



Keys to keeping the first urban cable car in operation after 20 years, 135,000 hours and 260 million passengers mobilized

Summary

In 2004, Metro de Medellín put into operation the first urban cable car in the world: Metrocable Line K. Twenty years have passed since then, during which several strategies have been implemented that have contributed to keep the cable system operating successfully, overcoming initial paradigms and developing the way to carry out an operation adequate to the needs of the city.

Background

7 years ago, at the OITAF congress held in Bolzano, Italy, we had the opportunity to show the progress of the cable system network in the city of Medellín, at that time with 4 cable cars operating and we shared some important data regarding its operation. Today we already have 7 years of additional experience and 6 cable cars, all integrated with other means of transport such as heavy metro or tramway operating successfully. In this case we will concentrate our analysis on first urban cable car around the world: Metrocable Line K.

Metrocable Line K

The Metro that serves the metropolitan area of the city of Medellín started its commercial operation in 1995 with 2 heavy metro lines. Since then, alternative transportation corridors were sought to integrate territories that until then had no easy access to the Metro. One of these corridors was proposed in the northeastern part of the city and due to the conditions of the terrain and the precarious planning of services, it seemed appropriate to implement a cable car.

Metrocable Line K was inaugurated in 2004, overcoming paradigms such as:

- Implementing a system in a densely populated urban area.
- Having 2 intermediate stations
- Being integrated to a metro system
- Intensive use: operating 20 hours a day for 360 days a year.

Keys to success

Today Metrocable Line K has 135,000 hours of commercial operation and has mobilized 260 million passengers during 20 years of operation. What have been the keys to maintaining a reliable and successful operation of the world's first urban cable car during this time?

1. Specific maintenance

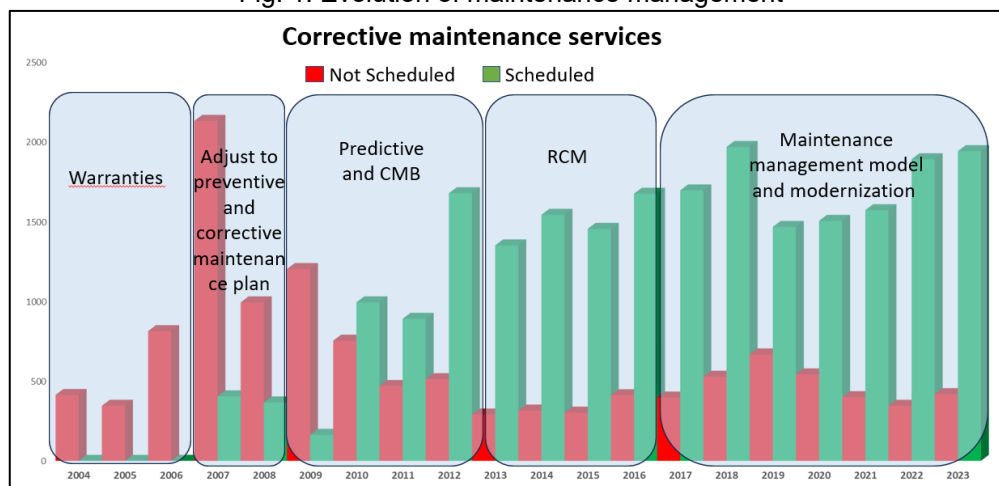
The maintenance manuals only say in general terms what macro activities should be performed and give guidance on frequencies, but do not say how to do it in detail. One of the first challenges was to tailor a maintenance plan so that all activities could be performed throughout the year without affecting user service beyond the scheduled annual inspections.

After having a maintenance plan in place, other adjustments were made including condition-based maintenance (CBM), which is based on monitoring the conditions or status of the different elements of an asset to predict the optimal time to perform maintenance tasks. In this way:

- Asset reliability is maximized.
- Generate practical improvements applied to operations and maintainability.
- Optimize maintenance tasks and their cost.
- Improves the efficiency and effectiveness of maintenance and the ability to anticipate failure events, to schedule timely interventions favoring the operational continuity of the equipment.

Then, the Reliability Centered Maintenance (RCM2) methodology was implemented, through which the operational reliability of a system operating under defined working conditions is optimized, establishing the most effective maintenance activities according to the criticality of the assets belonging to such system, taking into account the possible effects that will originate the failure modes of these assets, safety, environment and operations, and thus determining the most appropriate actions to reduce the probability of its occurrence, definitively eliminating its possible repetition and/or mitigating its consequences.

Fig. 1. Evolution of maintenance management



Our company currently has a maintenance management model with 25 components:

- 1 strategic plan
- 2 structural elements (guidelines and policies and organizational structure)
- 21 specific tactical actions
- 1 measurement action

2. Knowledge management

Corporate University

This strategy has the purpose of integrally training our human talent, to strengthen essential and distinctive skills for the operation, business and leaders, and thus support the fulfillment of the objectives, strategies and sustainability of the organization. Through this we have carried out the training and certification of all the people who perform the work. After 20 years we can proudly say that we have certified 83 cable operators (drivers of the installation) and 217 people who are or have been in the maintenance team.

Each position has a theoretical and practical training program, which prepares people to adequately meet the challenges of operating the systems and performing maintenance activities.



The Corporate University program is complemented with other training, such as predictive vibration techniques, thermography, tribology, as well as practical training in welding, electricity and general safety issues.

Laboratory and training tower

Some stages of the process are carried out in the workshop laboratory implemented by the Company in 2018, where the operation and functioning can be simulated. It was the first laboratory developed by a system operator purely for training and product development purposes. The school tower is an independent structure where the activities to be performed in cable installations are simulated.

3. IDi

Enabling environment for research, innovation and development.

We have a corporate innovation system that takes advantage of internal and external input components and is based on research, the development of prototypes and projects, and the appropriation of innovation by the entire team.

We worked successfully by homologating some elements with local suppliers, with which we were able to develop them with higher quality and durability. This is a process with local universities, through which research processes are carried out to ensure that the service is in accordance with safety and reliability standards and requirements.

To date, 240 elements have been homologated and the respective specifications, memories and prints have been drawn up.

4. Modernization and in-depth maintenance of critical equipment.

Within the framework of the life cycle of critical equipment, we have carried out interventions to equipment such as gearboxes, traction motors, power plant and tension cylinders, multipair cable, cabins, and traction cable. Interventions have ranged from repairs to the replacement and installation of equipment with better performance.

- Cabins: the structure of the cabins was thoroughly maintained, from the correction of faults to the aesthetic recovery after so many cycles. The suspension system has undergone all preventive interventions and replacement if necessary.
- Multipair communication cable: the multipair signal wiring was renewed, allowing the safety lines to be upgraded with improved performance.
- Tension cylinders: renewal of the tension cylinder with redundant system.
- Second generation roller batteries: replacement with completely redesigned ones to reduce maintenance interventions and reduce vibration levels. Installation of additional safety.

In addition, some improvements have been made, in some cases to increase reliability and in others to address the obsolescence of some components:

- Variable speed drive: a backup was installed, allowing to continue operation in case of failure of the original one and to perform interventions that would imply having the line out.
- Pressure air system: to maintain constant air pressure in the station traction tires.
- Personal safety aids: lifting systems in stations and towers, modification and improvement of personal safety.



5. Social transformation of the territory

The implementation of Line K 20 years ago brought about a total transformation in the territory. In addition to the benefits expressed for users in terms of economic savings, less environmental pollution, safer transportation, the greatest impact was the improvement in city conditions.

- - Improving the quality of life of the low-income population.
- - Reduced transportation costs.
- - Accessibility for all users of the transportation service.
- - Violence reduction in neighborhoods

Proof of this are investigations and studies such as the one published in the American Journal of Epidemiology, on the impact that the works of Metrocable Line K produced in the reduction of violence in 25 neighborhoods in the area of influence of the project, between 2003 and 2008, which marks a before and after in the process of transformation of the city. This study is based on the report "Reducing violence through neighborhood transformation: a natural experiment in Medellín", which evidenced the recovery of the territory in communes 1 and 2 of the city with the arrival of Línea K, generating a 66% reduction in violence rates above the rest of the areas not intervened and determined that the reduction of high impact crimes in the corridor with the presence of the Metrocable was 75%. The study also recorded that in 2002, Medellín had a homicide rate of 185 per 100,000 inhabitants, and after the Metrocable construction works, that figure was reduced to 30 per 100,000 inhabitants, according to control figures for 2008. This impact on the miracle of preserving lives allows us to affirm that the Metrocable is environmentally sustainable and socially inclusive.

The Metro Culture that Company has developed throughout its history is implemented during the life cycle of the system's expansion projects and remains in the lines in commercial operation, based on an intentional social management that added to the physical-spatial impact of the environment allows an exercise of social, economic and cultural transformation of the territories.

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