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# URBAN MORPHOLOGY AND INDUSTRIAL HERITAGE PERSISTENCE

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## ABSTRACT

An important part of the historical Hacienda Nueva changed its land use into a factory and became the first company town in the city of Aguascalientes, Mexico in the year of 1861: San Ignacio. Infrastructures were made to connect the factory to the city, including a stone bridge and roads. Even though the factory is almost lost nowadays, historical facts, foundation walls and infrastructure persist. A parallel situation occurred with the main railway installations in town. During the last two decades, governments have financed restoration works in that place. Most of the manufacturing facilities were recovered by public works. Even though the original buildings changed the use of their architectural space, structures still maintain their industrial designs made in the 19th and 20th centuries. A main goal of this paper is to recognize industrial heritage persistence in the city of Aguascalientes. Changes in the city, besides its increasing urban growth, include several architectural époques; indeed, construction materials. Changes also have occurred in the shape of buildings, windows and entrances. In order to compare historical typologies versus industrial typologies an analysis was done. The biggest three companies in town towards the end of the 19th century used to have leisure activities for workers and owners. But what happened with such architectural unique designs? Can society and governments preserve them? Sustainability politics are necessary to support such places. Government efforts are not enough to preserve industrial heritage, but society can do a lot about it. A survey was made to observe how people perceived urban morphology, heritage persistence and sustainability. Likewise, a qualitative statistical method was applied. Actually, a multifactorial evaluation was done. Furthermore, it is convenient to set new rules to promote a circular economy in order to preserve industrial heritage and make the city a sustainable place to live.

*Keywords: urban morphology, industrial heritage persistence, circular economy, sustainability.*

## 1 INTRODUCTION

Architecture and urbanism are always changing the image of the cities, but if we refer to several periods of times, changes and new shapes are evident. Skyscrapers change the skylines and old buildings usually become obsolete. Even though city planning makes a big effort nowadays by controlling zoning and designing new roads, unique buildings tend to disappear, unless city administrators restore them or promote a culture of historic preservation as well as trying to achieve sustainable development goals.

In Aguascalientes City, three main historic industrial facilities can be recognized by historical documents or records, and also by reminiscences of buildings. Aldo Rossi said – based on Poète’s theory – that cities tend to remain on their axes of development, maintaining the position of their original layout and growing according to the direction and meaning of their older artifacts, which often appear remote from present-day ones [1, p. 59]. In fact, this becomes monuments persistence. Local history mentions the main Guggenheim American Smelting and Refining Co. (ASARCO), also called GFCM as a big industry, located on the western side of Aguascalientes City [2, p. 225]. According to the census of the city in the year of 1900 the population was 102,416 inhabitants [3]. In the year of 2020, the population of Aguascalientes was 1,425,607 [4]. Also on the western side of the ASARCO facilities there used to be a company town named San Ignacio. A Frenchman, Pierre Cornú, founded this textile factory in the year of 1861. It looks like it intended to become an urban growth pole, but after several years it got isolated from the urban area. It is convenient to mention





that a main road and a stone bridge were built to communicate both industrial facilities. Further, a third big company built in town was the railroad company. During the years of 1840 to 1850 the first railroad tracks were installed to communicate Veracruz City [2, p. 21] with El Molino, but in fact, this was the beginning of the expansion of an industry that helped a lot with the development of the main cities in Mexico. Porfirio Díaz as a president of Mexico urged to build railroad stations and railway tracks at the ending of the 19th century and at the beginning of the 20th century. But later governments decided to stop promoting the use of trains and some of them became obsolete, as well as train stations and facilities were abandoned throughout the late decades. This is the case of the railway facilities in Aguascalientes. Fortunately, throughout the last two decades, several city administrators have financed restoration works in that place.

So, the three main historical industries mentioned on this paper: ASARCO, San Ignacio company town and the railway station facilities became part of the development of a city that increased its urban growth almost 14 times during 125 years. Nowadays there are left a few traces of the ASARCO company facilities. These include two buildings, the foundation bricks of a big chimney and a large amount of the refuse from melting of metals. This scoria can be seen besides Aguascalientes River nearby.

San Ignacio company town did not last for generations, and a few walls stand still as a persistence of its magnificent past. Contemporary practices of adaptive reuse of buildings – including city planning and society – have forgotten such place for the last decades. In fact, new residential areas nearby create land speculation nowadays.

But the story is different in the case of the railroad installations. Indeed, proximity to the historic centre was essential for the persistence of most of the buildings of such industry. There used to be a special interest by situating railroad stations very close to the centre of the main cities in Mexico. Adaptive reuse of the railroad buildings became a key to preserve them. The main station was restored at the beginning of the 21st century and frequent restoration of the rest of the buildings of the site has happened for the last 22 years.

Urban morphology in Aguascalientes has been conditioned by the persistence of the railroad facilities during the last 100 years. These changes will be explained on the next pages of this article. Also, it can be inferred that the three industrial facilities just mentioned were built to become urban development nodes, but only the railroad services succeeded.

A survey was made to observe how people perceived urban morphology, heritage persistence and sustainability in Aguascalientes. Also, a typological analysis helped demonstrate the historical persistence of buildings and contexts.

## 2 URBAN GROWTH AND MORPHOLOGICAL APPROACH

During the last two decades, urban morphology has been linked with urban growth. Scientists are trying to understand how the city changes in shape and its main causes. Li et al. say: “Urban morphology is an interdisciplinary approach focussing on physical form to reveal the characteristics of transformation and replacement of urban areas over time on various spatial scales” [5, p. 2]. Spatial scales have changed surroundings of cities. Nature has suffered human activity and expansion of cities. So, sustainability seems to be an adequate vision to keep a balance between human activity and natural resources. Sustainable development principles include: social, economic and environmental. Abascal et. al. relate them with the urban form, that facilitates the social, economic, and cultural life of the city, and when a design is inadequate, processes are hindered (e.g. mobility) [6]. This means that the use of sustainability codes can be applied not only as a global concept, but also inside the cities.

Social and cultural aspects include historic centres and those sites that used to be the foundation of a city. Li et al. comment “the urban morphological approach can provide

frameworks to explore and understand the conservation and evolvement of historic cities and towns” [5, p. 3] and also a singular analysis of historical urban development is useful to understand how progress of a society becomes useful or negative for preservation of traditional urban areas.

Nowadays technology used by city planners to analyse urban issues is very advanced. Wang and Debbage comment that applying spatial metrics to quantify urban form offers an opportunity to provide a more holistic view of how urban polycentricity and other aspects of urban form influence congestion within US cities [7]. Indeed, researchers and city administrators can apply spatial metrics to obtain more accurate images of a city. Also, interdisciplinary approaches can help to understand how urban growth affects historic places and environments. The use of cars inside the cities requires dynamics of movement – making time a precious resource. Thus, the faster you get to a place, the better it is. Wang et al. say “urbanization processes are manifested by the change in the physical morphology of cities” [8, p. 1]. Transportation becomes a part of the process of urban changes. So, the fact of going shopping to a place means the use of different transportation means for people, and the urban contexts of a shopping place require spatial and functional adaptations. The practice of being transported has become essential for people. Also, technology used for mass transportation is changing frequently and impacts urban dynamics, for example, during the 20th century; railroad tracks were removed from several historic centres in Mexico in order to give room for improvement of transportation systems.

Correspondingly, Wang et al. say “The development of Earth Observation (EO) technology has significantly lifted our scale of observation above ground to obtain a synoptic view towards cities” [8, p. 3]. Aerial images are useful to analyse urban growth patterns and specially if it affects nature and climate changes. Xiang Zhu et al. consider that in the past decades, satellite remote sensing has been the foundation of data collection and the development of knowledge about our Earth. During that period, new initiatives in global urban mapping have advanced the quality of spatial knowledge [9]. Advantages of such advancements benefit historical analysis of urban growth.

A framework of conservation and evolvement of Aguascalientes historic centre has to do with city planning, sustainability and urban morphology analysis (see Fig. 1). The three industrial heritage facilities mentioned in this paper: San Ignacio company town, ASARCO Company and the railway facilities were situated, as it can be inferred, to become development poles in a city context, but only the railroad station facilities became persistence architecture through the years. The evolvement of the city has to do with such facilities and the historic centre as a significant centrality. The three factories have historic facts that help understand the importance of industry in town. Architecture of these buildings shows fine-looking typologies to be preserved as well as genius loci. The concept of genius loci – introduced by Rossi – refers to a relationship between a place and the architecture built nearby. Rossi says: we consider locus the characteristic principle of urban artifacts; the concepts of locus, architecture, permanences, and history together help us to understand the complexity of urban artifacts. The collective memory participates in the actual transformation of space in the works of the collective, a transformation that is always conditioned by whatever material realities oppose it [1, p. 130]. This indicates there was a sense of the place, including regional construction materials and a landscape interpretation when they were built.

### 3 METHODOLOGY

A questionnaire was designed to understand people’s points of view about architectural persistence, urban morphology and preservation of industrial heritage. It was applied



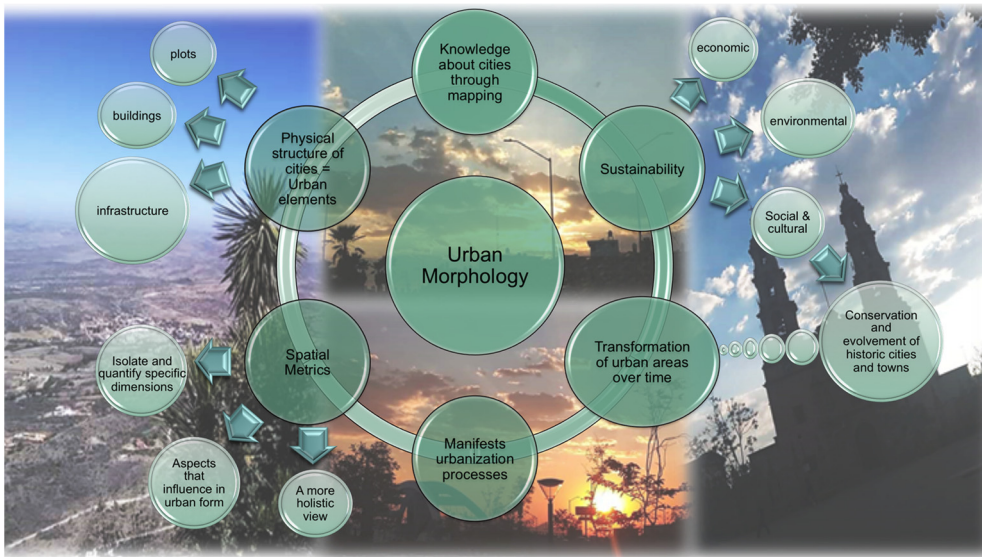


Figure 1: Urban growth and morphological approach. (Source: Author's research, 2022. Drawing made and edited by Alejandro Acosta Collazo and Judith Areli Segovia Félix. Photographs by Judith Areli Segovia Félix, 9 September 2022.)

regarding the perception of common people to understand historic persistence of buildings and sustainability aspects. A multifactorial statistical method was used, specifically a multiple correspondence analysis (MCA). The Burt's matrix helped interpret the pattern of interactions of different dependent qualitative variables. The answers were coded as binary variables. The following items were included in the questionnaire: 1. Age of people: Young (13–17), adults (18–60) and senior (+60). 2. Gender: Man or woman. 3. Educational level: Basic studies, undergraduate or post-graduate. 4. Origin: Mexican or foreigner. 5. How do you understand the city growth? It means the size of the city or the shape of the city. 6. How does urban growth affect the historic centre? It affects preservation of historic houses, it makes demolishing of old buildings or it produces urban alteration. 7. Do you consider city planning and urban design important for the city? Yes or no. 8. Why do you think it is important to understand the city limits? So city planners can make a better urban design or to improve mobility or to improve comfort (and life quality of its inhabitants). 9. Do you think excessive tourism could affect the city and heritage buildings? Yes or no. 10. Do you think bad urban planning could affect the city (reason)? This could affect street designs or on architecture typologies or by increasing heavy traffic and pollution. 11. Why do you think it is important to preserve the railroad station and its facilities? Because of its history and preservation of typological facts or for its contribution for city development. 12. What are your memories when you pass by the historic centre? The place means decadence, progress or cultural relevance. See Fig. 2 and the way a Burt's matrix was applied.

Considering that the main goal of the questionnaire was to obtain information about people's point of view concerning historic persistence of buildings and sustainability aspects, question 11 related to importance of history and preservation of typological facts became relevant to connect the questionnaire with a typological comparison. So, a typological

Urban morphology survey	
1. Age of people: <input type="checkbox"/> Young (13-17) <input type="checkbox"/> Adults (18-60) <input type="checkbox"/> Senior (+60)	8. Why do you think it is important to understand the city limits? <input type="checkbox"/> So city planners can make a better urban design <input type="checkbox"/> To improve mobility
2. Gender: <input type="checkbox"/> Man <input type="checkbox"/> Woman	<input type="checkbox"/> To improve comfort (and life quality of its inhabitants)
3. Educational level: <input type="checkbox"/> Basic studies <input type="checkbox"/> Undergraduate <input type="checkbox"/> Post-graduate	9. Do you think excessive tourism could affect the city and heritage buildings? <input type="checkbox"/> Yes <input type="checkbox"/> No
4. Origin: <input type="checkbox"/> Mexican <input type="checkbox"/> Foreigner	10. Do you think bad urban planning could affect the city (reason)? <input type="checkbox"/> This could affect on street designs <input type="checkbox"/> Architecture typologies <input type="checkbox"/> By increasing heavy traffic and pollution
5. How do you understand the city growth? <input type="checkbox"/> Size of the city <input type="checkbox"/> Shape of the city	11. Why do you think it is important to preserve the railroad station and its facilities? <input type="checkbox"/> Because of its history and preservation of typological facts <input type="checkbox"/> For its contribution for city development
6. How does urban growth affect the historic centre? <input type="checkbox"/> It affects preservation of historic houses <input type="checkbox"/> It makes demolishing of old buildings <input type="checkbox"/> It produces urban alteration	12. What are your memories when you pass by the historic centre? <input type="checkbox"/> The place means decadence <input type="checkbox"/> Progress <input type="checkbox"/> Cultural relevance
7. Do you consider city planning and urban design important for the city? <input type="checkbox"/> Yes <input type="checkbox"/> No	

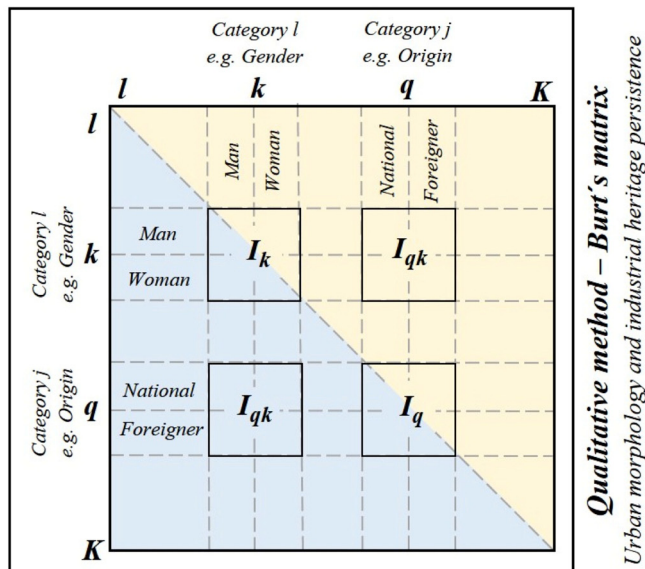
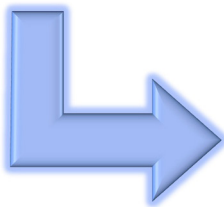


Figure 2: Urban morphology survey and Burt's matrix. (Source: Author's research, 2022. Drawing made and edited by Alejandro Acosta Collazo and Judith Areli Segovia Félix.)

comparison was done for this paper, using the shapes of windows of industrial heritage buildings and those mainly used in historic architecture in Aguascalientes historic centre.

#### 4 RESULTS

The statistical information collected from the questionnaire-applied showed that 65% of the inquired people were adults between 18 to 60 years old. 55% of the inquired people have an undergraduate degree. Once the people were asked about understanding of city growth, 70% mentioned the topic had to do with the size of the city, rather than the shape of the city (30%). After asking the people their opinion about seriousness of city planning and urban design for a city a 100% answered: absolutely. Another question was about the importance of understanding city limits and 70% of the inquired people agreed it helped improve comfort and life quality of its inhabitants. An interesting question had to do with tourism and if it had changed city heritage: 60% of the people answered positively. The question about how bad city planning has affected the city was answered as follows: 75% agreed it affected traffic and produced pollution, 15% mentioned architecture typologies were affected and 10% mentioned incorrect street designs.

In relation to the topic of railroad station and its facilities preservation, 60% linked it as a result of historic preservation and 40% as a contribution for city development. And finally, when people were asked about their memories of the historic centre, 85% of the inquired people answered cultural relevance, 10% answered progress and only 5% mentioned decadence.

About the typological contrast, it is convenient to mention that Carranza Street in Aguascalientes keeps the most historic buildings density in town. A scale of blocks was used to compare several historic typologies of entrances and buildings of Carranza Street with Ferronales suburb (see Fig. 3). The reason for choosing Ferronales it was because its persistence architecture throughout the time. Unfortunately, this situation did not happen with the other two companies mentioned at the beginning of this paper: ASARCO Company and San Ignacio company town. The railway facilities, especially Ferronales suburb still keeps industrial heritage typologies in houses. Even though, on Carranza Street long-lasting buildings were basically made of stone and Ferronales buildings were made of wood and metal, sizes of windows – as well as entrances – keep similar shapes. The results of the typological contrast can be seen in Fig. 3. Windows and entrances shapes of typology C (proportion 1:2) can be found also at Ferronales site. This seems to be a casual similitude, but it is not. Construction culture at the beginning of the 20th century was influenced by contextual facts and building traditions brought from abroad e.g. European architectural techniques and in the case of railroad industries from the USA. But apparent contrast of typologies in Carranza Street and Ferronales Suburb becomes a similitude because of the use of shapes of windows and entrances, but not in the way they used construction materials. An exception of this rule is the gothic shapes of typology “F” and “G”, likewise the roman arch of typologies “A” and “H”.

#### 5 DISCUSSION

The Burt’s matrix showed interesting results and also qualitative research interpretations can be stated: 33% of young people (13–17 years old) think urban growth causes alteration on the historic centre. 75% of women inquired said understanding of city limits can help improve comfort and life quality of its inhabitants. 54% of undergraduate people say tourism does not alter the city heritage. This means the more people study the better they understand most of the tourists respect historic places and industrial heritage buildings.

100% of the elderly people (+60 years old) inquired agreed bad city planning increases heavy traffic and pollution. It happens that some city administrators do not correctly analyse





Figure 3: Typological contrast. (Source: Author's research, 2022. Drawing made and edited by Alejandro Acosta Collazo and María Fernanda Pérez Sifuentes. Photographs by María Fernanda Pérez Sifuentes, 9 September 2022.)

mobility dynamics and it becomes essential a contemporary point of view on circular economy. Additionally, 50% of inquired women think that preservation of railroad stations and facilities contribute to cultural sustainability. But 75% of inquired men think the same way about this topic.

66% of young people from the survey (13–17 years old) say that historic centres have cultural relevance for society. They also agree heavy traffic and pollution are increasing in the city due to a lack of quality in city planning. This is a common image of the people who were inquired and supported – with valuable answers – to the writing of this paper.

In addition, typological study demonstrates that persistence of iconic buildings have to do with aesthetics, construction materials, contextualization and social recognition. It can be observed in typology “A” (see Fig. 4) the main entrances to buildings keep a proportion of 1:2, but in the “G” entrance (Parroquia El Sagrario); the proportion of the entrance is 1:1.5. Anyway, in the three cases fine woodworking can be observed on the doors and they keep a contextual language with the rest of the street entrances as well. Religious buildings have bigger entrances than houses, but they keep a similar proportion. Most of these important entrances are made with ebony wood.



Figure 4: Comparison of typologies “A” (La Merced and Regional History Museum) with “G” (El Sagrario Church). (Source: Author’s research, 2022. Drawing made and edited by Alejandro Acosta Collazo, Ana Patricia Martínez Alba and María Fernanda Pérez Sifuentes. Photographs by María Fernanda Pérez Sifuentes, 13 September 2022.)

In order to identify the importance of the historic centre of Aguascalientes – and the city growth – city limits were overlapped, starting from the foundation in 1575 and ending in a nowadays-aerial photograph of the city. Airborne imagery reveals glimpse of future and the urgent needs of a circular economy for the city.

Comparing the city limits of 1575 with those of 1855 we can detect that the capital of the state became an example for the rest of the Mexican cities, especially because of the surrounding orchards that helped keep a sustainable place.

It can be observed in Fig. 5 the persistence of the railway facilities for more than 100 hundred years. The shape of the site conditioned somehow the urban morphology of the surrounding suburbs, infrastructure and city limits. This urban development node, besides the historic centre became an important centrality for the whole city. Nowadays there are new centralities, especially those created by the construction of shopping malls.

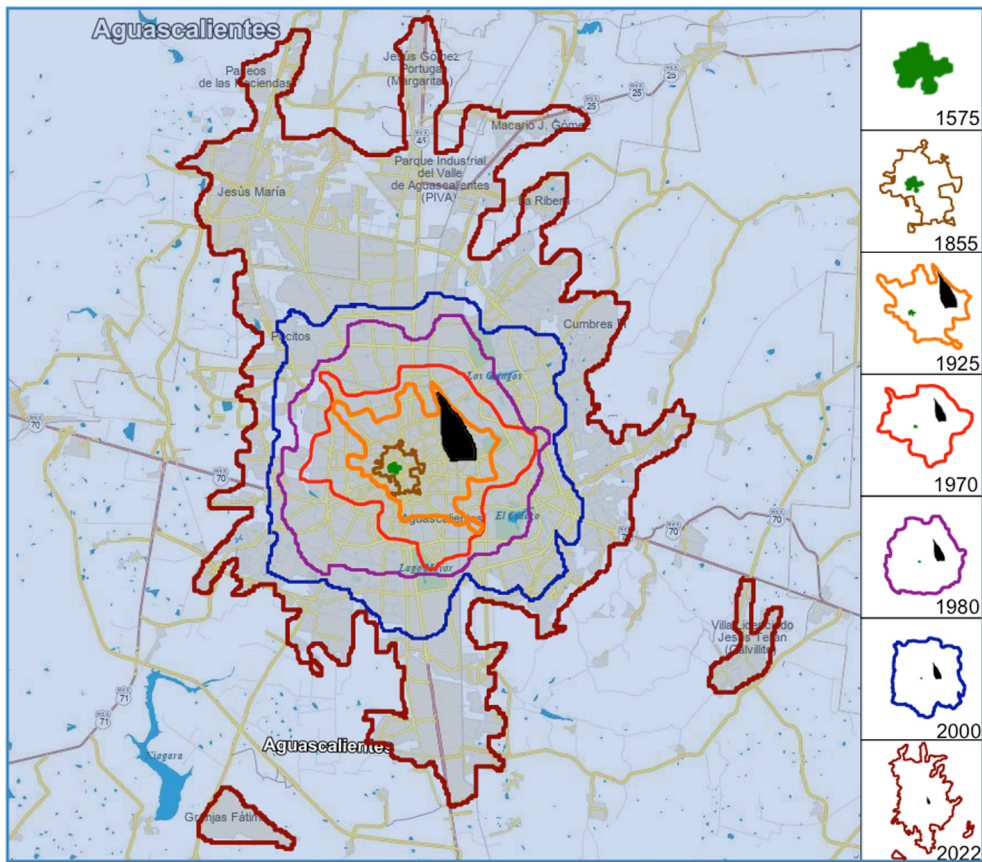


Figure 5: Industrial heritage persistence. Comparison of urban growth and contrast with historic centre, railroad facilities (in black colour) and nowadays morphology. (Source: Author's research, 2022. Drawing made and edited by Alejandro Acosta Collazo and Judith Areli Segovia Félix. Photograph behind drawing by INEGI 2022.)

## 6 CONCLUSIONS

Nowadays researchers can use several methods to study urban morphology. Spatial metrics gives the possibility to quantify detailed areas of a city. Thus, projections can be made on city planning tasks. Also, spatial metrics allows interdisciplinary approaches in order to solve urban issues. But in the evaluation of architecture persistence and sustainable cities, registration of historic phases of urban growth becomes fundamental to understand urban centralities.

The results of the 500 copies of an inquiry form – correctly filled out – were relevant to understand a decay of industrial heritage. Also, the application of a multifactorial statistical method, precisely an MCA – based on a Burt's matrix – was useful to comprehend the pattern of interactions of relevant qualitative variables. Nowadays, persistence of industrial heritage has motivated governments to improve restoration projects in order to preserve what was left of the main railroad station and its facilities. At the present time citizens can observe the



history of a significant industry in the city that conditioned urban morphology throughout the times in Aguascalientes City. But also there are still several challenges ahead: for example, the design of electric trains to attend sustainability measurable aspects of economic, environmental or social systems.

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