefore see how the quality approach is above all: (i) work on the entire production process of administration services including all stakeholders, whoever they may be; (ii) work or rather a constant process, of permanent monitoring, or if you prefer, of steering, involving all employees in a common administration project. The principle that this wheel allows us to visualize is that of the constitution of a virtuous circle in complete opposition to bureaucratic vicious circles, emphasizing the capacity of the system to be able to be permanently corrected according to errors made or new opportunities revealed.

The administration is supposed to constantly monitor the quality of services and make the necessary adjustments in order to improve it as much as possible and as closely as possible to the principles of the five zeros (zero defects: the service does not present any errors; zero delays: the service is delivered within the expected time; zero breakdowns: the service does not experience any failures; zero paper: the procedures for obtaining the service are simplified and brought together on a single site; zero stock: these procedures are completely predictable and are monitored over time and we will add "zero contempt": can we talk about quality when in a service, the user does not know who to contact, feels unwelcome, has the impression of being a nuisance and begging for a service, when it is due to him?

For Darbon (2014), the four phases of the Deming wheel (PDCA: Plan, Do, Check, Act) follow one another interactively. They are:

Step 1 «Plan»: The "plan" stage is used to prepare and plan. In this particular stage, we can rely on three specific tools that facilitate diagnoses: First, the QQOQCP analysis: this is an information collection technique that allows us to capture all the useful information to conduct a critical reflection and establish a diagnosis (we also speak of Quintilian's hexameter, the method being used by the Romans to conduct their criminal investigations...). The QQOQCP method could be used for effective solid waste management by asking the following questions: Who? What? Where? When? How? and Why? This last question (why?) allows us to move from observation to the formulation of action hypotheses and the proposal of actions. With this method, it is not only a question of gathering information to identify a problem, but also of posing it, rationalizing the diversity of information, looking for causes

and proposing solutions. For example, in line with the subject of the article (highlighting quality tools for effective solid waste management inConakry), the problem can be defined as follows: the inadequacy of the management system of the services responsible for solid waste management in Conakry.

Table 2:- Quintilian's hexameter.

	Who	What	Or	When	How	For what
Task 1						
Task 2						
Task 3						

Then, the fishbone analysis called Ishikawa diagram or “cause-effect” diagram or five M method, is a tool for identifying the causes of a problem.

After identifying a problem (for example, the failure of the current solid waste management system in Conakry), the possible causes of failure are grouped into five major groups of causes (identified as the "M" families): Environment: everything that is the external environment; Materials and materials: everything that is consumable; Labor: everything that concerns human resources; Means: everything that concerns equipment (machines and materials, etc.); Methods: everything that concerns procedures, methods, instructions, etc.With the fishbone analysis, we construct a fishbone diagram whose central line oriented towards the right by an effect (the production of the problem) gathers around it the five (5) edges. We thus identify for each edge the causes according to their level of importance and we associate them to graduate them. We can thus value the failures and provide remedies.

As can be seen, the research tool (Quintilian's hexameter, Table 2) allows cause-effect relationships to be determined using the classification tool (the cause-effect relationship diagram or fishbone diagram, also called the Ishikawa diagram or 5M (Method, material, environment, equipment and labor)) developed by Kaoru Ishikawa in 1962 and used in quality management. Its principle is to allow ideas to be synthesized and structured. It is a particularly effective visualization tool for good communication and is above all a decision-making tool aimed at resolving problems and malfunctions. The Ishikawa diagram is a tool for solving business/organization problems.

In accordance with the nature of the determined causes, classified into primary and secondary causes, appropriate solutions are provided. In a driving or piloting situation for example, the primary causes could be linked to, among other things, manpower, materials, etc. while the secondary causes could be related to incompetence, sabotage, etc.

Illustration of the LIMSO model in efficient solid waste management

It is established that solid waste management in Conakry is faced with persistent weaknesses attributable to the management system implemented. By applying the MKT-LIMSO model (integrated strategic and operational management flowchart) shown in Figure 1, and by respecting the principles of quality management, the approach follows the following process: problem definition (use of the first element of the Deming wheel “Plan to plan, "prepare"); identification of possible causes (Ichikawa diagram); synthesis of the causes and solutions to the problem posed (summary table); return to the Deming wheel (Do/make; Check/verify; Act/act).

Definition of the problem

The problem can be defined as follows: the inadequacy of the management system of services responsible for solid waste management in Conakry. Thus, Quintilian's hexameter makes it possible to determine the parameters of the problem defined through the following questions: What: the weaknesses of the solid waste management system; Who: 2,328,338 inhabitants live in an unsanitary, degraded environment; Where: the cityof Conakry; When: permanently; How: implementation of professional, stabilized and predictable procedures and logics of public management profitability; Why: qualify the management system of urban services responsible for solid waste management.

With the problem clearly stated, the next section consists of identifying possible causes through the Ishikawa diagram.

Identification of possible causes

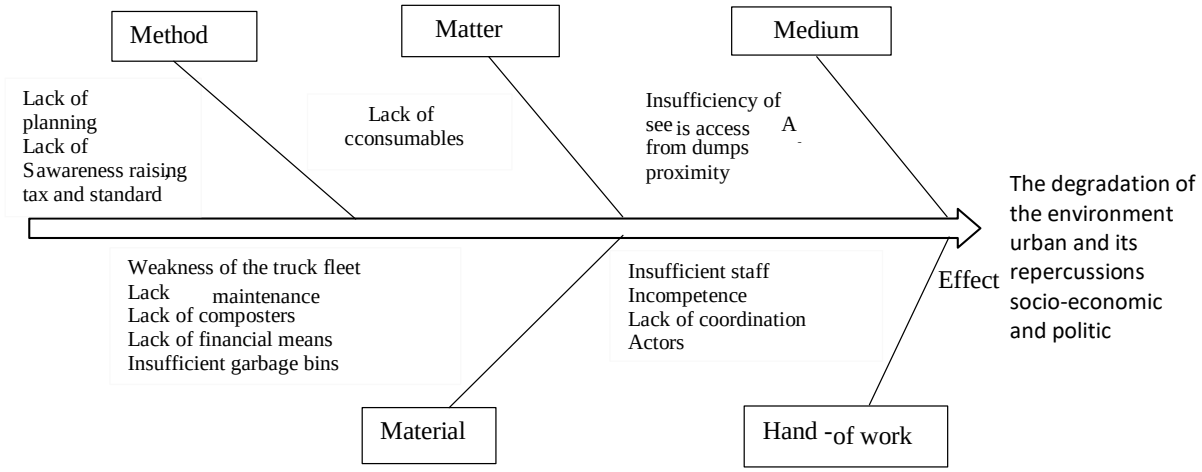

Figure 3:- Application of the Ishikawa diagram to solid waste management problems in Conakry.

Table 3:- Summary of the causes and solutions to the problem posed.

No	Main causes	Secondary causes	Solutions
1	Method	Lack of planning Lack of awareness Lack of valuation	Strategic planning; ERE, Valorization Taxation, Standardization
2	Matter	Lack of consumables	Regular provision of services
3	Medium	Insufficient access roads Lack of nearby dumpsites	Development of roads and dumps
4	Material	Weak truck fleet Lack of maintenance Insufficient garbage bins Lack of composters Lack of financialmeans	Logistics and equipment maintenance; composters; financing
5	Workforce	Insufficient staff Incompetence Lack of integration of actors	Recruitment and training of managers and workforce; Participation and coordination of actors

Return to the Deming wheel

After defining the problem using the first element of the Deming wheel (plan), identifying the causes and proposing solutions using Quintilian's hexameter, return to the Deming wheel for the implementation of the proposed solutions.

Implementation of the proposed solutions

This step corresponds to the second element of the Deming Wheel as indicated in Figures 2, i.e. "action/do/Do"). It consists of implementing the proposed solutions, starting with preliminary tests, allowing the achievement of defined objectives.

Verification

This is a control step to validate the quality processes tested and the solutions implemented. When each activity is carried out in the implementation of the solutions, verification must be carried out to ensure the effectiveness and completeness of the activity carried out.

Act

The adjustment or concrete implementation stage of the program consists of making the necessary adjustments to the process based on the solutions either implemented or proposed to resolve the problem posed, but also to seize new opportunities. For each solution allowing a milestone to be reached, provisions are also made to maintain the course. Hence the presence and usefulness of the wedge on the Deming Wheel (Figure 2) which allows to

permanently stabilize the results acquired by registering them in clear procedures and rules thus guaranteeing the performance of the organization. As can be seen, the application of the quality management system described and illustrated through the LIMSO model (Integrated Strategic and Operational Management Flowchart) proposed by this study could contribute to improving the provision of services by urban areas responsible for solid waste management in Conakry. This model (LIMSO) is a guarantee for the search for and/or maintenance of the performance of any public/private organization.

Discussion:-

The integration of quality management in urban services calls for training and the will to change the paradigm. In order to propose a quality management system (SMQ) for sustainable solid waste management in Conakry, a series of semi-directed interviews were conducted within public services (governorate, municipalities, etc.), the Albayrak company (responsible for the collection and transfer of waste in the city of Conakry since March 2020), and the ANASP which has replaced the Public Waste Transfer Service (SPTD) since 2016. The summary of the results in Table 1 indicates the activities by actor, the administrative and private entities, the observations/specificities of responsibility of each actor as well as the activities shared by all of said actors. Regarding the activities, it emerges from the results of the interviews with the municipalities that pre-collection is carried out except for that of Kaloum, whose information could not be determined due to lack of respondents. On the question of collection points in the municipalities, three municipalities claim not to have any while one municipality remained imprecise. Regarding the transfer of waste to the landfill, it is carried out in two out of four municipalities surveyed, two others were unable to determine how this activity is carried out. The latter's statements stating a lack of knowledge about the transfer procedures are symptomatic of an administrative dysfunction given that the activities of the company in charge of the transfer are visible to some extent in each of the five municipalities concerned by the study. When analyzing this first set of activities, in particular that of transferring waste to the landfill, an apparently trivial but nevertheless take-in-account inadequacy can be identified, which could be described as a lack of responsibility.

Indeed, the municipalities should be able to know who is responsible for the transfer of solid waste in Conakry given that according to ANASP (2020), this service has been officially provided by Albayrak since March 4, 2020. This is all the more remarkable since beyond field observation, Albayrak claims to be responsible for the transfer of waste in all five municipalities covered by the study. On the issues of sorting and treatment, two out of four municipalities interviewed claim that these two activities are not carried out while they remain undetermined in one of these municipalities and another affirms the effectiveness of sorting and treatment, particularly in the recently completed ZTTs. On these two issues of sorting and treatment, efforts still need to be made to improve solid waste management in the municipalities of the city of Conakry, both administratively and technically. On the issue of a municipal solid waste management plan or scheme, none of the four municipalities interviewed have one. This state of affairs reveals the absence of any professionalism in solid waste management in Conakry. Given this reality, we understand why difficulties persist regarding the lack of control of the problem of sanitation and solid waste management in the Conakry area. When asked about the aspects related to an improvement approach that should result in the possibilities for innovation in solid waste management, the four municipalities evaluated claim to have undertaken improvement approaches that remain modest but are counting on possible achievements from the SANITA clean cities project. In this context and on the innovation aspect, none of the four municipalities evaluated have a plan that should lead to innovative actions in solid waste management in Conakry. However, they are unanimous on the need to rethink the entire solid waste management chain. As for solid waste management equipment and infrastructure, three out of four municipalities claim to have some but of insufficient quantity and quality, while in one municipality, the question on equipment and infrastructure remains undetermined. On the issues of household subscription fees to collection SMEs and the establishment of collection monitoring committees, three municipalities make proposals for subscription fees ranging from 15,000 GNF to 100,000 GNF. Based on different subscription fee proposals, an average of 93,000 GNF emerges, given that one municipality makes a proposal of 25,000, 30,000, 50,000 and 100,000 while two other municipalities are making an offer of 60,000 and 15,000. The gap in subscription fees offered by three municipalities is significant and should be the subject of a substantial assessment. On the need to set up monitoring committees for solid waste collection, one municipality claims to already have its committees while three others do not have them but recognize this need. The analysis of the different results (research documentary and semi-directed interview, and observation in this case) leads to the need to rethink the current solid waste management system in Conakry from the perspective of a quality approach in urban services responsible for solid waste management. The difficulties of solid waste management throughout the world, in Africa and in Guinea are addressed by a number of studies. Addressing the management of this waste, Ngambi (2015), states that: "waste management faces several obstacles: the removal of subsidies by the State, the

precariousness of the road network, the low rate of tax recovery, and the absence of local standards or suitable regulations, etc." However, Sarraf (2016) sets out the advantages of management that could make household waste a resource that would stimulate the economy and reduce the environmental impact.

Conclusion:-

To practice quality management in the administration of urban services, prerequisites such as training, willingness to change including taking into account topography in the planning and implementation of urban waste management projects are essential. An assessment of the current solid waste management system in Conakry, Guinea, was conducted through semi-directed interviews with public and private stakeholders. The analysis of the results highlights the need to rethink the solid waste management system in Conakry, by integrating a quality approach to overcome the identified obstacles, improve management and potentially transform waste into beneficial economic and environmental resources. They also made it possible to propose, interpret and illustrate the LIMSO model (Integrated Strategic and Operational Management Flowchart) in efficient solid waste management. To provide a quality service in solid waste management, the administration must rely on competent human resources and effective leadership. This highlights the need for any manager to master the concepts of quality management and their application in the day-to-day management of services.

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