IMPACT OF MANAGING DRINKING WATER SERVICE USING AN INTELLIGENT PRE-PAYMENT SYSTEM ON THE PERFORMANCE OF THE REGIDESO CITY OF LIKASI

NTEPE KISANGUKA Olivier [1] KISANGUKA PANDAKUFUA Henry[2], ILUNGA WA NSANKI André[3], KIKOSA WA NKABI JOHN[4], PWETA MWALABA John[5], KABWE BANGWE Tohers[6], KAZADI KATOMPA Aubin[7], MALEMBA KATANGA Laurent[8], MUSALE MUYABALA Ephraïm[9], LUMBU WA NYUNGU Séraphin[10]

Resume: Cet article porte sur impact de la gestion de la desserte en eau potable à l'aide d'un système intelligent de prépaiement sur le rendement de la Regideso ville de Likasi. Face aux nombreuses difficultés de recouvrement des factures, à la fraude, et aux plaintes des abonnés concernant des coupures injustifiées ou des erreurs de facturation et des longues files au guichet pour le paiement des factures, il s'est avéré urgent d'introduire une solution plus équitable, automatisée et fiable.

Le système proposé repose sur une technologie STS (Standard Transfer Spécification) permettant la génération de codes de recharge par l'IEC ou via le réseau GSM, offrant ainsi aux clients un accès facile au crédit d'eau, et payer à l'avance leurs consommations via mobil money sans dépendre d'un guichet physique, ceci rendu possible grâce à une architecture intelligente, intégrant des compteurs prépayés électroniques, L'analyse des résultats a démontré une nette amélioration du taux de recouvrement, une hausse des recettes de la REGIDESO, ainsi qu'une réduction significative des pertes commerciales. Le système a aussi permis de réduire les désagréments entre l'abonné et l'opérateur, puisque la consommation est désormais maîtrisée et anticipée par l'utilisateur.

Le système de prépaiement s'est avéré être une solution durable, favorisant à la fois la gestion efficiente de l'eau potable et l'équilibre financier de la REGIDESO

MOTS CLES : *Prépaiement, Client, Service*

---

[1] NTEMPE KISANGUKA Olivier, Assistant at the Higher Pedagogical and Technical Institute of Likasi

[2] KISANGUKA PANDAKUFUA Henry : Head of works at the school of industrial engineers, University of Likasi.

[3] ILUNGA WA NSANKI ANDRE, Assistant at the Higher Pedagogical and Technical Institute of Likasi

[4] KIKOSA WA NKABI JOHN, Assistant at the Higher Pedagogical and Technical Institute of Likasi

[5] PWETA MWALABA John : Assistant at the school of industrial engineers, University of Likasi

[6] KABWE BANGWE Tohers, Assistant at the school of industrial engineers, University of Likasi

[7] KAZADI KATOMPA Aubin : Assistant at the school of industrial engineers, University of Likasi

[8] MALEMBA KATANGA Laurent, Assistant at the Higher Pedagogical and Technical Institute of Likasi

[9] MUSALE MUYABALA Ephraïm, Assistant at the Higher Pedagogical and Technical Institute of Likasi

[10] LUMBU WA NYUNGU Séraphin, Assistant à l'Institut Supérieur Pédagogique et Technique de Likasi

Summary: **This article focuses on the impact of the management of drinking water supply using an intelligent prepayment system on the performance of the Regideso city of Likasi. Faced with numerous difficulties in bill collection, fraud, and complaints from subscribers concerning unjustified cuts or billing errors and long queues at the counter for bill payment, it became urgent to introduce a more equitable, automated and reliable solution.**

The proposed system is based on STS (Standard Transfer Specification) technology allowing the generation of recharge codes by the IEC or via the GSM network, thus offering customers easy access to water credit, and paying in advance for their consumption via mobile money without depending on a physical counter, this made possible thanks to an intelligent architecture, integrating electronic prepaid meters. The analysis of the results demonstrated a clear improvement in the recovery rate, an increase in REGIDESO's revenue, as well as a significant reduction in commercial losses.

The system has also made it possible to reduce inconveniences between the subscriber and the operator, since consumption is now controlled and anticipated by the user.

Keywords: **Prepayment, Customer, Service.**

1. INTRODUCTION

In a context where the management of public services is becoming a crucial issue for the sustainable development of Congolese cities, the REGIDESO (Water Distribution Authority) of the city of Likasi is facing increasing difficulties linked to low profitability, poor management of invoicing and financial losses due to unpaid bills. The current post-consumer payment system is proving ineffective, both technically and commercially. Faced with these challenges, the establishment of a prepayment system for drinking water appears to be an innovative solution adapted to local realities. This work therefore proposes to analyze, design and evaluate a viable model of prepayment system for REGIDESO in the city of Likasi.

2. MATERIAL AND METHODS

2.1 MATERIAL

2.1.1 Study environment

Likasi is the second city in the province of Haut Katanga, in the Democratic Republic of Congo, located 78 km from the former capital of King M'SIRI and 120 km from the city of Lubumbashi, it has been a copper center for centuries. The inhabitants of the SANGA and KAONDE region, called copper eaters, used clay ovens and antelope skin bellows to melt crushed malachite, extract the copper and shape it.

In 1931, the colonial administration gave the city the name Jadotville and on December 21, 1943, the city of Likasi was elevated to the administrative status of a city. Formerly, Jadotville was the third city in the Belgian Congo after Léopoldville (Kinshasa) and Elisabethville (Lubumbashi). It was renamed Likasi in 1966, during the policy of resorting to authenticity advocated by President MOBUTU. The town of Likasi is subdivided into four communes: Likasi, Kikula, Shituru and Panda.

Located on the Haut Katanga plateau, the town of Likasi has a tropical type two climate with an average temperature of 20°C. The city is full of hills with an average altitude of 1265 m and a line that joins the point of equal altitude at 1100 and 1400 m.

The town of Likasi has ten mines including two large ones (Panda and Mura) and eight small ones (Likasi, Buluo, Nguya, Kikula, Kaponona, Kampemba, Kakontwe and Kampumpi).

2.1.2 REGIDESO Likasi

REGIDESO (Water Distribution Board) is a public company in the Democratic Republic of Congo, responsible for the production, treatment and distribution of drinking water in several urban centers in the country.

In Likasi, an industrial town located in the Haut-Katanga province, REGIDESO plays an essential role in supplying water to households, public institutions and local industries, etc.

ISSN 2394-9686

International Journal of Novel Research in Education and Learning
Vol. 13, Issue 1, pp: (22-38), Month: January - February 2026, Available at: www.noveltyjournals.com

The main missions of REGIDESO are:

- Production, distribution and marketing of drinking water;

- Management of hydraulic resources;

- Improved access to drinking water.

- has.

1•History of REGIDESO

The history of water in the Democratic Republic of Congo does not have a beginning in itself. It begins with the first form of life on earth and will evolve with It; adapting over the years to demographic growth, the organization of life, industrial expansion and the development of the country in all its areas.

It was in this capacity that the Léopoldville distribution company appeared on November 18, 1929, with its head office in Brussels.

On March 28, 1933, by royal decree, the Belgian Minister of Colonies established the first draft of what would become REGIDESO, to which it entrusted the operation, development and modernization of Boma Water Distribution, Matadi, Mbandaka with the extension of this mission which is the study and establishment of new distributions.

On December 30, 1939, by royal decree, the State created a real Colonial public company for the distribution of water and electricity for the entire territory of Congo-Belgium and Rwanda-Burundi. In 1942, it began the distribution of electricity to Mbandaka and in 1945, the distribution of water to Lubumbashi and Likasi.

From 1947 to 1953, the large-scale production and distribution of electrical energy in the Belgian colony and in Ruanda-Burundi experienced development.

From December 31, 1949, the Authority began to ensure water production in the following cities: Boma, Matadi, Mbandaka, Kinshasa, Kisangani. The period following the independence of the country and particularly from 1960 to 1965, was characterized by great political, economic and social turbulence which disrupted the proper functioning of REGIDESO.

In 1972, the nationals took over the management of the company until today, November 24, 2023, we proceeded to the inauguration of the first phase of the water treatment complex in N'djili with a production capacity of 110,000 m3 of drinking water per day.

2°Services and infrastructure

2•.1 Services

Regideso has the following services:

- Technical services which are responsible for production, distribution and maintenance;

- The sales department which is mainly responsible for marketing and certain auxiliary services;

- Accounting services which are interested in the monitoring of financial operations, the preparation of financial statements and also the analysis of costs and profitability.

2•.2 Infrastructure

Regideso has the installations, engineered equipment and devices interconnected between them and constituting a well-established network. REGIDESO Likasi has the catchment infrastructure (water sources, pumping stations, catchment pumps); Treatment infrastructure or water purification plant(decantation cells, filtration, disinfection, PH correction); Storage infrastructure (water tower, floor tank).

2•.2.1 Infrastructure distribution

Pipes, pipes, taps, meters etc.

2•.2.2 Energy infrastructure

Generators, transformers, substations, electrical equipment for powering machines.

ISSN 2394-9686

International Journal of Novel Research in Education and Learning
Vol. 13, Issue 1, pp: (22-38), Month: January - February 2026, Available at: www.noveltyjournals.com

2°.2.4 Administrative infrastructures

Administrative office, customer service etc.

3°Pumping station

The REGIDESO SARL/LIKASI operations center has two of its own pumping stations, both located to the west of the city, which are:

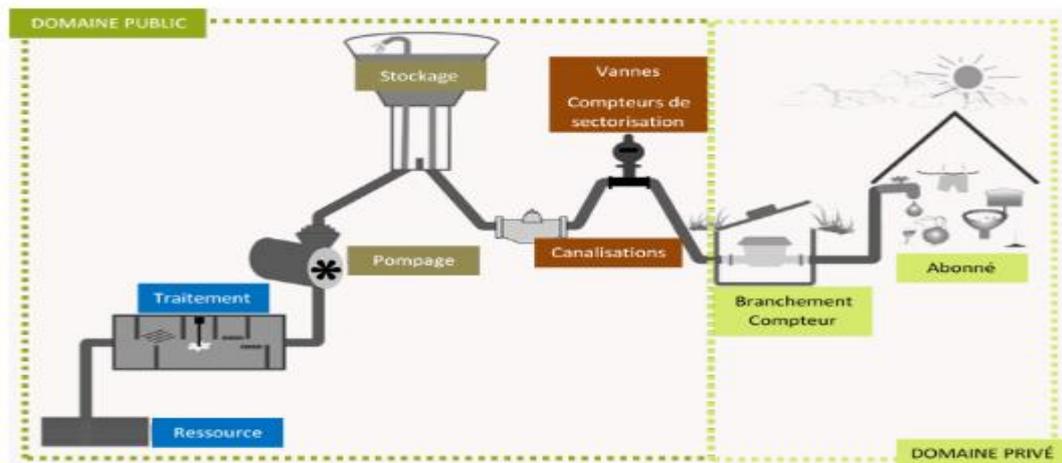- The KAMPEMBA pumping station;

- The LWAMBO pumping station.

3°.1 KAMPEMBA pumping station

It is located more or less 7 km from the town of Likasi with an installed production capacity of 300 m3/h. A 210 m deep drilling well, supplied with electrical energy by a bare copper MV line, specific to REGIDESO with a cabin including a 630-kVA transformer.

3°.2 LWAMBO pumping station

The LWAMBO pumping station is located in the Upper Katanga province in the KAMBOVE territory in the locality of KABISHIKI, SOURCE village. The pumping station is more or less 7 km from the KAMBOVE substation and 21 km from the central direction of Likasi. The water collected comes from the source of the river bearing the same name as the village.

Figure 1 below gives an illustration

Figure 1 : Example of a pumping station

4°Coverage area in Likasi city

REGIDESO Likasi mainly covers the commune of kikula and also the commune of Likasi.

The kapemba station mainly covers the following areas: Bel air, Tchatchi, Kolomoni, Kanona, Lumumba, Cinquants, Kakontwe, Lufira, Lualaba, Mukumbi districts; Basanga; kasongo michel.

LWAMBO station water path towards Kolwezi road the districts served are: KITABATABA, district Zout, Industrial district, Kampemba, Kolwezi road.

5°REGIDESO commercial system

Subscriber payment problem

Regideso has 3 categories of subscribers, namely:

- Solvent subscribers: These are subscribers who meet the deadline,

- Insolvent subscribers: These are subscribers who are always late in paying the bill, that is to say they do not respect the scheduled date.

- Difficult subscribers: These are the subscribers who pose problems in terms of payment, the relationship with the distribution company.

They can be "difficult" for several reasons:

- Regular non-payment: They do not pay their bills or pay them very late;

- Insolvency: They do not have the financial means to pay for what they consume;

- Fraud: They manipulate meters, make clandestine connections;

- Statement refusal: They refuse access to survey agents or contest the statements;

- Uncontrolled consumption: They have internal leaks, waste, or abnormal consumption;

Frequent conflicts They often dispute the bill or behave aggressively. When Regideso notices that there is no bill payment, they will look in their file to list all these subscribers who are not paying. Before regideso decides to go to these subscribers, primarily they will issue a reminder notice of everything that the subscribers have as credit for 48 hours and they will remind them of arrears debts, and if the subscribers are not able to pay; the regideso will order him to pay half and if it is negative the last measure of the regideso is to cut definitively.

2.2 METHOD

Our study began with the identification of active and inactive subscribers, the technical-economic analysis of the traditional collection system as an option and was followed by the architectural presentation of the prepayment system, the operating principle, pricing under smart meters as well as the forecast evaluation of the prepayment system.

3. RESULTS AND DISCUSSION

3.1 RESULTS

The results obtained relate to:

3.1.1 Identification of Regideso customers and pricing

Table 1 below gives the image of customer identification and appropriate pricing

Table 1: identification and appropriate pricing

CATEGORIE	TRANCHES	TARIFS fc /m³
BORNES FONTAINES ET DOMESTIQUES		
A1	1-10 m³	829
A2	11- 25 m³	1487
A3	26 - 40m³	1887
A4	> 40 m³	2173
INTERMEDIAIRE		
B1	Sociale	3917
B2	Agro-pastorale	4374
B3	Autres	4632
COMMERCIALE		
C1	Moins de 100 m³	7490
C2	Entre 101 et 1000 m³	8977
C3	>1000m³	10521
INDUSTRIELLE		
D1	Autres	13409
D2	Brasseurs	10607
D3	Grand hôtel	8234

source: Regideso Likasi 2025 document

the results below relate to the mapping made available to us by the technical service of the Régideso, as shown in Figure 2 below.
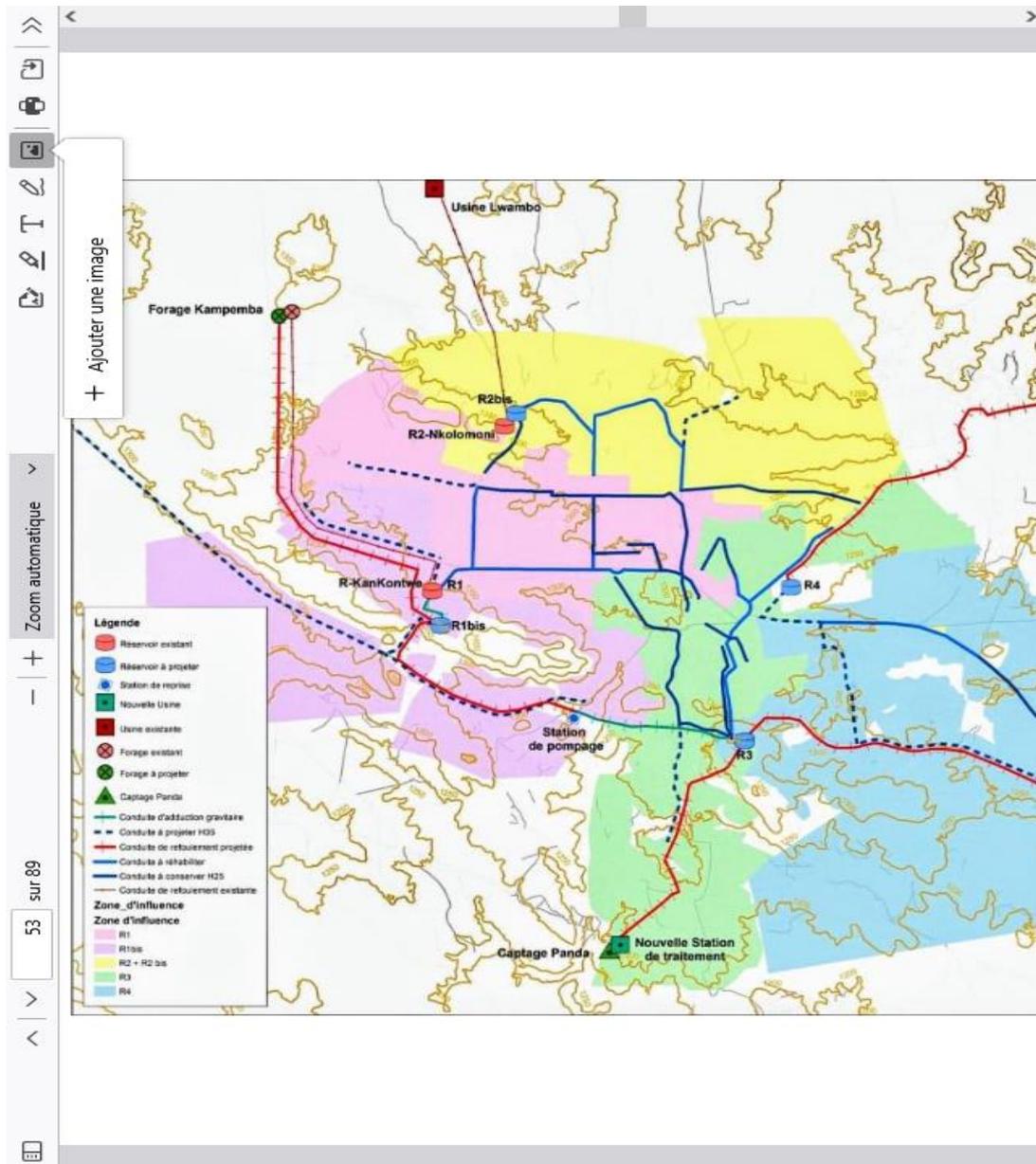

Figure 2: mapping of Regideso Likasi

3.1.2 General architecture of the prepayment system

The architecture describes all the interconnected technical, electronic and software components that make it possible to manage access to water based on credits purchased in advance by consumers.
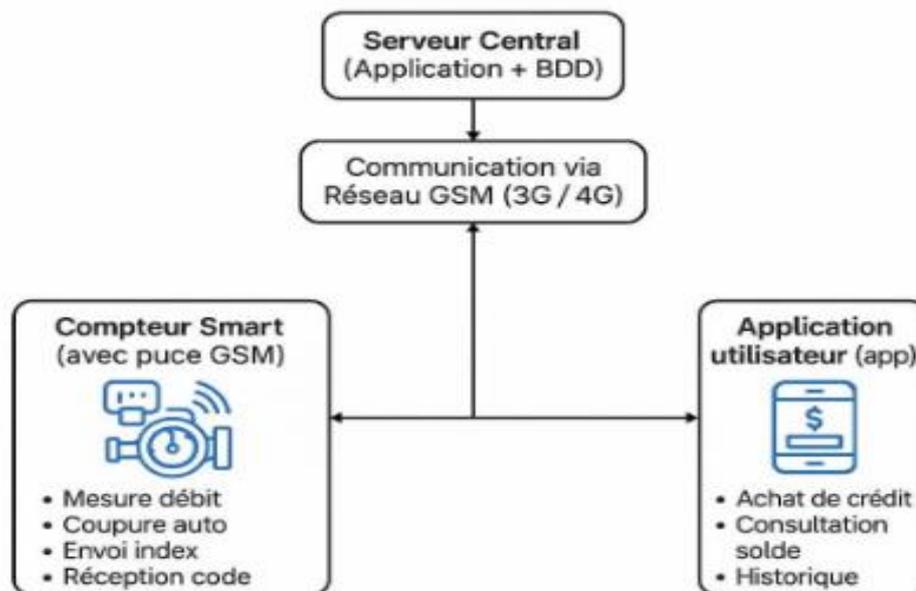
It includes:

- Central server;

- Smart meter;

- Credit management infrastructure;

- Communication system.

1•Central server

✓ **Definition**

The central server is an IT platform (software + hardware) which centralizes, monitors and controls prepaid meters. It allows you to monitor consumption, manage recharges, detect fraud and produce reports for the operator

Figure 3: Block diagram of a server

✓ Functions of the central server

- Processing of refills:

When a customer buys credit, the central server validates the transaction, updates the balance and possibly generates a code (like a token for a card meter);

- Security :

All transactions are encrypted and authenticated to prevent fraud;

- Communication with terminals:

It communicates with credit distributors (ATMs, mobile applications, etc.) and equipment in the field (smart meters, terminals, etc.).

- Monitoring and reporting

Operators can monitor network status: online offline status, low battery, leakage, etc.,

Generate statistics: Consumption by zone; recharge rate Recoveries

Inactive clients, losses and responding to outages, all from the central server.

- Hardware and software component of the server:

Software and hardware components provide management, processing, storage; communication and security of data (customers, meters, credits, transactions, etc.).

ISSN 2394-9686

International Journal of Novel Research in Education and Learning
Vol. 13, Issue 1, pp: (22-38), Month: January - February 2026, Available at: www.noveltyjournals.com

3.1.2.1 Software layers

Table 3 below illustrates the different layers.

Table 3: Software layers

Couche	Fonction
1. Couche d'application (frontend)	Interface utilisateur (web ou mobile) utilisée par les agents ou administrateurs
2. Couche métier (backend)	Gère la logique : calculs de crédits, génération de codes, gestion des transactions
3. Couche base de données	Stocke les données des clients, compteurs, recharges, historiques
4. Couche API / Interface de communication	Permet la communication avec les POS, applications mobiles, compteurs

As for the different components and their role, Table 4 below shows the details.

Table 4: components and their role

Élément	Rôle
Serveur physique ou cloud	Héberge toutes les couches logicielles
Base de données (ex : MySQL, PostgreSQL)	Stocke toutes les données du système
Système d'exploitation serveur (ex : Linux, Windows Server)	Environnement logiciel de base
Firewall et sécurité réseau	Protection contre les accès non autorisés
Sauvegarde (backup)	Copies de sécurité des données
Système de monitoring	Surveillance en temps réel du fonctionnement du système

3.1.2.2 Choice of server

For our case we opted for the Hybrid Cloud Server (Cloud + Local Backup) NASS SYNOLOGY DS423

Table 5: Technical characteristics of the SYNOLGY DS423 NAS server

Composant	Spécifications recommandées
TYPE	NAS Synology DS423
RAM	16 GIGA
STOCKAGE	1 To (RAID 1 recommandé)
BANDE PASSANTE	1 TB/mois minimum
SYSTEME D'EXPLOITATION	Ubuntu Server 22.04 LTS ou Debian
BASE DE DONNEES	PostgreSQL ou MySQL
SERVEUR APPLICATIF	Node.js, Python (Django/Flask), ou PHP (Laravel)
SECURITE	Certificat SSL, firewall, authentification à deux facteurs
SAUVEGARDE	Automatique depuis le cloud (une fois par jour)
CONNEXION	Ethernet + GSM (modem secours)
NOMBRE DES COMPTEURS SUR SERVEUR CLOUD	5 000 à 50 000 compteurs intelligents
NOMBRE DES COMPTEUR SUR SERVEUR LOCAL	100 à 2 000 compteurs en relais ou backup
PASSERELLE LORA OU GSM	Chaque passerelle peut connecter 50 à 500 compteurs

Recommended Safety:

- VPN for communication between agencies and the server;

- Encryption of data at rest and in transit;

- Access control by role (agent, technician, supervisor);

- Security logs and alert notifications.

3.1.3 Smart drinking water prepayment meters

A smart prepayment meter is an electronic device for measuring water consumption only after prepayment, with control, remote management and data visualization functions.

We chose the iSAtech Prepaid Smart Water Meter (model: iSA-PWM-GPRS); communicative, compatible with connected systems (GSM/LoRa) and secured by code (STS).

It is an STS certified smart prepayment meter, which can operate with code, smart card and/or remote communication via GSM, perfectly compatible with a central cloud server.

Table 5: Constituent elements of a prepayment meter

Composant	Description
Capteur de débit	Mesure le volume exact d'eau consommée (en m³ ou litres)
Électrovanne	Ouvre ou ferme l'arrivée d'eau selon le crédit
Module de traitement (processeur)	Gère les données, le calcul de crédit, les alertes
Interface utilisateur	Afficheur LCD, LED ou écran pour montrer les données (volume, solde)
Clavier (optionnel)	Pour saisir un code STS (si système à 20 chiffres)
Lecteur de carte/token	Pour charger un crédit par carte à puce ou RFID
Batterie	Alimentation en cas de coupure de courant
Boîtier étanche	Protège le dispositif contre l'humidité et les chocs

Benefits

- Low credit warning;

- Consumption history stored;

- Automatic cut-off in the event of zero credit;

- Fraud attempt detection.

3.1.4 Choice of communication system

For our situation we opted for communication with the STS system for automatic code generation directly via meter ID; which can be done manually on the meter keypad or automatically via GSM with M2M card (Orange; Vodacom and Airtel)

The M2M (Machine to Machine) card is a special SIM card, used to enable automatic communication between machines, without human intervention.

1°Definition of the M2M card

An M2M card is a mobile SIM designed for machines to exchange data between them via a GSM, GPRS, 3G, 4G or even NB-IoT network. It will be inserted into the smart water meter: finally to communicate with the central server.

2°Special functionality of the SIM card

- Receive STS codes;

- Send consumption or status data remotely;

- Be controlled remotely (cut-off/reset).

3°Advantages of an M2M card:

- Stable connection: Optimized for long and stable communications;

- Two-way communication: Automatic sending and receiving of data;

- Multi-network: Can work on several operators (M2M roaming);

ISSN 2394-9686

International Journal of Novel Research in Education and Learning
Vol. 13, Issue 1, pp: (22-38), Month: January - February 2026, Available at: www.noveltyjournals.com

- Resistance: More robust and durable than a classic SIM;

- Managed remotely: Activation, deactivation, monitoring via an M2M platform

4° Structure developed

✓ Physical components of the prepayment system

Commposants	Compteur intelligent	Unité centrale	SIM M2M
Type	iSAtech Prepaid Smart Water Meter (modèle : iSA-PWM-GPRS)	NAS synolgy Local et cloud	VODACOM AIRTEL
Mode de communication	Via GSM et IUT	GSM et STS	GSM /GPRS

✓ **payment method**

5° Recharging system

Mode de vente	Type
Au bureau	Centre de distribution
Via mobile money	AIRTEL MONEY ORANGE MONEY ; M PSA
TMB	l'application PEPELE MOBILE

Via a 20-digit code generation system.

3.1.5 General operation of the prepayment system

✓ *Principle of operation*

This system is based on the principle of "pay-as-you-go", that is to say that access to water is conditional on a previously purchased credit. The system is based on the idea that the user must purchase a quantity of water in advance (in volume or monetary value), via a technological device integrated into a smart water meter, generally electronic and programmable.

3.1.6 Purchase of water credit in m^3

- The user goes to the point of sale precisely at the REGIDESO agency or from mobile money: Airtel money, orange money, or on the PEPELE mobile application, to buy a certain quantity of water desired.

- The mobile money server communicates with the REGIDESO company server via the payment gateway to validate the payment.

- The server validates the payment and generates an STS recharge code (20 digits) which it sends directly to the meter via the M2M sim and to the user via an SMS to their number

3.1.7 Loading the meter

The meter receives the code and records the credit purchased in m3 if the network is good and the M2M server communication is perfect, otherwise the user must insert the code manually on the meter through the human machine interface.

3.1.8 Water consumption

- The meter authorizes the flow of water as long as the credit is available;

- It measures consumption in real time and automatically deducts the volume used from the available credit.

3.1.9 Exhaustion warning

- When the credit is almost exhausted, the meter displays an alert (light indicator, beep, and the customer receives an alert message;

- This allows the user to anticipate a new recharge.

3.1.10 Automatic shutdown

- If the credit reaches zero, the meter automatically blocks the flow of water;

- Access to water is restored as soon as the meter is recharged with a new credit.

3.1.11 Estimated gain

Forecast profitability of the prepayment system

- *Point de ventes* : 11858 *Clients connectés* ;

- *Point de vente en service* : 5708 *clients actifs*;

- Inactive point of sale to recover: 6150 customers who are generally not served due to technical problems.

In 2025 only 5708 subscribers will be served with water by REGIDESO LIKASI.

Taux de recouvrement 64

- *Clients fideles* : 3653 *abonné*,

- *Clients problématiques*: 2055 *ne payant pas leurs factures*.

Out of 5708 active customers; only 3,653 pay their bills regularly.

EXISTING POST-PAYMENT SYSTEM

Table 6: Economic data of the existing pricing system

3.1.12. Prepayment system

Données	Valeurs en FC	Valeurs En USD
Taux de recouvrement	64 %	64 %
facturation moyenne mensuelle	15000 FC	5,2 $
Montant total attendu (5708 x 15000 Fc)	85 620 000 Fc /mois	30 042 $
Montant perçu (3653 x 15000 Fc)	54 795 000 Fc/mois	19 226,3 $
Pertes mensuelles	30 0825 000 Fc soit 36 %	10 815,7 $

ISSN 2394-9686

International Journal of Novel Research in Education and Learning
Vol. 13, Issue 1, pp: (22-38), Month: January - February 2026, Available at: www.noveltyjournals.com

Table 6 : Economic data of the prepayment system

Données	Valeurs en Fc	Valeurs en USD
Taux de recouvrement	90 %	90 %
facturation moyenne mensuelle	15000 Fc	5,2 $
Recette attendue [5708 X 15 000 X 100]	85 620 000 Fc/ mois	30 042 $
Recette perçue	77 058 000 Fc/ mois	27 038 $
Pertes mensuelles	8 562 000	3004,2 $

Calculation of gain

$Gain = R\acute{e}cette\ prepaiement - R\acute{e}cette\ post\ paiement$

$Gain = 77,058,000 - 54,795,000 = 22,263,000\ Fc$

The gain with the prepayment system is 22,263,000 Fc/month; i.e. an increase of 40 in additional revenue compared to the post-payment system, without even changing the prices.

Calculation of Return on Investment (Brigham, 2016)

The return on investment or R.O.I is an indicator which makes it possible to assess how long and at what level the implementation of the system will be profitable for REGIDESO

$$R.O.I = \frac{Cout\ d'investissement}{Gain\ mensuel}$$

Estimated evaluation of the investment cost for a start-up with 1000 meters for 1000 customers.

Table 7: Estimated investment cost

Désignation	Quantité	Prix unitaire Fc	Total Fc
Compteur intelligent	1000	125 000	125 000 000
Carte sim M2M	1000	28 500	28 500 000
Serveur et logiciel local +Cloud	1	400 000000	250 000 000
Sensibilisation et Formation du personnel		30 000 000	30 000 000
Total du cout d'investissement			181 500 000 Fc

Le gain 22,263,000 *Fc/ mois ; et le Coût est de* 835,000,000 *Fc*

$$R.O.I = \frac{181\ 500\ 000\ Fc}{22\ 263\ 000\ Fc/mois} = 8\ mois$$

Or after 8 months we will make real profits if we want to launch the system just with 1000 customers for 1000 meters for the test.

3.2. DISCUSSION

3.2.1 Financial aspect

Table 8: Indicators of economic parameters

DONNEES	POST PAIEMENT		PREPAIEMENT	
	Valeurs en FC Par mois	Valeurs en USD Par mois	Valeurs en FC Par mois	Valeurs en USD Par mois
Taux de recouvrement mensuel	64 %	64 %	90 %	90 %
Facturation moyenne mensuelle	15000 FC	5,2 $	15000 FC	5,2 $
Montant mensuel total attendu	85 620 000 FC	30 042 $	85 620 000 FC	30 042 $
Montant mensuel perçu	54 795 00 FC	19 226,3 $	77 058 000 FC	27 038 $
Pertes mensuelles	30 082 500 FC	10 815 ,6 $	8 562 000 FC	3004,2 $

Examination of the data contained in table above clearly shows that:

- The recovery rate is significantly higher than that of the traditional system, 64% compared to 90%, an excess of 26%;

- Given that payment is made in advance, the losses recorded drop from 36% to 10%;

- With the post-payment method, losses are estimated at 30,082,500 FC or 10,815$ compared to $3,004 with a prepayment system;

However, economic simulations revealed that by establishing a prepayment system, monthly revenues could increase from 54,795,000 to 77,058,000 FC, or from $19,226 to $27,038; which leads to a gain of 22,785,000 FC or $80,000 per month.

However, the return on investment remains remarkable at 8 months due to the high cost of equipment, notably smart meters, SIM cards, and associated technical infrastructure.

3.2.2 Social aspect

From a social point of view, the study shows that the success of the system will strongly depend on community acceptance. A segment of the population could perceive prepayment as a constraint, especially if problems with reduced water pressure persist in the distribution network.

Consequently, it appears that targeted awareness-raising actions, associated with network improvement and a well-supervised pilot phase, are essential conditions for the success of the project. Social inclusion issues, particularly for poor households, must also be anticipated to avoid marginalization of the most vulnerable.

ISSN 2394-9686

International Journal of Novel Research in Education and Learning
Vol. 13, Issue 1, pp: (22-38), Month: January - February 2026, Available at: www.noveltyjournals.com

With around 11,858 customers officially connected, REGIDESO faces a low activity rate, since only 5,708 customers actually use water, and among them, only 64% or 3,653 regularly pay their bill. These figures reflect a low level of commercial performance, which fully justifies the search for a more secure and automated payment system.

3.2.3 Technical aspect

On a technical level, modernizing the drinking water supply and billing system in Likasi would reduce fraud, automate administrative tasks, and optimize the use of limited human resources.

However, investments will be needed to strengthen maintenance capacity and ensure long-term system reliability.

The major positive impacts that a drinking water prepayment system could have in the city of Likasi, taking into account local realities (low recovery, inactive customers, network under pressure, lack of agents, etc.) are:

1°Improvement of financial recovery

- Payment is made before consumption, therefore no more accumulated debt;

- Increase in REGIDESO's monthly revenue;

- Allows you to self-finance maintenance or extension work.

2° Control of water consumption

- Households can monitor their consumption using the digital meter display;

- Encourages thrifty behavior (reduction of waste);

- Better management of demand in the event of a shortage.

3°Transparency and trust

- Elimination of disputes linked to estimated invoices or statement errors;

- The customer sees what he pays for, so no more disputes;

- Fewer conflicts between subscribers and REGIDESO.

4°Reduction of fraud and illegal connections

- Prepaid meters are more difficult to hijack;

- Each user is registered, traceable and identified;

- Fewer commercial losses for REGIDESO.

5°Customer autonomy

- The customer can buy credit at any time via Mobile Money;

- No need to wait for the invoice or an agent to intervene;

- The service becomes accessible even on weekends and outside business hours.

6°Reduction of the administrative burden

- Fewer staff needed to read meters, bill or cut off water;

- The system is automated (server + STS code);

3.2.4 Challenges of prepayment system

Establishing a prepayment system for drinking water in Likasi, although beneficial, also involves several challenges and negative risks if they are not well anticipated.

1° Risk of social exclusion

- The poorest households risk not having the means to purchase credit regularly;

- This can lead to frequent water cuts, affecting health, hygiene and schooling.

2° High cost of initial installation

- Smart meters, SIM cards, gateways, servers, training... all this is expensive;

- REGIDESO Likasi, with its small workforce working at a loss, may not have sufficient human and financial resources without external assistance.

3° Difficult acceptance by the population

- Sudden change of habit (paying before = constraint);

- Some people may believe it is a scam or a political strategy;

- Risk of social resistance if communication is not done well.

4°Dependence on the mobile network and energy

The system is based on GSM technologies, servers, and sometimes even power supplies. In the event of power outages or network outages, some customers will not be able to top up their credit on time.

5° Emergency management and social cases

With the prepaid system, no credit, no water; In the event of a critical situation (childbirth, illness, fire), families without credit risk being without a quick solution.

6° Fraud or technological piracy

Even with an STS system, circumvention or hacking attempts may appear (stolen codes, duplication, etc.); Need for a good security and tracking system

4. CONCLUSION

It emerges from this study that the establishment of a prepayment system for drinking water in the city of Likasi constitutes a relevant and realistic solution to the technical, commercial and social difficulties encountered by REGIDESO, in particular the flat rate billing which does not take into account the quantity of water actually consumed, and the low recovery rate.

The study demonstrated that the prepayment model, based on smart meters and digital platforms, not only meets the requirements of a modern service, but also makes it possible to secure revenues, reduce arrears and optimize network management.

The choice of this system was justified by its capacity to increase the drinking water supply rate, to improve the economic profitability of REGIDESO, and to strengthen the reliability of distribution operations. The results of the surveys and analyzes highlighted a clear improvement in performance, both in terms of subscriber satisfaction and the company's internal management.

Ultimately, this prepayment system represents a significant step forward in the modernization of urban public services in Likasi. It is recommended to consider its gradual deployment in other districts of the city, or even in other urban centers of the country, taking into account local realities and social support mechanisms.

REFERENCES

[1] Brière FG. Access to drinking water: economic and social issues, 1994, Paris: Presses Universitaires de France.

[2] Brigham E, Financial Management: Theory and Practice. 15th ed. Boston: CengageLearning, 2016.

[3] Dupont A, Environmental economics and water resources. 1979, Paris: Economica.

[4] Eberhard R, Infrastructure for water services in developing countries: The challenges of access, sustainability and finance. London: Water Policy Journal, 2002.

[5]   GIZ, Prepayment Systems for Water Services in Sub-Saharan Africa. Bonn: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) 2011.

[6]   IEC, Electricity prepaid metering systems – Guidelines and standards. Geneva: International Electrotechnical Commission 2014.

[7]   Lemoine G, Economics of public services and water pricing. Lyon: Éditions ENS2007.

[8]   Mbongo T, The effectiveness of the prepayment system in improving drinking water supply in Kinshasa. Kinshasa: Presses de l'Université de Kinshasa2017.

[9]   Ogata H, Emerging Technologies for Smart Water Management in Africa 2023.

[10]   REGIDESO LIKASI, technical documents 2025.

[11]   Tokyo: Journal of Smart Infrastructure.

[12]   WHO. Progress in drinking water and sanitation. Geneva: World Health Organization; [year not specified].

[13]   USAID, Prepaid Water Systems in Sub-Saharan Africa: Lessons and Recommendations. Washington (DC): United States Agency for International Development 2020.

[14]   Zougrana D, Equitable access to drinking water in West Africa: comparative study. Ouagadougou: Research Center for Development 2003.

[15]   INSTALLATION GUIDE for power supply systems for isolated sites, 2013 Edition.

[16]   BENLARBI. K., Flower neural and neuro-fuzzy optimization of a photovoltaic pumping system driven by different electrical machines, master's thesis University of Batma, 2003.

[17]   J. ROYER and E. SCHILLER, photovoltaic pumping, course manual for engineers and national technicians of Canada, 1998.

[18]   HALOUANE ASSIA, Globalization of radioactive transfer in the upper strata of a photovoltaic module, 2017 edition

[19]   BOUKHLIFA HAMZA, Technical sizing of a photovoltaic installation, 2017 edition.