URBAN TRANSFORMATION IN LOW-INCOME SETTLEMENTS
AND COLOMBIAN CABLE-CAR TRANSPORT SYSTEMS:
TRANSFERABILITY AND POLICY IMPLICATIONS

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Summary: This paper examines the challenges faced by urban transformation projects in a low-income city with weak institutions, political instability, and poor finances. Using the case study of the city of Soacha, a low-income municipality located southwest of Bogota, the paper analyses the urban transformation and potential transferability of the cable car transport technology. The analysis draws on primary and secondary data including interviews with local communities, policy-makers and technicians. The overall conclusion is that the Soacha’s situation depicts the many challenges faced by numerous cities throughout the developing world when it comes to transforming urban environments. The need for improved governance and better tools to measure benefits for low-income communities in order to deliver spatial transformation and sustainability is paramount.

Key Words: Transport planning, project appraisal, transport inequities, accessibility
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I. INTRODUCTION

Politicians, consultants and researchers often refer to cities in developing countries with successful transport and urban transformation projects and assume that these may also be an appropriate solution for other similar cities. In reality, “customising” such projects for a city-specific context is a difficult yet necessary challenge that is not always successful.

The city of Medellin, Colombia developed a cable-car transport system (Metrocable) in 2004 to serve low-income settlements in mountainous areas. Researchers from various fields found it to be successful at reducing transport costs and improving the poorest people’s accessibility to city services and employment opportunities (Bocarejo et al., 2012). The project also enabled major improvements to the local neighbourhood’s living conditions and environment (Brand & Dávila, 2011). Other cities in Colombia and Latin America, including Bogota, Rio de Janeiro and Caracas have since followed suit, developing similar systems.

This paper aims to review the case of the cable transport project in Soacha (Cazucable), the biggest satellite city of Bogota, to identify possible difficulties in reproducing this kind of transport solution for low income and poorly accessible areas. The focus of the paper is on governance and the role of transportation in social equity. Governance is addressed by examining the project’s genesis in Soacha and comparing it to the success of Metrocable. The second focal area on social development is approached by examining the effectiveness of these kinds of projects and the methodology used to evaluate equity issues, drawing on an analysis of accessibility as viewed by Bocarejo and Oviedo (2012).

We will first present a theoretical framework, focused on accessibility as a way to assess the impact on equity of a transportation project. We provide an assessment of the Medellin Metrocable project by applying the accessibility methodology. We then go on to describe how cable-car technology has evolved in Colombian cities with the success story of the Metrocable in Medellin and comparing it with the failed project of Soacha Cable-car. We identify the key issues that should be considered in order to replicate these kinds of projects in developing country cities and conclude with policy recommendations that can be applied to urban transit projects in developing countries.

II. THEORETICAL FRAMEWORK

1. Accessibility and equity

The cable car projects recently promoted in Latin American cities are aimed to improve conditions in low-income areas. Yet, when evaluating transport projects for financing and prioritisation there are no specific or solid indicators to measure how improved social equity can contribute to promoting better access to opportunities, particularly for the most vulnerable
segments of the population. Traditional appraisal techniques such as Cost-Benefit Analysis (CBA) are an insufficient tool to assess these impacts.

Bocarejo & Oviedo (2012) developed a methodology aimed to assess the impact of transportation projects on social equity, originating from the accessibility theory. This methodology is used to evaluate the successful Metrocable in Medellin. The concept of accessibility is used in a diverse range of academic studies in mobility and is now a determinant tool in the definition and analysis of urban transit policies. The measure serves as a vehicle to include different stakeholders in the creation and management of transport networks that result in increasing access to mobility options and interaction opportunities, adding a wider dimension to transportation planning and the management of transport networks (Halden, 2002).

Diverse approaches to the concept of accessibility can be found within the literature. Some of the general definitions developed decades ago are still valid and represent the foundation for more recent studies. Some of these basic axioms include: the interpretation of accessibility as the potential of opportunities of interaction (Hansen, 1959), the ease for reaching any area of activity using a given transport system (Dalvi & Martin, 1976), and the overall benefits provided by a given transport system (Ben-Akiva & Lerman, 1979), among others. A recent interpretation of accessibility defines it as the ease of reaching specific destinations inside the city given a number of available opportunities and travel-related costs (Bocarejo & Oviedo, 2012).

The number of accessed activities (jobs, education, etc.) depends on the quality of the transport system, the location of those activities and the characteristics and abilities of the individual, known as motility (Kaufmann, 2004). For developing countries, affordability plays a key role in the possibility to access opportunities. Low-income communities may spend more than 20% of their income for poor and inefficient mobility. Bocarejo & Oviedo (2012) showed that projects aimed to improve efficiency, such as Transmilenio, could have a limited impact on accessibility if the fare policy is not carefully designed.

Introducing an indicator to measure accessibility provides a way to evaluate the improvement in access to activities for low-income communities. At its core, the accessibility methodology considers the location of activities, the improvement on transit conditions and the affordability. One of the most useful approaches to the estimation of accessibility in urban environments consists of combining measures of attractiveness to specific areas with the cost of travelling between different origins and destinations. This method of estimation of accessibility in developing cities is based on the general equation proposed by Hansen (Hansen, 1959) that defines accessibility as:

\[ A_i = \sum_j a_j f(d_{ij}) \]

Where,

- \( A_i \) = Accessibility of the zone \( i \) (origin zone)
- \( a_j \) = Attractiveness of Zone \( j \) (destination zone)
- \( f(d_{ij}) \) = Function of the distance (cost) between zones \( i \) and \( j \)
The traditional approach when using equation (1) was interpreting the cost as a function of travel time or distance between a given Origin-Destination pair. However, considering that affordability becomes a main issue in developing countries given the social inequalities and poverty levels, this component is therefore integrated in the impedance function f(dij) and expressed in terms of the percentage of individual income spent on transportation (Bocarejo & Oviedo, 2012), obtaining:

\[ f(d_{ij}) = e^{-\beta C_{ij}} = e^{-(\beta_1 C_t + \beta_2 C_c)} \]  

(2)

Where,

- \( C_{ij} \) = Generalised travel cost (impedance) between zones i and j
- \( C_t \) = travel time cost between i and j
- \( C_c \) = percentage of the individual income spent on travelling

In this function of impedance, the cost is given in terms of travel time between origins and destinations (Ct), and affordability, as a monetary cost variable for the estimation of the generalised cost of accessing a specific area of the city. The variable of affordability has two sub-components that are related to the purchasing power of individuals and the costs of transport supply expressed as the average cost of travelling between an O-D pair divided by the average income of the origin zone. As a result, this methodology seeks to reflect budget restrictions and purchasing power that vary depending on income and socioeconomic conditions. It recognises that there are both temporal and financial restrictions limiting the ability of individuals to mobilize. According to Bocarejo & Oviedo (2012), these constraints underlie the dynamics that directly affect accessibility of an individual in a defined study area.

It is worth noting that in this methodology, accessibility is only calculated for employment opportunities. This is mainly due to the general conditions of developing countries in which it is often difficult to find reliable information related to other activities. One of the basic assumptions behind the methodology is that the labour market was selected as the core of the accessibility methodology because of the relevance in travel needs in developing cities.

If we assume that the “sacrifice” to access job opportunities remains constant, meaning that the \( \beta_1 \) and \( \beta_2 \) coefficient remain constant for a given population, an individual will be able to access a larger number of jobs if a new transport project changes both travel time and cost. The results obtained indicate that low-income individuals sacrifice travel time rather than money to improve their transport conditions.

### III. CABLE TRANSPORT PROJECTS IN COLOMBIA

Metrocable in Medellín started operations in 2004, after a short and efficient planning process led by Metro Medellín Company. This 2.4 km system has 3 stations and carries 30,000 passengers daily. Benefits in transportation such as travel time reductions and a decrease in users’ monetary costs (Bocarejo et al, 2012) and social equity (Brand & Dávila, 2011) have been
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important. The difference between the before/after situation in a low income and previously
dangerous area has produced enthusiasm among urban planners and city officials.

However, what seems to have driven social progress is an ambitious urban plan that was
developed simultaneously with the Metrocable, improving public spaces and local facilities,
promoting small business development and integrating this former ghetto to the main productive
areas of the city (Brand & Dávila, 2011). Interviews with key institutional actors and
stakeholders allowed the authors to give an accurate report on the project genesis, planning
process and key decision making.

The project originated within the Medellin transport planning authorities and was strongly
supported by the mayor of the city. It was then included in the city’s medium and long term
plans so that it was not just a single transportation project promoted by a politician, but rather a
well integrated piece of the city’s long-term plans. This enabled the next stage to happen, where
technical and financial plans were developed. Innovation by the Metro de Medellin Company, a
city-owned company that operates the city’s metro, included adapting a technology that had not
been used in this context before.

As part of the plans, technicians were very careful to consider the wider social impacts of a
transportation project, developing a plan to majorly upgrade the built environment in the
violence-ridden area. This meant that major investments were directed towards improving social
spaces, ensuring proper road and walking connectivity from the neighbourhood to the cable car
stations and building high-quality spaces for the enjoyment of the community. This included
sports facilities, community centres and a major public library. This part of the project was in
fact the most expensive, and required separate funding from non-transport authorities and even
international donors. From the beginning, the project was completely financed and no important
over cost occurred.

The Metro de Medellin Company led the plan to develop the cable car and now provides
consultancy services to cities around Latin America looking to implement similar projects. Its
institutional capacity is key to the success of the project.

Similarly, other authorities in Medellin have strong technical capacities, allowing them to
properly coordinate policies across different agencies. Medellin also has healthy finances due to
a very good capacity to collect taxes from local businesses and from the large profits received
yearly by the city-owned public utilities multinational company. This gave the city the necessary
funds to invest in the project, and the right institutions to spend the money properly.

Following this successful project, various Latin American cities have built similar schemes. For
example, the city of Manizales (0.6 M inhabitants) built a cable that has been in operation since
2007, although patronage has been lower than originally expected. The city of Cali (2.2 M
inhabitants) also developed a project in order to improve accessibility to one of their poorest
area. However, difficulties in the bidding and contracting of the project have slowed the process.
The municipality of Soacha (0.5 Million inhabitants) started the planning of a similar project, but
institutional and political obstacles have stopped the plan from moving forward. With a new
mayor elected in 2012, there is no certainty that the project will be implemented. Similarly,
Bogota developed a plan for a network of cable cars in mountainous neighbourhoods, and is planning to start the construction of the first line within the next year.

IV. ACCESSIBILITY ANALYSIS

A research study funded by the Lincoln Institute of Land Policy (Bocarejo et al., 2012), evaluated the change in accessibility produced by the cable in Medellín (Table 1). Having access to OD surveys in Medellin before and after the Metrocable, we were able to calculate the impedance factors and the number of jobs accessible to population in the project area for each OD pair. The transport survey analysis showed an important improvement in terms of travel time, even though a higher monetary cost had to be paid.

<table>
<thead>
<tr>
<th>Treatment group</th>
<th>Change in time expenditure</th>
<th>Change in monetary cost as a percentage of total income</th>
<th>Change in accessibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-10%</td>
<td>+3%</td>
<td>+75%</td>
</tr>
</tbody>
</table>

Source: Bocarejo et al (2012)

The high positive change in accessibility includes the fact that access to the higher employment zones such as the CBD was greatly improved. The impact of the Metrocable was not just visible in terms of an average time reduction but it also implied improved access to the Metro line that serves the zones with the highest job densities.

The accessibility for the project in Soacha could not be evaluated given the lack of detailed information related to the mobility conditions of individuals. Even so, an ex-ante evaluation showed that travel time reduction could be very important for their users if activities were based in Bogota. In fact, the connection to Transmilenio would allow them to access the integrated transport system of the capital, which is currently still in the process of implementation. However, the demand of the cable line could be limited as access to stations was poor given that no improvements on public spaces were considered. Similarly, accessibility can also be greatly limited by the fare scheme, especially in the context of Soacha where purchasing power is very low.

V. CONDITIONS FOR TRANSFERABILITY

The context of a multidisciplinary research developed jointly with University College London, Universidad de Los Andes in Bogota and Universidad Nacional in Medellín, allowed the identification of key success elements in the different phases of the Medellin Metrocable project. The research included analysing how this successful story could be replicated in other developing country cities, using the case study of Soacha, where a cable car project is being
planned. Key elements about Soacha’s social conditions and governance were explored to understand the potential for transferability.

1. The Context of Soacha

Soacha (0.5 M inhabitants) is the largest satellite municipality of the Colombian capital, Bogota. Since the new constitution approved in 1991, municipalities like Soacha enjoy large autonomy, including planning their cities and transport systems. Like other Colombian cities over 0.1 M inhabitants, it has a land use plan (POT by its acronym in Spanish) approved by the city council which defines, among other aspects, where and what can be built in the different areas of the city. Soacha’s POT is not well coordinated with the one in Bogota.

The population growth in Bogota and its surrounding region has been driven by the increasing urbanisation of Colombia, resulting in large migration flows from rural areas into the cities, both for economic reasons and due to the internal armed conflict. The lack of affordable land within Bogota to build low-income housing has caused many of these families to seek housing in neighbouring Soacha. The municipality’s population has seen high population growth rates during recent decades, and much of this growth has been along the border with Bogota, resulting in the conurbation of both cities.

Figure 1. Bogota and its surrounding region

The demand for low-income housing in the Bogota region has largely surpassed supply. This gap has been filled by illegal developments, where individual plots of land are sold in areas where building is prohibited and where there is no suitable transport or utilities infrastructure. Families that buy these plots then start building their own houses over the years, create unauthorised connections to nearby electric and water lines and finally are able to exert enough political
pressure to have their neighbourhood “legalised”. Once this has occurred, utilities are properly connected, and the local authorities build other infrastructure like sewage, pavements, roads and street lighting. In a similar process, squatters occupy undeveloped private property and develop the neighbourhood in a similar fashion. Altos de Cazuca, the area in Soacha where the cable car is being planned, started as a combination of these two processes.

![Figure 2. Altos de Cazuca in 1996 and 2007](image)

The 2005 census estimates that 70,000 people live there. But living conditions are difficult. Table 2 contains the coverage for some public utilities in the area and compares them with Bogota. The contrast is very stark, showing that the problems in Altos de Cazuca are much more acute than the problems in low-income areas in Bogota. During the field investigation, it was clear that the community understood these differences very well.

### Table 2. Socioeconomic Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Altos de Cazuca</th>
<th>Ciudad Bolívar (Bogota’s Poorest District)</th>
<th>Bogota Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Households without Water Supply (%)</td>
<td>74</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Households without Sewage (%)</td>
<td>66</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Teenage Mothers (%)</td>
<td>13</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Population Over 12 without Primary School (%)</td>
<td>26</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>Unemployment (excludes informally employed) (%)</td>
<td>15</td>
<td>10</td>
<td>9</td>
</tr>
</tbody>
</table>

*Source: Colombian National Department of Statistics (2005)*
The institutional capacity of the local authorities in Soacha is generally perceived as very weak according to entities like the Chamber of Commerce of Bogota and the Association of Local Businesses. The judiciary suspended its previous mayor due to investigations on alleged corruption, and had several interim mayors who were in office only for a few months each. This makes Soacha a very politically unstable city, which makes it more difficult to have adequate medium and long term planning and to build strong institutions.

This situation also worries the officials interviewed within the project at the Secretary of Planning in Bogota, and the planning department in Transmilenio (the city-owned agency in charge of planning Bogota’s BRT system). They argue that Soacha has a very limited capacity to collect taxes and that city officials change very frequently, which makes joint planning extremely difficult.

Similarly, the National Planning Department carries out a yearly evaluation of all the municipalities in the country using different indicators like legal capacity, financial efficiency and achievement of certain goals. Municipalities are ranked according to their position relative to the approximately 1,000 municipalities in the country. The results are far from what is expected from the 10th largest city in Colombia, and clearly depicts its difficulty in carrying out medium or large-scale projects. The following table 3 shows Soacha’s yearly performance in this evaluation.

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Ranking</td>
<td>265</td>
<td>285</td>
<td>147</td>
<td>173</td>
<td>311</td>
</tr>
</tbody>
</table>

*Source: Colombia National Planning Department*

Institutional capacity was also measured by the state of the city’s finances. This is especially important to understand the replicability of certain urban policies that require significant capital investments like a cable car. As part of the institutional performance ranking developed by the National Planning Department, financial indicators were obtained for a four-year period. The results showed that Soacha might be slowly losing its capacity to collect taxes within the city due to weak institutions and to fading economic activity. This means that it is increasing its dependence on cash transfers from the national government. Likewise, more of its income is being spent running its administration with no evidence that this has lead to improved governance. As a result, funds available for new investment in education, health, transport and urban programmes are becoming increasingly limited.

<table>
<thead>
<tr>
<th>Year</th>
<th>Income Spent on Administration (%)</th>
<th>Income Generated within the City (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>31.6</td>
<td>25.8</td>
</tr>
<tr>
<td>2007</td>
<td>36.9</td>
<td>20.6</td>
</tr>
</tbody>
</table>
2. The Cazucable Project

The project emerged from a participatory meeting between the president of the republic and the local community. In a country where decentralisation plays an important role, the presidential engagement was somehow atypical, as the proposal had not been included before in any land use plan or transportation plan.

In parallel, another transportation project, the BRT extension from the satellite town to Bogota was being built. The idea, similar to Metrocable in Medellín and the project in Cali, was to connect Cazucable to this BRT extension, providing a quick access to Bogota’s CBD for a community that takes over 90 minutes commuting each way (OD Survey 2005).

Following direct order from the country’s president, Metro de Medellin Company, with participation of the French specialists that developed Metrocable produced an engineering design within a short period. Since then, the project has been in the political agenda of the many mayors Soacha has had over the last few years. It is a politically attractive project that is also embraced by the local population, but Soacha’s administration has been unable to lead the planning process. Currently, the project is halted and there is no certainty about how it will move forward.

This is in contrast to the Medellin project, which went through a very different process. First, the project was strongly supported by the mayor of the city. It was born from a local context, introduced in the metropolitan development plan and the transport plan. Thus, the project was not seen as an isolated piece but rather as part of a future transport network and a local urban plan.

Second, technical and financial studies were dully developed. The technical difficulties of introducing a cable as a daily public transport system and connecting it to the metro station and the building of massive stations in the built areas were properly developed. It included social plans that provided employment in this poor area during construction and operation phases. From the beginning, the project was completely financed and no important over cost occurred.

Third, the cable system was developed as the centre of a comprehensive urban and social plan that included public space improvement, road and walking connectivity strategies, construction of social infrastructure such as a high design library and sport facilities. It was also accompanied with social plans that promoted private entrepreneurship in the area.

Fourth, the plan was lead by a competent institution with high credibility among the population. The Metro Medellin Company has been able to create a “culture” of respect and good behaviour around the metro facilities. Its citizens usually rate it as the best institution of the metropolitan area. Daily operation of the cable is adequate and efficient.
However, when the Soacha experience is reviewed, conditions for an adequate transferability of the project are not present:

As mentioned before, the project was proposed directly by the president of the country. The local authority then saw the opportunity of getting a “gift” from the national government but the project was never included in the local development plan or the local land use plan. The Metro de Medellin Company lead all the project design, with very limited involvement from the local transportation or city planning units. Within the local context, the project was not a political, technical or financial priority.

Although the technical design was adequate, it focused on the transport solution and did not involve an urban development project. As was noted before, the area of the project in Soacha lacks basic public utilities and its roads and public space are very poor. Part of the area that will be served by the cable car is built in zones with high risk of landslides, found unsuitable for urbanisation. In this case, the project was not thought as an urban transformation project but as the construction of a specific transport facility. Some basic analysis that could have included relocating part of the high-risk neighbourhoods in the zone instead of providing costly access should have been considered.

The absence of a strong institution made the project stop abruptly. The interviews with the Soacha city officials and the Metro de Medellin team involved in the project designed made it clear that basic definitions are lacking. A responsible agency for its operation was never identified. A specific budget for the project was not included, nor at the local or national level. It is not clear whether subsidies will be required for its operation and maintenance or who will pay for them. There is no strategy in place to create a proper institutional structure enabling enables the Bogota transport agencies to work with the Soacha cable operators.

In summary, Soacha was expecting a handout from the national government. It was and is not able to pay for any part of the cost. The poor state of the city’s finances makes the operation and maintenance over the project’s life very uncertain. The municipality was not prepared to receive the project, integrate it to the existing transport network and successfully lead its planning and implementation stages. Constant changes in city officials at all levels from mayors to technicians make the planning of large projects unfeasible due to lack of political leadership and weak technical planning agencies.

Finally, the opportunity to trigger economic and social development through a major urban upgrade was not seized by the city. After generating interest and hope in the local population, the promise of the Cazucable was not kept. It is a project without a proper budget, political interest and institutional leadership.

VI. CONCLUSIONS

Transferring successful transportation projects to new areas or other cities is an important challenge. Key factors for success must be considered:
First, when these projects are aimed to improve low-income population mobility, as it is usually the case for public transport projects, and specifically for cable cars, it is indispensable to approach the solution as an overall urban project that should consider public space, land use changes and provision of public facilities. Even if financial resources are not immediately available, it is important to optimize the potential of transport system to integrate the territory, in middle term plans.

Second, the integration is also related to the rest of the transport system. For decades, large mass transit projects in developing cities, such as metro lines, stood isolated from the rest of the public transport network, limiting their impact. Cable cars have been essentially used as a feeder of the main mass transit lines but their potential will be limited by the connectivity of the network and the capacity of the technology.

Third, the project must be included in the priorities of the local governments. In some countries national plans of transportation propose projects such as BRT or light rail to be developed in a number of cities. The indicator for measuring the success of the plans is the number of mass transit km developed, without integrating them properly. In some cases a lack of local interest is the reason for failure.

Fourth, carefully studying the travel patterns and characteristics of the population is necessary to have an adequate solution. For cable cars, developing the adequate local connectivity to stations is essential. Income information is a key aspect to be considered in order to give real accessibility.

Fifth, local authorities will have to deal with the construction and operation challenges. A bad understanding of the project will be costly. It is important that before the design process begins, there is a local technical and financial team trained to manage the project. Institutional strengthening is an essential element for the success of these projects.

Sixth, considering *a priori* that the project has to be developed may be missing the larger picture. Trying to force accessibility to a zone with high-risk of natural disasters or prioritising the project over more basic infrastructure may not be suitable. Promoting better and more secure living conditions may include relocating communities instead of providing them with better transport systems.

Concerning the appraisal of impacts that transportation projects generate in equity, the accessibility theory is a useful tool, as it includes several aspects that are especially important for low-income areas such as location, affordability and means of transportation. The results show for the case of Metrocable in Medellin an important improvement on the access to CBD and other areas that offer high employment, producing potential benefits to the population. As a consequence, the project has a positive influence on the social development of the poor communities that it serves, despite its limited capacity.

In terms of transferability, this comparison allows us to state that an appropriate technical design is not enough to ensure the development of a successful project. The promotion of “à la mode” transport projects needs to go hand in hand with institutional strengthening and urban planning.
Local authorities need to be involved with the development of the project, but this is often difficult to achieve if local institutions are very weak. Additionally, when the projects are aimed to impact low-income communities, a wider project that also includes basic public utilities, public space improvement, and construction of community spaces will significantly increase the benefits of the project. Involving the communities throughout the planning process can be very helpful in the design successful projects.

Cable cars in Medellin have had a measurable impact on equity, allowing access to CBD and other employment areas to low income communities, but it is also the improvement of local conditions that has contributed to a better quality of life for the poor. Integrating urban development projects and transportation projects needs efficient governance but that is not always easy to find in developing cities. When multilateral agencies promote transport projects in the developing world, institutional capacity and integration with urban development are important aspects to be considered.

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