Evolutionary resilience
The case of Valparaíso, Chile
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Abstract
Valparaíso is a port city known for its colourful architecture that perch on the steep hills of the Cordillera de la Costa, the mountain range that lies parallel with the Andes. Before the Panama Canal opened in 1914, Ships had to sail round South America in order to reach the east coast of North America. Valparaíso became the main stopover point for ships packed with goods from the Atlantic traveling to the Pacific. After this new and faster route opened up, the city lost its glorious growth and saw a great decline in port activity. Ever since they lost their status as a main stopover point, the city has had difficulties getting back on track with new developments.

Like many cities at that time, the city of Valparaíso also experienced the global trend of urbanization as people started moving to more urbanized areas in search for better opportunities. From 70,000 inhabitants in 1970, it greatly increased to 300,000 in 2014 (INE, 2014). Together with its neighbouring communities, like Viña del Mar, this region is called the Greater Valparaíso Metropolitan and has now reached about 800,000 residents, becoming the second largest metropolitan region in the country (INE, 2015).

This increase of the arrival of new urban citizens entails an excessive demand in new housing stock. Being enclosed between the Pacific ocean and the Cordillera de la Costa, the city had difficulties expanding with new infrastructure systems and amenities. In many developing regions, supply is often limited by inadequate governance systems, as well as by institutions and regulations which are either obsolete of lacking capacity, or are poorly informed” (UN-Habitat, 2014). Consequently, most governments in poorer nations seem to not be capable of responding to this immense demand of affordable housing. Inevitably, what we could perceive as one of the most visible outcomes of poverty urbanization is the explosive formation of informal settlements. This has also occurred on the hills of Valparaíso causing them to become excluded from the formal city centre.

Since Valparaíso is situated closely to large forested areas, it is at risk of forest fires. On average, there are 5,000 wildfires during the summer period (SECPLA, 2014a, p.64). Due to rapid urban expansion there is now an increased risk in the level of impact of a single fire. On April 14th, a great wildfire, one of the biggest in Chilean history, consumed more than 3,000 homes, leaving around 12,000 people homeless (UNDP, 2014; Quirk, 2014). 6 months after the disastrous event, people are still living with their neighbours or living in tents, showing little sign of a certain level of resilience.

It is an immense task to transform an impoverished city like Valparaíso into a resilient and operative city. Luckily some change is about to happen as the government has become deeply inspired by the successful redevelopment plans in Medellin, Colombia.

The municipality acknowledges the importance of redeveloping all areas, including the poorest settlements which have been excluded from city services over decades. Through the implementation of interventions at all three scales; the city, the community and the neighbourhood, it will hopefully gradually transform into a resilient and sustainable city that can inspire other cities.
Abstract

Chapter #01 | Introduction
- Problem description
- Scope & Methodology
- Design objectives & question
- Thesis structure

Chapter #02 | Relevance

Chapter #03 | Steps 1, 2 & 3 of the design process
- Problem Identification
- Data Collection
- Location analysis

Chapter #04 | Steps 4, 5 & 6 of the design process
- Risk Assessment
- Detect level of vulnerability
- Identify opportunities
Introduction

photograph by Massimo Vitali (Vitali,, 2014)
The case of Valparaiso, is predominantly chosen because of its recent misfortune that has occurred in April 2014. Rapid urbanization has struck on the steep slopes around the centre of Valparaiso causing them to perch on precarious land. Due to its geography, landslides, earthquakes and wildfires are a common threat that might contribute to the disturbance of transforming an existing poor community into a safe and secure neighbourhood. On April 14th, wildfires have consumed more than 2,900 homes, leaving around 12,000 people homeless (UNDP, 2014; Quirk, 2014).

A notable remark is that this was not the first disaster the people of Valparaiso needed to witness. In fact, there was a similar wildfire back in 2008 and in 2013 that occurred on these same hills (UTFSM, 2014).

With the former residents already commencing to reconstruct their homes on these ashen hills, it is important to prevent entering in the same recurring cycle of a disaster prone area with vulnerable communities.

In the first part of this graduation project, a strategic approach for in situ settlement upgrading has been formed based on the concept of evolutionary resilience. The object of this part of the paper is to test the strategic approach to the specific case of Valparaiso. This integrated response, addressing the importance of evolutionary resilience in a disaster prone vulnerable community, will ultimately be reassessed to seek for possible replicable solutions for communities in similar situations elsewhere in the world.
**Scope**

Valparaíso, Chile
The scope of this paper is confined to the case of Valparaíso in Chile. More specifically, the design is located on a site where two communities intersect, Cerro Las Cañas and Cerro La Cruz.

Post disaster
Back in April 2014, the city of Valparaíso was severely hit by a wildfire that caused nearly 12,000 people to flee their homes and almost 3,000 homes were destroyed. 6 months have passed and this area is still under reconstruction. The scope of this design is limited to designing within a post disaster situation.

In situ-settlement upgrading
In-situ settlement upgrading can be defined as an intervention in which the residents are not required to relocate or rebuild their homes elsewhere in the city peripheries.

The built environment
This paper only addresses in situ settlement upgrading with the focus on the built environment. The design is a combination of two types of infrastructures, the physical and social.

**Methodology**

A fieldwork consisting of site documentation, specific consults and multi-scalar mappings were carried out to support the previous literature study in further enhancement of the design phase.

**Objectives**

The objectives of this design paper are twofold. The first objective is to gain an in depth understanding of the various issues within this specific case of in situ settlement upgrading in Valparaíso.

The second objective is to design a spatial intervention according to the strategic approach for in situ settlement upgrading. With this architectural design on a neighbourhood scale, it is of crucial importance to determine the effects on the urban and metropolitan scale.
How can architecture contribute to the reduction of vulnerability levels against large shock of wildfires, landslides and earthquakes and facilitate opportunity for the informal settlement on Cerros Las Cañas and La Cruz?
This paper consists of a design proposal based on the strategic approach that was presented in the qualitative research study. Chapter 1 is an introductory chapter revealing the main topic and structure of this paper. Chapter 2 explains the relevance of this paper within the faculty of architecture.

The design process for the specific case of Valparaíso is divided in four chapters. The ten steps within this strategic approach are paired up and spread over these chapters.

**Chapter three** includes the first three steps of the strategic approach. After identifying the problem it will shortly give an overview of the obtained data collection. The location analysis is presented through a series of scales. Starting at the biggest scale, it maps the country of Chile on a worldmap, supported with general information on the country’s well being and economic growth. It also draws attentions to climatic and geographical features, since these are a main topic within the entire paper. A brief introduction is given on the historic growth and the formation of informal settlements within Valparaíso. Analytic illustrations are a supporting tool to give an in depth understanding of the important aspects that have shaped this city in the past decades. A spatial analysis is carried out through multi-scalar mapping to reveal any remarkable observations.

**Chapter four** covers the risk assessment, detection of the level of vulnerability and identification of new opportunities. This chapter is entitled to the specific characteristics of evolutionary resilience. As part of the risk assessment, an analysis is carried out of a previous hazard that occurred in 2008. By becoming aware of the lessons learned from a previous disaster, a city may respond with precautionary measures.

**Chapter five** shortly proposes the design concept and introduces the program, which is based on the conclusions derived from the previous steps in the design phase. It then introduces the design proposal through a series of illustrations.

**Chapter six** is an evaluation of the obtained design proposal. The financial feasibility is an important section to be able to give a certain level of affordability and perhaps a sense of realism of the project.

**Chapter seven** is a concluding chapter, linking back to the previously stated design question. It also provides several recommendations referring to some of the design decisions that were made along this process.

Ultimately, an answer is given to the question whether the strategic approach is suitable for in-situ settlement upgrading processes.

Each chapter starts with a paragraph, which shortly introduces the outline of each chapter.
Strategic Approach

in situ slum upgrading

01 | Problem identification
02 | Data collection
03 | Location analysis
04 | Risk assessment
05 | Detect level of vulnerability
06 | Identify opportunities
07 | Design Development
08 | Design Proposal
09 | Project Evaluation
10 | Documentation
Relevance

Fire in Valparaíso 2014 (Plan Cerro, 2016)
Most projects within the field of architecture can be achieved according to a general design process. After a problem is identified, data is collected and analysed, the first starting points are formulated. This often results in a first design concept that eventually leads to a design.

This paper addresses the upgrading of informal settlements that are usually found in developing economies. Through public-interest architecture, “good design has the potential to benefit many more people than it currently does” (Fisher, T., 2008, p.10).

By improving the built environment within informal communities, local dwellers may gain a better opportunity to improve their own living conditions. This incremental growth may lead to a sustained and resilient environment.

In order to reach a level of replicability, there is a strong need for a strategic approach to be applied to in-situ settlement upgrading processes.

In the first part of this paper, such approach was formed based on the concept of evolutionary resilience. This has been integrated within the well-known design process within the field of architecture. In order to evaluate its plausible successfulness, it is tested to the specific case of Valparaíso.

Most projects within the architecture curriculum prepares its students to work for wealthy clients leading to the design of a private studio, the expansion of a faculty or the design of a museum of contemporary art, to name a few.

Today, the economic recession has ensured “there is much less meat for the same amount of animals” (Timberg, 2012). After a rather costly study of the profession, recent graduates are forced to accept whatever comes their path to “full-time employment with internship wages” (Timberg, 2012).

There has been a significant decline observed in job opportunities in most architecture firms. Thomas Fisher, one of the authors of Expanding architecture and dean of the College of Design at the University of Minnesota points out that “non-traditional job opportunities for architects have never been better and we should see the decline of traditional jobs not as a “meltdown” (Timberg, 2012) of architecture, but as the beginning of its rebirth” (Fisher, 2012).

Public-interest architecture can “act as a catalyst for public discourse through education, advocacy, and the design of public spaces and amenities” (Peterson, 2008, p.96). Designing within these often challenging circumstances involves a much wider range of actors.

But, like Charles Correa has mentioned in his lecture at the TUDelft, is that the issues are far too big to solve my merely architects. But what we can do is “draw attention to these questions and act transformative in these critical urban areas” (Correa, 2014).
Steps 1, 2 and 3

Problem identification
Data collection
Location analysis
Risk assessment
Detect level of vulnerability

Identify opportunities
Design Development
Design Proposal
Project Evaluation
Documentation

The ten steps for in-situ settlement upgrading
(Author, 2014)
This chapter covers the first three steps of the strategic approach for in-situ settlement upgrading. It starts with the problem identification, going into more depth of the misfortunate event that took place in April, 2014. After a short description of the collected data, the larger part of this chapter is devoted to the data analysis. This can be further subdivided into three sections. Going from the biggest scale of the metropolitan area into the urban scale looking at the specific characteristics of the urban environment. Finally, a study of the neighborhood scale reveals all its peculiarity that form a supportive tool in the further phases of this design process.
Today, Valparaíso has a population of approximately 300,000 people (INE, 2014). The port city is known for its characteristic colourful architecture and steep slopes that embrace the city centre. It is set on the cordillera de la costa, a very old mountain range that stretches parallel with the Andes.

Due to its geography and climate, landslides, earthquakes and wildfires regularly take place in the Valparaíso region.

Rural households seeking for a better life in the city prefer settling in Valparaíso since there are more opportunities to be found to support their families. Life is generally cheaper compared with the capital city, since port activity triggers the market of leftover goods so even the poorest families have a higher chance of survival.

Since the Panama Canal opened in 1914, the city has been struggling to answer the demands of new developments to expand the city in terms of affordable housing and the expansion of infrastructure systems.

Over the past decades, these poor families have settled on the steep slopes, further away from the inner city, easily excluded from the city centre.

This exclusion and the constant threat of a hazard might contribute to the disturbance of transforming an existing poor community into a safe and secure neighbourhood.

On April 14th, 2014, wildfires have consumed more than 2,900 homes, leaving around 12,000 people homeless (UNDP, 2014; Quirk, 2014). 6 months after the disaster, many families are still living with their neighbours or sleeping in tents.

But the key problem is not the slow reconstruction after a single hazard. It is the low level of evolutionary resilience, the ability to rebuild and improve from prior poor living conditions. Although the greatest in history, this was not the first fire the people of Valparaíso needed to witness. In fact, there was a similar wildfire back in 2008 and in 2013 that occurred on these same hills (UTFSM, 2014). Figures 1, 2 and 3 give an impression of the magnitude of these fires that took place.

With the former residents already commencing to reconstruct their homes on these ashen slopes, it is important to prevent entering in the same recurring cycle of a disaster prone area with vulnerable communities.

The main issue is therefore the lack of a resilient community able to adapt to reduce their level of vulnerability towards future hazards.
January 2008
79 homes destroyed

Figure 1.
(UTFSM, 2014, p.22)

January 2013
284 homes destroyed

Figure 2.
(ClimaValpso, 2013)

April 2014
2,900 homes destroyed

Figure 3.
(Gaete, 2014)
The collected data contains various forms of information like maps, government reports, site visits, consultations with Chilean architects and construction engineers, and interviews with local residents. Most of this data was collected during a 3 week trip to Valparaiso. This data was further documented through personal experience and observation.
scan of annotated map
notes in booklet from consults, meetings
Republic of Chile
Chile stretches roughly 4,300 km from north to south and only 350 km from east to west (INE, 2014). It is enclosed between the Pacific Ocean on the west side and the high Andes mountain range on the east side.

Population
Chile has an estimated number of 17.8 million inhabitants in 2014 (INE, 2014). About 85 percent of the Chilean population live in urbanized areas (MVU, 2015).

Economy
Chile is one of South America’s most stable and prosperous nations. It leads Latin American nations in rankings of human development, competitiveness, income per capita, globalization, state of peace, economic freedom, and low perception of corruption (World bank, 2012).
Regions
Chile has 13 different regions of which Valparaiso is named the V region. The area is more than 16,000 sqkm. This region is located in the small Central Valley just like Santiago, which has the best agricultural resources (INE, 2014).

Earthquakes
Chile is situated along a seismic and volcanic zone. Every Chilean will have experienced a severe earthquake at least once in their life. The strongest earthquake ever recorded took place in 1960 in Valdivia, Chile, with a magnitude of 9.5 and a destructive tsunami, killing over 1,500 people.
17.6 million
756,096 km²
16.8 million
41,526 km²
the dependent centralization of Santiago
city scale
A satellite image of Valparaiso (CNES 2014)
Climate
The climate is a mild Mediterranean climate. Only an hour drive from Santiago, one can be mistaken from its temperature drop, especially at night times. It is very humid, and in winter times, for a short period, there is a slight chance of rain. But when it rains, it rains short but heavily.

Tourism
The historic centre of Valparaiso is known for its colourful architecture on steep slopes. It was declared a UNESCO World Heritage Site in 2003 which meant a new economic driver through tourism.

Population
Valparaiso was founded in 1536. It rose from 70,000 residents in 1970 to an estimated 300,000 residents in 2012.

Transport
Funiculars, microbuses and trolleybuses are still in use which give the tourist an old, historic look at the city. Over the past years, there have been many improvements made on the bigger scale in terms of accessibility to neighbouring cities like San Antonio.

Camino “0”
Public transport is limited in the upper regions due to the difficult accessibility. The Camino “0” is a microbus that reaches until the avenida Francia which lies at 100m. However, the city of Valparaiso has expanded to over 400m height.

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**Informality**

Although many dwellings belong to the families, there is a certain division between formal and informal communities. Informal communities are situated on the edge of the city excluded from city services like public transportation, amenities like health care and supermarkets.

**Furniculars**

These type of elevators are world famous for Valparaiso. Many have been abandoned. Today, only a handful are still functioning.

**Cerros**

There are 42 different hilltops. These are called cerros and each have their distinct characteristics.

**Port**

The seaport used to be the main driver of the city's economic growth. After 1914, the opening of a new route for ships to cross to the Pacific coast, the port witnessed a staggering decline with the departure of many immigrants. Nowadays, it still is actively involved in container traffic.

Figure 5.

The information is based on the development report by the Government of Chile.
Migrating native Americans, called Llolleo, first made use of the fertile soils in this region.

The first European to set foot on Chile was Ferdinand Magellan. He discovered the southern passage for ships to cross from the Atlantic to the Pacific Ocean. Nowadays still known as the Strait of Magellan.

Arrival of the Spanish explorers. Diego de Almagro is known as the first discoverer of Chile. He named Valparaiso after his home town in Spain. Chile became past of the Spanish empire.

Chile became independent of Spain, leaving its colonial times behind. This also meant the opening of international trade.

The California Gold rush also played a crucial role for Valparaiso. The city profitted and became the major stopover port for ships coming from the Atlantic passing South America through the Strait of Magellan.

Valparaiso grew rapidly from 24,000 people to 52,600 in 1854 and 121,600 in 1895. In 1905, it reached 162,000 residents of which 12,000 were European immigrants.

A large earthquake hit Valparaiso causing many thousands of deaths and the destruction of many monumental buildings.
One of the key characteristics of Valparaiso are the funiculars situated at the base of the inclined slopes. The first was built in 1887, and there were about 30 more to be build afterwards. Today, there are still several functioning, for residents to ease their trip uphill or for tourists to enjoy the panoramic view.

A fire consumed roughly 80 dwellings in the community of Cerro La Cruz. Although wildfires are common in the area, Urban damage of this magnitude is rare.

Valparaiso is now widely known for its colourful architecture that are settled on steep slopes. It has attracted many tourists since 2003, when this area was declared a World Heritage site by Unesco.

The opening of the Panama Canal, meant a disastrous economic decline for the city. the city was principally dependent on the arrival of ships and goods.

Only the larger ships were still arriving in the seaport, those who could not pass the canal.

Today, the seaport is still functioning but to the most extent devoted to container traffic.

In the same area as 2008, a fire raged through the community. Many dwellings are made out of wood and corrugated metal sheets, very flammable. Also, every household has gas tanks for heating and cooking. In case of the fire, there were many explosions which fed the fire, destroying nearly 300 homes.

The information is based on the development report by the Government of Chile.
Having a closer at the built form it is difficult to justify the densities. Some white areas are forms of public space while it others are the steep incline of a hill which makes it impossible to build or form roads. Although the densities remain the same, the conditions may vary extremely. 

The built form at the plane level are much bigger than those that are situated in the highest part of the hills. These are scattered along vertical lines directed towards the city centre. In an exceptional case, a clear form is recognized showing signs of affordable housing schemes.
There are various distinctions in the built form. Although there seems to be a clear distinction between the formal and informal city structures, this is not always the case. The grid structures show the urban development on the plane level, near the sea. Over the years, these building have become commercialed and many people have moved to the hills. These hills are very difficult to properly access, so there is no clear distinction to be made between the formal and the informal city residents. In many cases, the open spaces reveal the steepest unaccessible slopes.
Water streams are very important yet have been severely neglected over this past decades. The initial thought of these streams, water collected running down, and collected at square. If you look at a map of Valparaiso, you will see that every end of stream will have a square or some sort of public space (Plan Cerro, 2015).
Part of the reconstruction plan of Valparaiso is the environmental revival of water streams running in the creeks between the hills. Together with green zones and public space, this will ultimately also protect citizen both on the high as well as the lower plain from environmental hazards.

Illustration retrieved from ‘Plan de inversiones’ (gob, 2014) Figure 10.
Spatial analysis

Built-form

Built-Up area

0 1 km 2 km 3 km 4 km 5 km

0 0.5 km 1.0 km 1.5 km 2.0 km 2.5 km

Built-Up area
Spatial analysis

Land use

Residential

Governmental

Port activity

- Purple: Governmental
- Brown: Port activity
- Red: Residential
Spatial analysis
Landscape

Sea level
20 m
100 m
200 m
300 m
400 m
Spatial analysis

Infrastructure

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- asphalt road
- gravel road
Spatial analysis

Growth over time
Spatial analysis

Building heights

+8 storey buildings

4-8 storey buildings
Spatial analysis

Income

I Quintil: ABC1
II Quintil: C2
III Quintil: C3
Conclusions from the multi scalar mappings

The previous illustrations are based on various sources. This information is provided by the Federico Santa María Technical University and retrieved from interview with local residents.

Growth over time

In the late nineteenth century, Valparaíso experiences a fast demographic growth. Many European peasants arrive in the city which made Valparaíso one of the densest cities in Chile at that time. With a strong industrial footprint, very poor housing conditions for the working class, most units appeared as tenement housing (Secpla, 2014a).

Growth over time shows the expansion of the city from the flat plane towards the hillside. The design location contains housing dating back only a few years, no building is older than around the 1950s. In the city centre, there are many old buildings dating back from colonial times. Since 2003, part of the city has been declared a World Heritage site by Unesco which also meant that these cannot be destroyed. Therefore, there are some buildings which only date back from 2000s but have been placed within the old ruins of the previous building like in figure 11.

Built form

According to the INE in 2012, of an estimated 269,446 residents, a percentage of 99.75 represents the urban population and 0.25% rural population. The population density is 670.9 inhabitants per km2, which is quite high within its district but relatively low for a city (Secpla, 2014a). Figure 12. illustrates a typical housing unit of a household with an average income of 600 US$ a month.

Open space

Space is limited due to the complexity of the landscape. Apart from the steep slopes, no efforts seem to have been made to create open and safe spaces. The residents are already struggling to make their own land sufficiently accessible and protected. Figure 13. shows the border between public and private before the wildfire in April 2014.
Building height
Building height quickly declines as you reach the top of the slopes. Many residents in poor communities are not capable of building stable 2 storey housing as they simply cannot afford it. There are several exceptions to be observed of 3+ storey blocks which are situated in the cities peripheries. These are most likely affordable housing to provide poor residents with new housing like figure 14 shows.

Some buildings in the city centre are above 8 stores high. Since 2003, this has been strictly regulated since many of these tall buildings cause a lot of shadow and block the view towards the sea. In 2003, parts of the city was declared Unesco World Heritage which also meant that old buildings which have broken down cannot be destroyed but have to be incorporated within a new design. Figures 15 and 16 shows DIN99, architecture offices in a monumental building. The design is a fusion of the old burnt wood with corten steel elements.
Landscape

Valparaiso has an approximate height distance of 400m stretched over roughly 4km. Many residents need to walk to their house since most transportation systems stop at 100m altitude. There are, however, endless stairs. Figures 17 and 18 give an impression of the various conditions these stairs could be in.

Informal/formal

There is a broad diversity in quality of the various dwellings within a single community. Looking at the global definition by the UN habitat, a slum household lacks one or more of the following five indicators; durable housing of permanent nature; sufficient living space; easy access to safe water; access to adequate sanitation and security of tenure (2003, pg.12).

Unlike slum communities like Kibera, in Kenya, or many of the favelas in Rio, Valparaiso has many poor communities which are a mix of formal and informal housing units. The overall density remains low because of the complexity of the landscape.

Amenities

Most amenities are situated within the inner city below 100m altitude. All the residents that are living above this line have difficulties fulfilling their daily system with groceries, social and educational amenities and health care.

There is an extraordinary amount of higher educational facilities to be found in Valparaiso. There are also numerous primary schools, many of which date back to the colonial times, with European reference. But a key observation is that these amenities do not continue as you get closer to the design location.

Preschool is not mandatory but free of charge. The problem however, is that families get assigned a spot at a nursery which may lie at the other side of the city. Many poor households are not able to travel that distance and are forced to either leave their children unattended or not go to work (source interview).
**Income**

In terms of poverty, Valparaiso is one of the poorest regions with 16.5% of its population under the poverty line, 2.6% indigent people and 13.9% poor households. This number exceeds the national index which lies at 14.4% (CASEN, 2011). The average income per household is $637,668, which is almost 20% lower than the national average of $782,953 (CASEN, 2011). These statistics have been placed in Appendix A.

The legend below the illustration on page 50 give 5 specific socio economic groups that give an overall impression of some of the characteristics that are usually found in a specific income area. group ABC1 represent the wealthy class with a minimum monthly wage of 3,700,000 CL$ or more per household. Most households living in the hills corresponds to group D, with an average monthly income of 403,000 CL$, which is roughly 600US$ per household. The poorest families make their living with an average monthly income of 176,00 CL$ or less, which is around 250 US$ a month per household (CASEN, 2011).

**Infrastructure**

In 1870, an important road was established which crossed every hill in Valparaiso. Avenida Alemania is also known as the “Camino Cintura”, an organic belt that passes at an altitude of 100m (Plan Cerro 2015, p.11). Figure 19 shows a plan of Valparaiso in 1895, with the Camino Cintura.

The successful implementation of the first funicular was realized on the first of December, 1883 in Cerro Concepcion. At 40m, where the plain and base of the hills meet each other, another 30 funiculars were constructed until 1931, becoming a crucial type of transport for city residents in their daily system (Plan Cerro, 2015).

There is an international design competition being held for the redevelopment of the funicular which is situated at the bottom of the hill of the design location.

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Valparaiso in 1895 (Plan Cerro, 2015) Figure 19.

Ascensor Baron, in Cerro Baron (Author, 2014) Figure 20.
community scale

Cerro Las Canas
Cerro La Cruz

city of Valparaiso
N° viviendas
0 - 13
14 - 27
28 - 51
52 - 98
99 - 238
The illustrations from the previous pages are based on official governmental reports from a department called “Equipo Plan Cerro”, whom are in charge of the redevelopment of this area. Recently, an international design competition has been announced to redevelop part of this region. In particular the revival of the funicular at the bottom of the hill, Ascensor Las Cañas. This design competition is part of a bigger reconstruction program initiated by the Chilean government and the municipality of Valparaíso. Some of the highlights of the ‘Propuesta Plan de Reconstrucción’ have been placed in appendix C.
The design location is situated along a secondary street called ‘Las Chonos’. It is where the two communities, La Cruz and Las Cañas meet. They share similar characteristics, giving a total of roughly 8500 inhabitants residing on 80 Ha.

The hills La Cruz and Las Cañas are principally residential areas, with little to no economic activity except for a few local grocery shops. Cerro La Cruz is the highest hill within the city. Most roads show an immense inclination which makes it difficult for cars to access the upper parts showed in figure 22. (SECPLA, 2014). On the next page, you will get a visual impression of the neighbourhood. The images were taken 6 months after the fire in April. More specific information on the design location at street level will be given in the next chapter as it involves statistics that were measured after the fire in April 2014.

Specific data on the two communities (Gob, 2014) Figure 23.
Steps 4, 5 and 6

01 | Problem identification
02 | Data collection
03 | Location analysis
04 | Risk assessment
05 | Detect level of vulnerability
06 | Identify opportunities
07 | Design Development
08 | Design Proposal
09 | Project Evaluation
10 | Documentation

The ten steps for in-situ settlement upgrading
(Author, 2014)
This chapter covers the fourth, fifth and sixth step of the strategic approach for in-situ settlement upgrading. It starts with a risk assessment which includes an overview of previous hazards in Valparaíso city. In short, the wildfire in 2008 is depicted to identify the lessons learned. It is important to understand the specific aspects that causes such hazards in order to avoid the recurrence of another tragedy. This chapter will continue with the identification of the level of vulnerability in the area, thereby justifying the specific design location which was chosen based on this outcome. Finally, new opportunities are detected that give a significant suggestion of the desired program for the design proposal.
ZONA DE SEGURIDAD
TSUNAMI
SECURITY ZONE
This fourth step within the strategic approach is the most crucial step to obtain a good perception of the level of resilience that needs to be achieved. This part is subdivided into three different topics:

A| An overview of previous hazards in Valparaíso city
B| Description and lessons learned from the fire in 2008
C| Risk assessment of design area

On the next two pages, an overview of previous hazards is given, presented in the form of a timeline. A short description is given on the fire that occurred in 2008. This information was provided by the UTFSM, the Universidad Técnica Federico Santa María. For more information on the fire in 2008, please refer to this institution.

The risk assessment has largely been carried out by Sernageomin, Servicio Nacional de Geología y Minería, which is a department of the government of Chile. The fire in April 2014 has been one of the greatest in Chilean history where President “Ms Bachelet declared the areas destroyed by the fire a disaster zone” (BBC, 2014). The official title of a disaster zone area might have brought several advantages for the purpose of this research. The promise of the government to rebuild the affected area means that the acquired information to be gathered within this strategic approach has become much more accessible. Usually, within informal settlements, it is difficult to gather detailed information of the specific data of the communities. 6 months after the fire in Valparaíso, the government has provided the city with detailed information about the affected residents and a full risk assessment of the urban area that has been severely destroyed.

This paper will present the conclusions of the risk assessment that was carried out by Sernageomin.
<table>
<thead>
<tr>
<th>Year</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1843</td>
<td>On March 15, 1843, there was a fire that destroyed a huge part of the business district. Back in 1843, there were no fire departments yet, so with the help of foreign ships the fire was put to an end.</td>
</tr>
<tr>
<td>1906</td>
<td>On August 16th, an earthquake with a magnitude of 8.6 on the scale of Richter and its epicentre in the city centre, caused nearly 3000 deaths. Rebuilding meant considering designing a new urban plan. The earthquake also initiated 39 fires which destroyed another great part of the city completely. Many tenements of the working class were destroyed which left many households homeless. Many families moved to the top hills and the ravines, in search for a place to settle. Over the year, they would gradually start connecting their neighbourhood with the city, through alleyways and staircases.</td>
</tr>
<tr>
<td>1985</td>
<td>On March 3rd, an earthquake hit the port district of Valparaiso. Several buildings were also destroyed including the hospital. It was severely damaged, repair was not possible. It had to be completely torn down. Today, the National Congress building is now situated at this location.</td>
</tr>
<tr>
<td>2007</td>
<td>On February 3rd, a gas leak produces a huge explosion at Calle Serrano and the port district leaving four dead and millions of damage of old monumental buildings.</td>
</tr>
<tr>
<td>2008</td>
<td>On January 14, 70 homes were destroyed by a great fire in the Cerro La Cruz, leaving four dead and 50 wounded.</td>
</tr>
<tr>
<td>2003</td>
<td>On January 24th, more than 50 houses burned down in Cerro Cordillera which was caused by two children burning trash on the hillside.</td>
</tr>
<tr>
<td>2013</td>
<td>February 14th, 284 houses burned down and more than 50 people were injured in Cerro Rodelillo y Placeres. The fire had been caused by poor management of welding tools.</td>
</tr>
</tbody>
</table>

*Figure 24: The information is based on the ‘Municipal Diagnosis for Reconstruction’ report prepared by the Government of Chile (SECPLA, 2014)*
Lessons learned from the fire in 2008
<table>
<thead>
<tr>
<th><strong>What</strong></th>
<th>Wild fire</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>When</strong></td>
<td>January 16th until January 17th, 2008</td>
</tr>
<tr>
<td><strong>Where</strong></td>
<td>Cerro La Cruz</td>
</tr>
<tr>
<td><strong>Affected area</strong></td>
<td>250 Ha (2.5km²)</td>
</tr>
<tr>
<td></td>
<td>79 homes burned down</td>
</tr>
<tr>
<td><strong>Residents</strong></td>
<td>4 deadly victims</td>
</tr>
<tr>
<td></td>
<td>280 homeless</td>
</tr>
<tr>
<td><strong>Damage</strong></td>
<td>1,500 MUS$</td>
</tr>
</tbody>
</table>

On the next two pages you will find an overview of the most important aspects that have contributed to the magnitude of the fire that took place in 2008. Since fires regularly take place within the Valparaiso region, both in rural and in urban areas, it is important to become aware of the aspects that either have caused or have contributed to the occurrence of this type of disaster.

It is important to identify the variables which are adaptable in order to decrease the probability of another event with similar magnitudes. This refers back to the formula introduced in the research paper, where the level of risk is the probability of an hazard times its vulnerability (Downing and Patwardhan, 2004, p.71).
Some of the conditions encountered in 2008 might have caused or reinforced the magnitude of the disaster. All these aspects are in direct relation to one another. The costs of gas and paraffin have seen a substantial increase over the past years. This means it has become too expensive for poor households to purchase traditional fuel. As a result, they generate their own energy source by burning wood for coal.

Figure 26 shows the socio economic structure of the inhabitants within Valparaiso. The majority of the people have a low income and therefore not capable of purchasing traditional fuel. As an illegal activity, many of these coal furnaces are situated in the peripheral areas, at the bottom of the hills. There is also a great lack in forest management.

Garbage is collected below an altitude of 100m. Poor households living above this line usually throw their garbage in the ravines, which obstructs the water from flowing down. In case of a hazard, the trash also feeds the fire, increasing the magnitude of the hazard. Figure 27 shows an image of illegal housing down the ravines, obstructing the streams and congesting the water with their waste.

95% of the houses are made out of wood. The community is a mix of informal ad formal housing, therefore many do contain gas tanks for kitchen use and heating. When a fire has hit 1 house, it is only a matter of minutes before the next house is completely burned down. Figure 28 shows an image of a formal house within the community. This family had sufficient income to be able to reconstruct their house within 6 months.
On the top of Cerro La Cruz hill are multiple housing blocks. This social housing was initiated by the municipality without the consent of the local residents. Many poor households did not want to live in such blocks and the project was canceled. The soil that was dug out to construct the foundations was left abandoned. New families arriving from the rural countryside were starting to settle on very unstable sand. Another issue was that the sand was obstructing the water stream from flowing to the sea. On July 15th, this cause an immense landslide as shown in figure 30.

The obstruction of the water flow not only reinforces a fire but can also have drastic consequence during the rainy season.

During summer time, wind usually comes from the South East. The slope have an average gradient of 20° and the difference in height between the bottom of the ravine and the top is 94 metres.

As the coal furnaces are usually situated at the bottom of the ravine. In case of a fire, the difference in temperature and the height difference between the hills, there is a great force of air buoyancy. This is also known as the chimney effect which, in Valparaiso happens often because the ‘perfect’ ingredients of its slopes and wind forces at the sea.

A last observation of the fire in 2008, is the lack of resilience. Local residents have not adapted their homes causing them to remain as vulnerable as they were before the fire. Due to the uncertainty of legal security of tenure of several houses, households rebuild as fast as they can to avoid being evicted from these grounds that are not theirs.
Risk assessment of design location
On April 12, 2014, a wildfire started in the southern part of the Valparaiso region, which quickly spread in the northern direction, headed to the city. That day, there was a code red alert for 17 hours, trying to mobilize all the necessary resources to combat the big fire.

One of the reasons why this fire was extremely big were the inaccessibility of the terrain, and the weather conditions with strong south east wind which cause the fire to move to the urban areas.

What caused this drastic event is still being investigated today. The fire consumed more than 10 sqkm of which 1,2sqkm contained urban area which affected the neighbourhoods La Cruz, Las Cañas, El Litre, El Vergel, Mariposas, Ramaditas, Rocuant and Merced. The fire lasted several days and was finally in control on April 19th. It is estimated that a figure close to $2.8 million within the formal economic sector has been lost and $ 1.1 million in the informal (SECPLA, 2014).

According to the Ministry of Housing in 2012, of a total of 657 slum communities identified in Chile, 146 are situated in the Valparaiso Region. Of these, 57 are located in the town of Valparaiso. It has been estimated that within the affected region, 11 slums were identified with a total of 657 families, of which 362 were destroyed (SECPLA, 2014a, p.86).
The affected urban area
La Cruz, El Litre and Las Cañas
<table>
<thead>
<tr>
<th>Macrozonas</th>
<th>Cerros</th>
<th>Héctareas Afectadas</th>
<th>Viviendas Afectadas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mariposas</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>La Cruz - El Vergal</td>
<td>484</td>
<td>900</td>
</tr>
<tr>
<td>3</td>
<td>Ramaditas - Rocuant</td>
<td>384</td>
<td>165</td>
</tr>
<tr>
<td>4</td>
<td>Las Cañas</td>
<td>45</td>
<td>923</td>
</tr>
<tr>
<td>5</td>
<td>Merced</td>
<td>27</td>
<td>334</td>
</tr>
<tr>
<td>6</td>
<td>La Cruz - El Litre</td>
<td>31</td>
<td>284</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1021 há</td>
<td>2656</td>
</tr>
</tbody>
</table>

Image of the affected 10,1 sq km area of land (Google Earth and SECPLA Municipalidad Valparaíso, 2014)  
*Figure 33.*

The affected area and houses per community (Municipalidad de Valparaíso, 2014)  
*Figure 34.*
The communities of Las Cañas and La Cruz-El Litre show the biggest numbers of affected residents which have lost their homes due to the fire. Regarding age, there are two remarkable observations.

The first observation is that over 67% of the affected population are economically inactive. These are the children (23%), the young (27%) and the elderly (17%).

The second observation is the fact that 50% of the total affected community is under 29 years of age. 23% under 14 years (SECPLA, 2014a).

Affected residents per age group
(SECPLA, 2014a, p.26)
Figure 36.
The majority of the affected residents correspond to income levels of the first quintile, representing the lower income families. These households have an average monthly income of roughly CLS 370,000 per family (SECPLA, 2014a, p.26). The average family size is 3.5 which means that per capita, the average monthly income is about CLS 100,000, which corresponds to 160 US$.

People have lost their homes, including everything else they possessed, becoming even more vulnerable. In some cases, local businesses were destroyed which caused an increase in unemployment rate within the affected region. It is estimated that in the upcoming CASEN survey, numbers will have shown an increase in poverty levels (SECPLA, 2014a, p.26).
Before and after the fire in Cerro El Litre (Morales, 2014)
Figure 39.

Before and after the fire in Cerro Las Cañas (Morales, 2014)
Figure 40.

Before and after the fire in Cerro Ramaditas (Morales, 2014)
Figure 41.
Below you find an overview of the most important aspects that form potential great risk. This risk assessment can be either used to stipulate dangerous areas in need of short term solutions and/or it can be used to identify crucial topics which need attention in terms of building resilience to avoid the occurrence of similar hazards.

Some of these aspects overlap with the previous assessment of the fire in 2008. This only reinforces the indispensable need for short term solutions.

After this overview has been given, it is important to identify the variables which are adaptable. This refers back to the formula introduced in the research paper, where the level of risk is the probability of an hazard times its vulnerability (Downing and Patwardhan, 2004, p.71).

A possible strategy to identify the levels of adaptability, ease of operation and level of impact is through ranking the numerous variables. This is to obtain a clear proposition and realistic picture of the overall operation.

The information presented on the following pages should not be considered as a complete overview of all the different risk measures. This paper has attempted to retrieve information that is suitable for the purpose of this project, a public-interest architectural design proposal.
01 | Micro landfills

The complexity of the landscape makes it extremely difficult to access the streets and collect garbage, which is one of the biggest problems Valparaiso is facing today. The Camino Cintura road, which lies at an altitude of 100m is seen as the border between formal and informal activities. Although the residential areas are a mix between informal and formal housing at all altitudes, city activity in terms of public transport, garbage collection and other services stops at this border which means that garbage is not collected for a great section of the city.

In a journal article retrieved from Ciper called “The $400 million that never came to prevent the fire, the history of neglect and corruption that burned Valparaiso” the authors have a critical standpoint towards the primitive actions of the municipality prior to the fire. Money that was inteneded to perform preventive work never came. There was an overall health alert which meant the urgent removal of trash from ravines to prevent infections or fires (Arellano and Bezama, 2014). During 2009 and 2011, The Micro Landfill Management Program, identified over one hundred micro landfills shown in figure 42.

The ease of adaptability is at its maximum since there are numerous ways to decrease the amount of landfills. Making roads more accessible for large trucks, the purchase of containers, clean up crews, like shown in figure 44, and the education on recycling waste are just one of the few short term solutions to decrease the level of risk cause by landfills (SECPLA, 2014b, p.65).

<table>
<thead>
<tr>
<th>Ease of adaptability</th>
<th>Short term solution</th>
<th>Level of impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>★★★★★</td>
<td>★★★★★</td>
<td>★★★</td>
</tr>
</tbody>
</table>
Management of coal furnaces

As seen in the evaluation of the fire of 2008, the costs of gas and paraffin have seen a substantial increase over the past years. This means it has become too expensive for poor households to purchase traditional fuel. As a result, they generate their own energy source by burning wood for coal.

The majority of the affected people have a low income and therefore not capable of purchasing traditional fuel. As an illegal activity, many of these coal furnaces are situated in the peripheral areas, at the bottom of the hills. Together with poor forest management, the illegal activity of burning wood has become one of the main reasons of a start of a fire.

A crucial observation is that the municipality is fully aware of this permanent risk of fire. The process of removing these illegal sites is slow and is not only caused through a lack of money or resources. Corruption scandals have been the norm within the municipal authorities for decades (Arellano and Bezama, 2014). “Three of the four major corruption scandals in the Valparaiso region in the last two decades have a total of over $2,389,000 in fraudulent acts” (Arellano and Bezama, 2014).

The ease of operation is therefore quite challenging and requires longer term development plans. The level of impact however, could be enormous. If fuel prices would be lowered for instance, lower income families do not need to burn coal as an alternative energy consumption.

**Ease of adaptability** ★★

**Short term solution** ★★★★★

**Level of impact** ★★★★★★

**Figure 45.**

*Fuel prices (UTFSM, 2014)*

**Figure 46.**

*Socioeconomic structure (UTFSM, 2014)*

**Figure 47.**

*Price per litre of gas, kerosine and diesel over time (UTFSM, 2014)*
03 | Housing materials

95% of the houses are made out of wood. The community is a mix of informal and formal housing, which means that some houses are constructed with adequate structures. Nevertheless, this material remains highly flammable compared with other building materials. In case of a fire, the fire can spread easily to its neighbouring houses being fed with the large quantity of wood. It is complicated to change this method of construction since it requires a significant change for the local dwellers. Wood is the cheapest construction material and many locals can build their own homes using their own timbercladding skills. The impact also remains limited since housing made out of concrete will also get highly damaged.

Ease of adaptability ●●●●●
Short term solution ●●●●●
Level of impact ●●●●●

04 | Media aguas

Mediaaguas are temporary shelter units provided by the government. For many poor families, this type of emergency housing gradually becomes more of a permanent structure. Although this is a good short term post disaster solution, measures should also include longer term housing programs to respond to the urgent formal housing demand.

But another problem is the placement of these mediaaguas. According to Sernageomin, a total of 1,299 mediaaguas have been reinstalled, of which 468 are situated in risk areas (>40% gradient slope) (SECPLA, 2014a, p.72).

Ease of adaptability ●●●●●
Short term solution ●●●●●
Level of impact ●●●●●
05 | Slopes (>40%)

Due to the sloping characteristic within the entire region, slopes with a larger gradient of 40% are categorized as dangerous grounds. These are more likely to cause landslides or erosion and thereby become unsuitable for inadequate structures like informal housing. In the process of reconstruction, old terraces have been used which have been built with waste materials such as rubble, tires and sandbags. They have also excavated new embankments, which are unstable and might provoke landslides, mudslides or erosion.

The ease of operation 6 months after the disaster is much more difficult since many locals have started to rebuild their homes on precarious land. It would be easier to act right after a disaster has taken place to guide the locals in finding new grounds to reconstruct their dwellings. Right now, it has become a much longer process, looking at relocation strategies.

To avoid occupation on these precarious grounds, affordable social housing programs must be initiated. Families will need to be relocated, but preferably very close to their initial occupation. Merely fencing the restricted area will not be sufficient as people will find their ways to reoccupy the land. It is therefore important to act within a short time span, with public interventions, transforming the critical areas into public space for instance.

This approach needs participation at all levels, ranging from municipality authorities to the local community but will lead to large risk reduction.

<table>
<thead>
<tr>
<th>Ease of adaptability</th>
<th>Short term solution</th>
<th>Level of impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔️</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Number of houses in different sloping areas (SECPLA, 2014a, p.72)  
*Figure 51.*

Critical risky areas assessed by Sernageomin (SECPLA, 2014a, p.72)  
*Figure 52.*

Identification of inadequate housing (SECPLA, 2014b, p.45)  
*Figure 53.*
06 | Floods

Most streams in the hills have artificial pipes running down which allows sediment and waste to be deposited in the sea. This also facilitates rainwater drainage. Due to lack in the maintenance and the illegal disposal of waste, these pipes have become severely deteriorated, increasing the incidence of flooding (SECPLA, 2014a, p.62). Due to long neglect, it has become a complex issue to be solved within a short time span.

| Ease of adaptability | ★★★★★
| Short term solution | ★★★★★
| Level of impact | ★★★★★

07 | Earthquakes & tsunamis

Chile is known for its vulnerability towards earthquakes which is generated the friction between the Nazca plate and the South American plate. These can generate severe damage with magnitudes over 8.5 of the Richter Scale (SECPLA, 2014a).

Buildings with multiple floors are more vulnerable towards earthquakes, yet the one storey self constructed houses do not contain proper foundations to the rocky ground which may also cause them to collapse during an earthquake. Valparaiso is also known to have had some sever tsunamis. This area is within the safe zone.

This type of risk is an not to be influenced in terms of its probability. It is estimated that a severe earthquake with its epicentre close to Valparaiso happens every 10 years.

| Ease of adaptability | ★★★★★
| Short term solution | ★★★★★
| Level of impact | ★★★★★

Housing installed on top of pipe with ESVAL drinking water (Plan Cerro, 2015, p.8) Figure 54.

Tsunami security zone (Author, 2014) Figure 56.
Wildfires

Since Valparaiso is situated closely to large forested areas, it is at risk of forest fires. Due to rapid urban expansion there is an increased risk in the level of impact of a single fire. On average, there are 5,000 wildfires during the summer period (SECPLA, 2014a, p.64). It is important to look at measures to prevent a fire becoming a disastrous urban event. This includes the proper management of surrounding vegetation and the improvement of the level of accessibility for fire fighters in the upper parts of the residential areas.

<table>
<thead>
<tr>
<th>Ease of adaptability</th>
<th>Short term solution</th>
<th>Level of impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>⚫⚫⚫⚫⚫</td>
<td>⚫⚫⚫⚫⚫</td>
<td>⚫⚫⚫⚫⚫</td>
</tr>
</tbody>
</table>

To conclude with, the design location is predominantly chosen because of the high level of risk within this area. Several families have started to rebuild their homes on slopes with an inclination of over 40%. Within this area, as described within the risk assessment, the majority of the housing are violating the Law of Urban Planning and Construction, as the structures are unstable and inadequately built to be living in safe conditions. It is necessary to transform this area with better construction material and proper foundations to the rocky grounds. The water stream is also being blocked by waste disposal and needs improvements so rainwater can flow throw the artificial pipelines to be deposited in the sea.
A hazard becomes a disaster depending on its “levels of exposure of the population and its physical and economic assets [...] The higher degree of exposure and vulnerability of both people and infrastructure within cities is a driver behind why natural hazards can have great social and economic impact” (World Bank, 2012, p.9).

According to this formula presented below, there are two options: reducing the probability of the occurrence of a disaster and reducing levels of vulnerability of the local community. On average, there are about 5,000 wildfires during the summer season within the Valparaiso region (SECPLA, 2014a, p.64). Due to the environmental conditions such like strong south east winds and steep slopes, in case of a fire, it can be difficult to control. Measures to reduce the probability of a fire are more within the responsibility of the regional and governmental authorities.

These include proper forest management and a decline of traditional fuel costs or propose an alternative energy onsumption instead of the illegal coal furnices that increase the likelyhood of a fire.

Measures to reduce the levels of vulnerability can be within the responsibility of the municipality in cooperation with the local communities. In Abbott’s essay A Method-Based Framework for Informal Settlement Upgrading, there are four elements of vulnerability sugested from the viewpoint of possible interventions (2002, p.321). The detection of the level of vulnerability within the specific design location will be categorized according to these four elements.

1| Physical and social problems
2| The absence of opportunities
3| Perception of poverty
4| Compromised use of space

**RISK = PROBABILITY OF HAZARD X VULNERABILITY**

(Downing and patwardhan, 2004, p.71)
1 | Physical and social problems

Public safety
- no streetlighting
- certain level of drug addiction
- crime

Fire sensitivity
- combustible waste disposal
- flammable construction materials
- gas tanks as energy source
- coal furnaces at bottom of ravines
- fire fighters cannot reach community

Trash
- attracts infection and disease
- no garbage collection
- numerous landfills
- waste in waterpipes

natural hazards
- vulnerable to landslides
- vulnerable to land erosion
- vulnerable to wildfires
- earthquake zone

2 | The absence of opportunities

Public space
- insufficient public space
- no space for cultural activity
- no space for sports activity
- lack of basic services
- poor drainage

3 | Perception of poverty

Infrastructure
- no proper paving
- low level of accessibility
- no public transport
- insufficient escape routes
- poor state of stairs
- majority of low income families

4 | Compromised use of space

landuse
- steep slopes
- 95% residential area
- no pedestrian space
In order to make a city more resilient to disasters, the reduction of the level of vulnerability is highly prioritized. Yet, the term resilience means to “spring back” into the conditions prior encountered before the disaster. Since we are talking about poor settlements that are often settled in hazardous situations, you would not want to go back to its previous conditions.

Instead of returning back to an equilibrium state, referring to the original physics term, evolutionary resilience could be a preferred approach to poor informal settlements. “The emphasis on bouncing back as in resilience fails to consider the disturbance as a “window of opportunity” for transforming to a radical transformation” (Davoudi, 2012, p.300).

For a start, informal settlements have seen a substantial increase in the past decades around the hills of Valparaiso. They have become integrated within the formal housing which raises the question what types of intervention should be implemented.

In reference to this dilemma, architect and researcher David Gouverneur has stated in a recent publication that this irreversible growth of this way of living, do pose certain opportunities to consider. “Informality is a phenomenon inherent in making a city, as well as planning is a tool to improve the conditions of collective settlements” (Plan Cerro, 2015, p.10).

Valparaiso was once a city with a glorious growth, highly dependent on port activity. Ever since the Panama Canal opened up in 1914, it has seen a staggering economic decline and since then has had difficulties to develop itself further. The port sector was privatized by 86% since the Pinochet dictatorship, which also meant that “the flow of goods and capital that circulated the city received only negligible benefits” (Crac, 2014).

Over the past decades, there have been numerous attempts to redevelop certain areas. Like many other developing cities, corruption scandals have been the norm within municipal authorities for decades (Arellano and Bezama, 2014).

“Three of the four major corruption scandals in the Valparaiso region in the last two decades have a total of over $2,389,000 in fraudulent acts” (Arellano and Bezama, 2014). The image on the right shows a critical viewpoint illustrated by Iconoclasistas, showing discrimination and neglect by the government.

The fire in April 2014, one of the worst in Chilean history, has caught international attention. Being deeply by the successful interventions in the cities of Medellin and Curitiba, the government is slowly shifting its priorities to crucial areas in need of immediate transformation.
"¿TE INVITE YO A VIVIR AQUI?" 

Con esta frase respondió el alcalde de Valparaíso ante el reclamo de uno de los dominadores por el incendio de abril, que dejó sin vivienda a miles de familias en las cermas. La única respuesta resumió la actitud de diversas gestiones de gobierno que fueron transformando la ciudad al ritmo de los beneficios privados, financieros y especulativos, vinculados principalmente con los intereses de los holding portuarios y el negocio del turismo. Este "Valparaíso para otros" se evidencia en la imposición de modelos de vida basados en un consumo de arte poder adquirir para unos, y la precarización laboral para muchas. La vida en barrios antiguos populares se ha visto perjudicada por procesos de gentrificación desplegados a partir de la especulación inmobiliaria, la especulación de viviendas y la privatización de espacios de uso público, privilegiando así el perfil de una ciudad construida para el visitante eventual.

La magnitud del esfuerzo ha colado el piso 17 de abril, con la trágica muerte de 15 personas, una de ellas de 13 años. El viejo hogar, quasi boca abierta, esta situación evidencia la dualidad entre el colectivo afectado a ciertos sectores y permitió la violencia de los vecinos, que han luchado por defender sus vidas. En el marco del proyecto "El Barrio, el futuro", se están planeando cambios, siendo el más alto reto el de transformar el tejido con la integración de nuevos espacios para vivir.

A pesar de y debido al escaso panorama arriba descrito, es notable la presencia de espacios culturales, sociales y comunitarios, de estudiantes y docentes, de trabajadores y militantes, quienes, junto a una comunidad solidaria y alerta, se alinean para pensar y actuar puntos transformadores desde la autogestión comunitaria y el trabajo en m.
In August 2014, the national government of Chile in cooperation with the municipality of Valparaíso has published three reports on the proposed reconstruction plan of the entire city. The approach is subdivided into three scales of interventions; the city; the community; and the neighbourhood scale.

Below you find an overview of the most important targets which have been based on these three reports. An additional source of information has been the recent release by the municipality of an international design competition of the revival of “Ascensor Las Canas”. This elevator is located in line with the design location. On the next pages you will find an overview of the numerous opportunities for the specific design location which will form the focal points for the design process.

- **Connectivity and mobility** | restoration of funiculars, new modes of transport, expansion of public transport routes, expansion of Avenida Alemania (Plan de Inversion, 2015, p.24)

- **Supply of basic services** | proper sewage, drainage, health infrastructure, potable water and garbage collection (Plan municipal, 2015, p.26)

- **Rehabilitation of the creek** | environmental restoration (Plan Cerro, 2015, p.10)

- **Natural viewpoint walks** | promoting natural condition, preventing degradation caused by landfills, introducing public space with benches, lighting, small businesses and access to creek (Plan municipal, 2015, p.29)

- **Public space and equipment** | local projects, recreational, cultural and sport facilities, improvement of pedestrian evacuation routes (Plan de Inversion, 2015, p.32)

- **Environmental conditions and security** | environmental education, forest plan treatment and response fire safety (Plan municipal, 2015, p.68)
The issue is not solely that of risk reduction measurements, it is through building resilience that we can integrate these communities within the larger context of the city of Valparaiso.

**Diagnosis**

**Problem**
- mainly residential area
- no opportunity space
- exclusion from inner city
- vulnerable to hazards

**Potential**
- good level of accessibility
- provision of opportunities
- integration formal city
- resilient to future hazards
Opportunity at neighbourhood scale

Every hill is known to have strong social structures within the communities. Due to the lack of proper infrastructure, many families have joined together to lessen the amount of times needed to go down to the city centre to buy groceries.

It is important to include the local community in the decision making process of transforming their neighbourhood. It is likely that when the municipality is focusing on improvements of social and physical infrastructure, the expansion of public transport networks and generation space for recreational, cultural and sportive use, the dwellings show incremental and sustainable growth over time.

50% of the affected residents are economically inactive, still attend school or are in need of preschool education. This age group is in need of outdoor space, both for recreational use as well as to continue their studies. Based on interviews with local students, it was found that study space and access to educational resources is limited in their own homes and their are in need of public space close to home to make their homework.

Preschooling up to the age of 5 is free in Chile. However, the amount of kindergartens within a close diameter of this area is limited. Many mothers need to travel a long distance to take their children to a daycare. They are either forced to give up their work or in some case leave their toddlers unattended at home. Data shows that this area is in need of children day care centre and a public building like a library for students to continue their study.
By using the slope as an asset, it can become a useful element within an architectural design. The rocky ground below only one or two metres of sediment can provide for stable constructions. The upper part of Valparaíso is set on the Cordillera de la Costa, which runs parallel with the Andes mountain range. These are layers of sea sediment composed of calcium carbonate. This calcareous rock type can be used as an asset within the formation of a design proposal.

The design location runs over a stream, which has been neglected over the past decades causing numerous problems. An artificial pipe runs down to deposit the rainwater to the sea. Due to the illegal waste disposal, it has become flooded several times causing the creek to be in a deteriorated state. One of the objectives of the municipality is to recover these creeks and transform them into public hubs for the local people. Through the integration of an attractive pedestrian route that runs down to the city centre, this creek could possibly be revitalized into a public park in which the local people are responsible for the maintenance.

A new construction material that replaces the construction of wood can minimize the rapid spread of a fire. Béton brut is roughly-finished concrete after pouring and left visually exposed. This type of construction and finishing is quite popular in Chile. It is therefore much more affordable than any other materials, picking up on local expertise, making it more affordable. Cement is also widely available in Chile.
The ten steps for in-situ settlement upgrading
(Author, 2014)
This chapter introduces the design proposal of a Parque Los Chonos. This design includes a children day care centre, a public library with a mediatheque, study area and a small coffee shop. Lastly, the design is situated between newly formed public space, a large square which can be multifunctionally used. On a week day it can function as a market place where groceries are sold, and on other days, the community can gather to enjoy cultural activities. The design is mainly shown through illustrations and diagrams.
The design process has been gathered in a sketchbook attached to this paper. The sketches are not sorted per specific design element or scale, but through time.
Picture of the booklet!
sketchbook
08 Design proposal
drawing of impression design
Stedenbouwkundig masterplan
opzet ontwerp
a la big
diagrammen
plattegronden
plattegronden
doorsnede over A3 breedte
gevels
impressies
Details
Details
The ten steps for in-situ settlement upgrading
(Author, 2014)
This chapter evaluates the design proposal of a Parque Los Chonos. It will give concluding remarks concerning the research and design questions. It will also give several recommendations either on the design process or of specific element within the design. Lastly, it will seek for a level of replicability in order to justify whether the strategic approach is suitable for other in situ settlement upgrading elsewhere in the world.
Conclusions


Gob (2014), ‘Plan de Inversiones, reconstrucccion y rehabilitacion urbana’, (Valparaiso), 44.

Hondius, Jodocus (1635), ‘Freti Magellanici ac novi freti vulgo Le Maire exactissima delineatio’, (Cartografía magallánica).


Olds, Harry Grant (1900), ‘bahia de Valparaiso ca. 1900’, in articles-67772thumbnail.jpg (ed.), (700 × 550; Valparaiso: Museo Histórico Nacional).


Appendices

Facade of the Cultural Centre Ex-Carcel in Valparaiso (Author, 2014)
### Acronyms & Abbreviations

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<th>Acronym</th>
<th>Full Form</th>
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<td>Instituto Nacional de Estadísticas</td>
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<tr>
<td>MDS</td>
<td>Ministerio de Desarrollo Social</td>
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<td>MVU</td>
<td>Ministerio de Vivienda y Urbanismo</td>
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<td>Secretarios Regionales Ministeriales</td>
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<td>UNFPA</td>
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<td>UN Habitat</td>
<td>United Nations Human Settlement Program (former UNCHR)</td>
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<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
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### Appendix A | Regional average monthly income

#### CASEN 2011

**Límites mínimos y máximos del ingreso autónomo per cápita del hogar que definen cada uno de los quintiles por quintil de ingreso autónomo per cápita(1) del hogar regional y nacional según región, zona y quintil(2)**

*(INGRESO EN PESOS DE NOVIEMBRE DE 2011)*

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<th>Población</th>
<th>Promedio de personas en el Hogar</th>
<th>Promedio Ingreso Autónomo Hogar</th>
<th>Ingreso autónomo per cápita del hogar</th>
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Notice: these numbers are based on the Valparaiso region, which holds a population 1,752,453 while Valparaiso city has roughly 300,000 residents.

### CASEN 2011

**Composición de los ingresos de los hogares por quintil de ingreso autónomo per cápita del hogar regional y nacional (INGRESO EN PESOS DE NOVIEMBRE DE 2011)**

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Notice: these numbers are based on the Valparaiso region, which holds a population 1,752,453 while Valparaiso city has roughly 300,000 residents.
### CASEN 2011

**SITUACIÓN DE POBREZA A NIVEL DE PERSONAS POR ZONA, SEGÚN REGIÓN**

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<td>82.5</td>
<td>100.0</td>
</tr>
<tr>
<td>Arica y Parinacota</td>
<td>2.1</td>
<td>13.6</td>
<td>84.3</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2.8</strong></td>
<td><strong>11.7</strong></td>
<td><strong>85.6</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

1 Se excluye servicio doméstico puertas adentro y su núcleo familiar. Los resultados se obtienen utilizando factor de expansión expr_r2.

Nota: Para evaluar la precisión de las estimaciones se recomienda, entre otros, considerar el número de casos en cada celda.

Estimaciones en base a celdas con más casos tienen

**Fuente:** Encuesta Casen 2011, Submuestra Noviembre 2011-Enero 2012, Observatorio Social, Ministerio de Desarrollo Social.
Objetivos del Plan de Reconstrucción
*Objectives for the Reconstruction Plan*

La Municipalidad de Valparaíso en conjunto con el Grupo Técnico Asesor (GTA) propusieron los siguientes objetivos:

Reconstruir la zona afectada por el incendio definiendo como escalas territoriales de acción La Ciudad, El Barrio y Las Viviendas
*Rebuild the affected area caused by the fire according to territorial scales of action; The city, The neighbourhood and the housing.*

Valorizar el tejido social y el sentido de pertenencia e identidad cultural de la comunidad que habita la zona siniestrada.
*Value the social fabric and sense of belonging and cultural identity of the community that live within the affected zone.*

Reducir el riesgo de desastres naturales y humanos futuros desarrollando estrategias de manejo y prevención atendiendo a las particulares condiciones socioculturales, ambientales y territoriales de Valparaíso.
*Reduce the risk of future natural and human disasters through the development of sociocultural, environmental and territorial strategies within Valparaíso.*

Promover alianzas y diálogos entre la institucionalidad pública local, la ciudadanía, la academia y el sector privado para desarrollar iniciativas de reconstrucción del área siniestrada y el mejoramiento integral de la ciudad.
*Promote partnerships and dialogues between institutions, local governance, citizens, the academic world and the private sector to develop initiatives to rebuild the affected areas and the overall improvement of the city.*
Impulsar una planificación urbana integral y eficiente que utilice la innovación y el mejoramiento de la calidad de vida de los habitantes de la ciudad como orientación principal. 
*To promote a comprehensive and efficient urban planning that focuses mainly on innovation and quality improvement of the life of the local dwellers.*

Abarcar obras emblemáticas de recuperación en el sector del Almendral
*To encompass emblematic works of recovery and the Almendral industry*

El fortalecimiento de la municipalidad, como organismo administrador local.
*Strengthening the municipality, as the local administrator*

For more information, please refer to the electronic document *Plan Municipal Valparaiso*, SECPLA