# How using architectural technology can improve reconstructing social structure in an industrial sector

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**Abstract.** A Smart City is one that places people at the center of development, incorporates Information and Communication Technologies in urban management and uses these elements as tools to stimulate the formation of an efficient government that includes collaborative planning processes and citizen participation. By promoting integrated and sustainable development, Smart Cities become more innovative, competitive, attractive, and resilient, thus improving lives. The social fabric of the industrial zone of Santa Catarina, Nuevo León, presents an important social disconnection, in addition to being an industrial sector, generating considerably a lot of environmental pollution. It seeks to find solutions through technology and the model of Smart Cities and thus contribute to improving the quality of life in the area.

Keywords: Architectural skin, reconstruction, smart cities, social disconnection, technology.

## 1. Introduction

The origin of the industrial city dates to the Industrial Revolution and the Steam Engine. Since then, many cities copied this system to implement it in them; the big problem was that they grew disproportionately, due to the migration from the countryside to the city. Thousands of people came to these new cities and decided to settle in the peripheries. Nowadays with the natural expansion and population growth, these peripheries are currently part of the city. [1]

However, sources of pollution are one of the most visible problems within industrial cities. Many of the inhabitants are exposed to toxic agents emanating from the factories and that are dispersed in the environment, such as pollution or chemical substances spilled on the waters. [2]

The increase in population within industrial cities can lead to a deterioration in the quality of life within these them. Overpopulation can lead to congestion in people's daily lives. Residents may be exposed to problems such as crime, high human trafficking, stress and more. Social disconnection is one of the consequences of these cities, scarcity of public and recreational spaces since most of the properties are destined for industry or are abandoned without giving them any use. [2]

This is how the term reconstruction emerges as a possible solution to the problem of social disconnection identified in the industrial city. It is proposed to regenerate the social fabric of the industrial zone of Santa Catarina, Nuevo León, Mexico, through three components; economic, social and sustainability and the implementation of technology in architecture (smart cities) as a contribution to the reconstruction of the social fabric, these components were proposed after previous analysis of the site.

## 2. Reconstruction of the social fabric

Eneida Guajardo [3] mentions that to rebuild the social fabric "it is necessary to promote the collective construction of social, economic, political and cultural conditions, which lead to an integral alternative of development and a model of life based on solidarity with others and the care of the land that ensures a lasting peace". The Good Coexistence involves a process of rebuilding the social fabric, this because it involves experiences between people, between the community, which lead to a relationship with the environment, giving it a sense of life. She [3] defines good living as the human balance and its environment, taking into account the social, spiritual, economic, political, natural, among others. It also implies taking care of oneself and taking care of others; an ethics of care and not of domination over others; an ethics that promotes relationships with others and promotes a culture of care for people and the planet, which prevails in all environments and among all people.

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In the municipality of Santa Catarina, Nuevo León, the industrial area, which used to be on the periphery, has been surrounded by residential areas. The excessive growth of the population in the area has caused that there is no planning or control within the urban fabric and public spaces of the area [4]. Marion A. Ferretti Ramos [5] mentions that there is not only a certain break in the social fabric thanks to the fragmentation of industries and residential areas, but that this is also directly related to a decline in its own social fabric, since it connects with how people inhabit and contribute to the community life of the area. This relationship is direct for the same reason that public spaces and the same urban fabric are those that give life to cities, which gives us spaces where the community can live, walk, cross lives with other inhabitants, and give character to the area; while it is also the one that gives security, identity, and belonging. [5]

If the urban fabric did not have an order and proper planning, it will be fragmented or broken and therefore its social fabric as well [5]. This is what happens in the industrial area of Santa Catarina, since, as mentioned before, the area was surrounded by residential zones and it wasn't planned properly, so the regeneration of the social fabric and its public spaces are of utmost importance to ensure good living.

## 3. Construction system - Tensile structures as an architectural roof

Tensile structures are born from the beginning of our history when the human throughout his existence has been looking for a space of refuge to protect himself from his context and from everything that happens around him. This need for shelter led to the emergence of different methods or forms of protection and new construction systems, which have been modified thanks to new materials and new technologies. Therefore, you can see various types of tensile structures in our history; from the Romans, who used to cover their homes with textile covers that protected them from the sun; until after the Second World War, which was when they began to generate more specifically the tensile structures that we know today. [6]

The development of the tensile structures as roofs of our buildings has meant a great evolution in the quality of our spaces, since these structures present advantages over the more rigid structures that we also frequently use in our constructions, such as concrete and steel. These structures meet specific needs as they adapt very easily to the characteristics of the project. Tensile structures are known for their flexibility and efficiency in assembly and workmanship. They can be classified by their form, but they are also very diverse thanks to their materiality and the functioning that is given. The evolution of materials in tensile structures has been evident, animal skins are no longer used as our ancestors used to do, but now we use different plastics and mixtures of these to give it the characteristic of lightness and practicality. Plastics are very moldable and the malleability of these varies depending on the material. [6]

The different combinations of materials and layers of it are what give them the characteristics that make it resistant; there are layers that use them as a fabric base so that the cover is resistant, other layers, PVC for example, cover for protection against sunlight and other atmospheric agents such as rain. Apart from the textile cover, the covers or tensile structures have another flexible element, the cables form the basis of the structure and are generally made of steel, they are the ones that transmit the forces. The cables act as tensioners that reinforce the textile cover. Another important element is the slings, which are the ones that go on the edges of the membranes, where much of the tension goes and serve as support and transition to the anchor points. These structures are usually accompanied by some type of mast, these are responsible for supporting all the hanging elements and give stability to the flexible form. These can also be anchor points and depend on the type of structure or design of the deck. [6]

Tensile structures, or the tense structures are highly variable and configurable, directly depend on the use you want to give and the use to which it will grant to the building, they are efficient because they are very flexible, resistant and give a lot of flexibility to the design, so that you can achieve a lot with the new technologies and new materials in the market.

This flexibility of the material is what makes it attractive for a project of reconstruction of the social fabric since these new technologies allow the shape of the buildings to be very adaptable to the needs that they have.

## 4. Architectural skin

"In the body and in nature, the skin, elastic and flexible, represents the filter and the connection with the world. Through the expressions of the skin and the gestures of the body, interpersonal relationships are established, and spaces are defined". [7]

New technologies have allowed great advances and changes in architecture. Today's needs are not the same as years ago. Architecture faces a globalized culture where technology is increasingly advanced.

The concept of architectural skin arises as a response to a need of the modern world. Not only was a facade needed to protect from the outside and give an aesthetic appearance, but the possibility of generating intelligent envelopes that connect with each other with a structure and building such as the skin in the human body was found; resulting in a much more functional interaction and allowing the connection of interior with exterior.

The facade became more than a decorative element, although it remains the first approach and space of transition from the outside to the inside, they can now be functional elements capable of containing the facilities and services; capable of receiving and transmitting energies. [8]

ETFE membranes today are an alternative to glass, as this material, in addition to providing transparency, is able to withstand 400 times its own weight and weighs 100 times less than glass. It is a material resistant to weather changes, even resists momentary loads such as wind and hail. Its durability has an exceptionally long life, even though neither UV rays nor atmospheric pollution agents can affect the material. Another important feature is that, when membranes are completely smooth and have an electrostatic behavior in which the coefficient of friction prevents dirt and dust from adhering to the surface, makes it self-cleaning with rainwater and prevents dirt in sandy and dusty environments. [9]

## 5. Smart cities

To be able to reconstruct the social structure in an industrial sector, it is needed to analyze and review other examples around the world that are implementing different technologies to upgrade their cities, converting them into smart cities. Therefore, the question arises:

How can you make a city much more equitable, safe, and efficient?

A Smart City is one that places people at the center of development, incorporates Information and Communication Technologies in urban management and uses these elements as tools to stimulate the formation of an efficient government that includes collaborative planning processes and citizen participation. By promoting integrated and sustainable development, Smart Cities become more innovative, competitive, attractive, and resilient, thus improving lives. [10]

The goal is to build cities with added values:

- Inclusion of all citizens in public life
- Transparency: that the steps taken by the administration are accessible and public.
- Improve the distribution of resources: through energy saving systems, lighting, or water distribution.

Cities could grow and expand by letting the market and the changes of the city dictate them. What smart growth proposes is that we can generate a movement or an established plan that allows aspects such as transport, land speculation and economic development to improve. Digital cities focus a lot on improving the physical infrastructure of their territory, while smart cities, on the other hand, look for the best way to use these infrastructures and technologies for the good of the community. Smart cities not only serve to improve the quality of life of its inhabitants, but also generate a certain competitiveness that leads to other cities taking the same initiative. [11]

## 6. Converged solutions in smart cities

Knowing what smart cities involve, and how different strategies can be implemented to become one, it is important to review some examples to specify the importance of technology to rebuild social structures.

Around the world, different initiatives and strategies are increasingly being implemented in urban centers to improve infrastructure, which will make cities more and more sustainable. There are cities that have more progress and more projects that lead the space to be more "intelligent", but you can find examples in many of the big cities. For this reason, to have a better and greater understanding about Smart Cities, we seek to analyse case studies to compare the different strategies and plans that have been carried out.

**Fig. 1** Aerial view of San Francisco

As a first case study, there is the city of San Francisco, California in the United States. San Francisco has been part of an international network of smart cities since 2011, since then, the city has set itself the task of improving its city by making it more sustainable and efficient. The city is known for its large technology industries that inhabit it, such as Adobe, eBay, Google, Apple, Tesla, Twitter, Facebook, among others. Therefore, the city uses technology to improve the city; making buildings more efficient, reducing their energy consumption, expanding their transport system, and other measures that have led the city to be more ecological and with better mobility. [12]

One of the most important problems that the city had was mobility and as a strategy to solve this problem, the city of San Francisco believes that autonomous vehicles are the ones that will revolutionize transportation today. The city has already proposed innovative transport proposals; they have one of the best transport systems in the United States and have implemented a “red carpet” system for public transport, where the lane is exclusive to it and therefore transport is more agile and fast. They

launched an SFpark pilot which is an initiative that helps you find parking faster and thus reduce greenhouse gas emissions. In the same way, they have many shared transportation options. In addition to all this, the city's Municipal Transportation Agency has an Equity Strategy plan to ensure that all citizens have access to public transportation. [13]

**Fig. 2** Rail cars on red lane in San Francisco

This is how the city takes mobility as a priority so that it is accessible and sustainable and continues in constant development through plans and programs that continue to be carried out to make San Francisco increasingly a smart city. They take the resources of their own city since they have the advantage that it houses many of the companies with the most advanced and innovative technology in the world.

As a second case study, we analyze the city of Singapore, which is a world leader city. It is a unique city and one of its characteristics, which can become an obstacle, is that it is not a very large land. In recent decades, Singapore has had a significant increase in population density and therefore urban density has also increased. This is why the city is constantly looking to deal with issues such as habitability, sustainability and economic competitiveness. Singapore is not only a city, but is also a sovereign state, this causes the buildings or services that are usually located on the outskirts of the city, such as airports, seaports, plants, waste, and power plants, to have to be within the city, further increasing the congestion of activities. [14]

**Fig. 3** Singapore skyline

Singapore's mission is to become the smartest city in the world, and for this it has developed a series of plans since 1971, every 10 years, with long-term objectives, and every 5 years more concrete and detailed plans for the smart growth of the city. Thanks to this the city is one of the most intelligent in the world, they have ICT technology (Information and Communication Technologies) in all its urban characteristics; they have a network of devices, cameras and GPS integrated in their public transport and in their taxis that allow to track the traffic and help not to generate so much traffic congestion, they use RFID technology a lot. In addition, they have one of the most advanced water management systems. The conceptual plan that began in 1971 for the improvement of the city, considered all areas; residential, commercial, and industrial areas, and the transport network and highways. By 1991, most of the Singapore's population had decent housing. By the 2000s the city had as its mission to improve the quality of life of its inhabitants through a plan in which it could have more variety of housing, amenities within the city and green areas. [14]

**Fig. 4** Singapore city at night

The city of Singapore continues to evolve day by day thanks to these plans that are constantly renewed and thanks to the ambition of its government to improve the quality of life of its inhabitants. Both cities, San Francisco, and Singapore, are an excellent example of how initiatives can be taken to improve the development of cities and make them increasingly intelligent and sustainable. Technology continues to innovate constantly and cities along with their governments must be aware to be able to guarantee the development and evolution of their urban spaces and the quality of life of their inhabitants, which is just what is sought in smart cities.

## 7. Santa Catarina, Nuevo Leon, Mexico

Focusing now on the industrial sector of the project and its characteristics, Santa Catarina is one of the municipalities of the state of Nuevo León, with a population of 306,322 inhabitants (49.8% men and 50.2% women). The municipality is bordered to the north by the municipalities of Monterrey and Garcia, to the south by Santiago, the municipalities of Ramos Arizpe, Coahuila, and Arteaga. To the east with San Pedro Garza García and Monterrey and to the west with

García and Ramos Arizpe, Coahuila. It has a total area of 876 square kilometers.

In Mexico there are industrial zones, where industrial parks are located. It is called an industrial park to a delimited, urbanized land, with all the services, infrastructure and permits for the required operation of manufacturing companies, offers all the equipment and infrastructure for the industry, in addition to basic services such as water, electricity and telecommunications, among others. In 2020, 11 industrial parks were registered. [19]

The technological strategies that have been mentioned throughout this article, aim to help the project to achieve the industrial area just described, the municipality and therefore the city, enabling them to improve and make the city of Monterrey and its metropolitan area, a city that is more sustainable and appropriate for their community, as do the smart cities.

## 8. Conclusion

The municipality of Santa Catarina is one of the municipalities whose main economic activity is industry. It presents several characteristics of industrial cities, in addition to environmental pollution, there is a disconnection of its population. Long distances, insecurity and other things have led people to put aside healthy coexistence. There is also a great lack of green areas, since large factories have occupied much of the territory and are covered with concrete. The surrounding areas tend to be unsafe and solitary, as a result there are many abandoned lands in poor condition, which could be rehabilitated for recreational use and/or coexistence.

To rebuild the social fabric many actions are needed, it is a complement of several components, such as economic, social, political, environmental, spiritual, among others. Covering three of them, a proposal is made in an important point of the area, precisely a property with an industrial area on one side and on the opposite side it borders with a residential area. How to strike a balance between them? Through a sociodemographic analysis of the area around the property it was concluded that there is many young people between 15 and 29 years approximately. There was also a shortage of green and recreational areas to meet the needs of these people within a radius of 1 kilometer.

In response to the needs found, a sports complex is proposed with a variety of possible outdoor activities, that also offers spaces for recreational use and coexistence, which allow to strengthen interpersonal relationships in a healthy and safe way. Allow young people to have a meeting point and promote sport as a contribution to health. Green areas that allow a better absorption in the soil and contribute to a better relationship with nature. Finally, the project culminates with a semi-professional baseball stadium, which thanks to applied technology has achieved an intelligent building, in which its main objective is to give comfort and safety to end users.

The choice of architectural skin was made seeking the transparency of its elements, achieving interaction with the interior and exterior. ETFE membranes are an alternative to glass, from its manufacture to installation the percentage of contamination that can be generated is significantly reduced. It is also proposed a rainwater harvesting system, with its proper storage space, for irrigation of the green areas of the complex.

The case studies mentioned above are a great example of how technological advances can have a positive impact on the city. It should also be stressed that there is a lot of responsibility in the government, since they are responsible for providing their cities with these possibilities for the development and evolution of urban spaces. From these two examples, the importance of sustainable mobility, the excessive use of the car and the fact that cities have become more towards the vehicle than the person is rescued. The SFpark initiative is a great proposal to reduce greenhouse gas emissions. In the case of Singapore, they decided to invest in public transport, resulting in a decrease in the use of the personal car; their transport system is completely intelligent, they have cameras, GPS that tracks traffic and prevents congestion. In short, to achieve a Smart City you need to implement technology both in buildings and get them to interact with their environment, as in their transport and connectivity.

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