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Who Has Benefited? A Socio-Ecological Chronology of Urban Resilience in the Early Reconstruction of Talca after the 27-F Earthquake, Chile 2010–2012

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Abstract: This article engages in the understanding of resilience from the perspective of socio-ecological systems (SES) and the reconstitution of events of recovery and reconstruction in the city of Talca after the 27-F earthquake in Chile, between 2010 and 2012. For such purposes, we have developed a chronological or timeline-analysis model. This methodology, which uses mostly ethnographic and participant-observation techniques to recapitulate these events, observes the interaction of social agents, elements of the built environment, government institutions, and other institutional functions of the urban domain within the socio-ecological panarchy. The results suggest that key events, such as local government institutional actions, the observation of probable property speculation events, and community agency efforts dismissal, among other factors, could alter both human and natural resilience processes. In turn, this could affect the capacity of this city, its inhabitants, and its social institutions to endure future crises, as a product of deteriorated and maladaptive resilience mechanisms, aside from the natural and geographical conditions of Chile, exposed to future earthquake events. Likewise, the partial loss of the civic environment in this historic city and weakened neighborhood networks, contrasting with the redevelopment of real estate in central areas, altogether portray considerable risks with regard to the (un)generated social mechanisms of resilience, affecting future developments. The final section focuses on discussing these findings and their relevance in integrating a coherent understanding of SES resilience in urban planning and governance practice, especially in cities or urban areas that are prone to natural risks or catastrophes.



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Keywords: urban resilience; socio-ecological theory; reconstruction

1. Introduction

On 27 February 2010, an earthquake of great magnitude hit various cities in Chile. The city of Talca was among the most damaged areas. It was however one of the earliest cases to develop a response to the disaster. Nevertheless, once the official reconstruction program took place, conflicts quickly arose between social collectives, government institutions, and other private and real estate stakeholders in the city. Many of these struggles were related to the displacement of residents from the city's centric (and oldest) districts, along with several real estate (de)regulations and the generation of urban sprawl. However, Talca is not alone in such matters. These issues are seemingly common as the result of other reconstruction programs in Latin America—often involving top-down rather than bottom-up strategies. Historic neighborhoods such as Managua in Nicaragua, Armenia in Colombia, or Mexico D.F. in México have also experienced the displacement of vulnerable communities and the perception of inadequate institutional actions. On the other hand, natural hazards such as earthquakes, tsunamis, or landslides, as registered in Chile and other global seismic territories within the “Pacific Fire Belt”, are unpredictable yet recurrent in time. The

ongoing development of these events throughout the years has been a problematic factor for establishing post-disaster strategies. As a result, such strategies end up as temporary solutions that amount to decades-long processes, or else providing transitional responses that finish as permanent modifications [1].

Now, 11 years ahead, many of the problems left by this massive earthquake and the city's subsequent reconstruction process persist. The particularities of the Talca case also require attention. Its reconstruction process was characterized by the existence of different (top-down) institutional plans, built on public–private partnerships and changing urban planning regulations. There was also the struggle of (bottom-up) vulnerable neighbors and communities to keep up with the transformed built and social structure of the intervened old city quarters. These issues now coexist with other recent crises, such as the 18-O social revolts [2] and the COVID-19 pandemic.

Hitherto, the constant deterioration of the city—with crumbling and abandoned buildings in sight—has kept the public opinion alert. In this context, the term resilience has become a recurrent object of discussion, widely used by politicians, public figures, and local academic circles. It is therefore relevant to state the following questions: (1) what can be understood from (urban) resilience considering the particularities of this case?; (2) why it is necessary to speak in terms of resilience?; and (3) what difference it would make to engage in a meaningful definition of this concept and its further utilities? Talca is a relevant case study in these respects. Concordantly, this research seeks to place an understanding of these social and institutional dynamics in terms of a revised notion of urban resilience.

The article is structured in four sections following this introduction. First, there is a revision of theory on urban resilience in the context of post-disaster recovery and reconstruction. Our literature review pays special attention to the description of resilience as a co-evolutionary mechanism of socio-ecological systems (SESs), mainly involving adaptive cycles and panarchy models. Socio-ecological contributions on urban resilience provide a sounding theoretical basis to develop assessment methodologies. Further on, in the methodology section, we present our chronological or timeline analysis model, also referred to the understanding of resilience as an evolutionary mechanism of socio-ecological systems. Our model consists of a reconstitution of recovery and reconstruction events in the Talca case study, using mostly ethnographic and participant-observation techniques. The purpose of this chronological analysis model was to explore and identify the social constituents and effects of urban resilience from a SES perspective. The results section includes the recapitulation of key events such as local government institutional actions, the observation of probable property speculation events, and community agency, between 2010 and 2012. The final conclusions section is led by a discussion on the conflicts of institutional inter-organizations, the stagnation of neighborhood organizations, their efforts to overcome the crisis, and the potential polarization of communities in Talca.

1.1. Theory on Urban Resilience in the Context of Post-Disaster Recovery and Reconstruction

Resilience is a term that has gained considerable attention across various fields during the last decades. Within the urban planning and design groups, the fixed term “urban resilience” has been used for reflecting on processes of recovery and reconstruction [3], addressing the social and physical impacts of natural and/or human disasters [4–6]. However, the late assimilation of this concept has not been exempted from misconceptions, confusing approaches, or else oversimplified descriptions [7,8], resulting in skepticism of this new buzzword in the field [9].

To overcome these definition conflicts, it is crucial to address the main influencing metaphors of resilience, found in two disciplinary groups: engineering and the evolutionary-ecology field [10–12].

From an engineering perspective, resilience is understood as the capacity of an object to bounce back to its original state or form after bearing a shock. Yet in the ecology field, resilience constitutes the evolutionary mechanism of interactive socio-ecological systems—systems of nature along with human activity. Interestingly, this definition has led to various

efforts to integrate socio-ecological perspectives with urban studies, considering extensive literature reviews on the matter [13], the analysis of shared dynamics of natural and human domains [14,15], and the incorporation of urban elements as part the evolutionary behavior of an ecosystem in general [16–20]. The use of the SESs resilience concept has dominated these theoretic and epistemological efforts, practically dismissing the former engineering perspective.

First observed in natural ecosystems and later integrating the social component, the constituents of such systems are prompted to constant adaptations and transformations—a dynamic cycle of multiple actions and responses, seeking stability and, ultimately, survival [12]. Whenever these systems face stressful events or shocks that may alter their regular activities, resilience mechanisms are triggered to swiftly regain stability or else transform the system. Sometimes, these occur through catastrophic events, which may lead to an abrupt transformation of the system or even its extinction [12,21,22]. Therefore, resilience is part of the adaptive capacity of a system, to maintain itself and keep going, pursuing stability thresholds but not necessarily achieving equilibrium [11,20]. This metaphor of resilience also crosses multiple levels, such as the capacity of individuals, communities, and natural or human resources available, with the vision of the whole system on top [21]. Accordingly, the resilience of a system is built upon the characteristics of its constituents and their potentials, connectedness, and adaptability. Under this perspective, resilience is by no means an isolated mechanism that guarantees the return to a previous stable condition, as in the engineering conception [9,23].

Hitherto, the evolutionary-ecology perspective would be coherent considering a discourse of cities as complex socio-ecological systems. This has evolved into various theories that integrate urban landscapes as part of ecosystems [24,25], and human behavior as a determinant field of study for the application of both resilient and sustainable futures in planning practice [26,27]. These visions altogether distinguish the different components and entities that conform urban environments whilst recognizing constant processes of adaptation and transformability, also with thought given to resilience cycles [17,28,29]. Accordingly, the urban condition may be defined by the context of a built environment, including the geography of its territory, the construction of homes, social institutions, the rule of law, and a series of cultural and abstract elements that shape the complex notion of what makes a place urban. In this sense, the urban condition in socio-ecological systems could be considered a parsed dominion of both natural and human components [30]. However, it is the human component behind urban systems that mainly characterizes behavior in these environments [30,31]. It is not enough to discuss urban resilience as a matter of resilience of cities or urban environments; instead, we must question ourselves on the understanding of resilience on disaggregated levels and entities within both the urban and the social-ecological system [13].

A meaningful parallel to address the latter is found in the work of Campanella [32]. Although his reflections on the recovery and reconstruction of New Orleans in 2005 do not necessarily refer to the principles of evolutionary theory on resilience, Campanella provides a thoughtful perspective on urban resilience and its social dimension by stating that “(a) city is only as resilient as its citizens. Resilient citizens have enabled urban resilience throughout history” [32] (p. 143). In his view, reconstructing the physical infrastructure must go hand in hand with safeguarding and reassembling the social fabric—urban built areas characterized by cultural and economic dynamics that resemble and gather their inhabiting communities. Urban renewal processes that neglect these matters may generate situations of potential conflict that endanger the socio-spatial stability of a city, its civic functioning, and its further capacity to withstand other events—whether these are natural or human disasters (such as earthquakes, hurricanes, or terrorist attacks).

By stating that resilience is part of the adaptive capacity of a city to stabilize or (re)transform throughout recovery and reconstruction, it should be then noted that not all forms of resilience may be desirable [20]—and certainly not when resilience is built at the expense of vulnerable communities [33–35]. Moreover, the process of adaptation

or transformation of a city, after bearing a large-scale catastrophe, is subject to a series of cross-scale events (or aftershocks), pursuing different and disaggregated processes of urban resilience. Likewise, changes occurring at the neighborhood-level, regarding social displacements, economic pressures, exclusion-related phenomena, in general and revolts could be connected to different patterns of resilience behavior, across social, ecological, spatial, and temporal indicators [36,37].

To a great extent, the SES perspective may be useful for representing these iterative and cyclical stages of disaster impact, recovery, and reconstruction [38–40]. However, several theoretical adaptation issues and challenges must be considered. There is, for instance, the notion of co-dependency and co-evolutionary behavior of the social domain with nature, regarding geographical conditions, the exploitation of resources, the development of economic systems, and the creation of social environments as a result from these interlinked processes, which may range from small rural agricultural communities to larger urban systems such as metropolitan areas (and the intricate relationship of more refined processes as technological production, and so on).

Yet more specifically, there is still little that is known in terms of the empirical assessment of the social dimension of resilience and how these mechanisms transform the very same conditions of urban life and socio-spatial phenomena in recovery and reconstruction contexts [37,41]. As a matter of fact, the exploration of the diverse aspects of urban resilience under the socio-ecological perspective has been focused mainly on the actions of humans and their impact over nature, as in climate change studies: see for instance [42,43]. However, contextual evidence on specific agency factors affecting exclusively human-social domains in urban territories is yet to be thoroughly explored [44].

1.2. Adaptive Cycles and Panarchy Models for Interpreting Urban Resilience

In engaging the work of evolutionary ecologists, resilience mechanisms can be better explained under the adaptive-cycle and panarchy models: a non-linear heuristic framework used to describe the evolutionary behavior of diverse entities and groups within natural or social systems, recognizing distinct stages of transformative behavior [13,45]. Figure 1 synthesizes the main notions of the adaptive cycle, panarchy, and resilience mechanism altogether.

The adaptive cycle, in summary, is a model that consists of four stages, representing external impacts and transformable behavior: conservation (K), release or shock (Ω), reorganization (α), and exploitation (r). First, the conservation stage (K) is characterized by the stability of the system and its ability to generate and store various resources, among other regular maintenance tasks. During the release or terminal phase (Ω), the system may enter to a point of collapse. At this point, previously accumulated resources are released to withstand the shock. This process is also known as “creative destruction” [15], due to the multiplicity of decisions that will be taken in order to ensure new stability thresholds and the imminent reconfiguration of the whole system in the midst of a crisis [15], taking us to the reorganization phase (α). Afterwards, the adaptive cycle will enter a growth or exploitation stage (r), where the system regains control over the production and (re)accumulation of resources, which may once again enter the omega phase and repeat the cycle.

Resilience is a mechanism represented throughout adaptive cycles. More specifically, resilience is known as a process of transferable behavior [12,21,45], triggered right after an initial shock or release (Ω), accelerating in pace towards the next stage of reorganization (α)—the point of greatest uncertainty and highest level of resilience [17]. The capacity to withstand a shock, reorganize, and regain control (and further learn from such processes) constitutes an evolving curve under this model of evolutionary behavior.

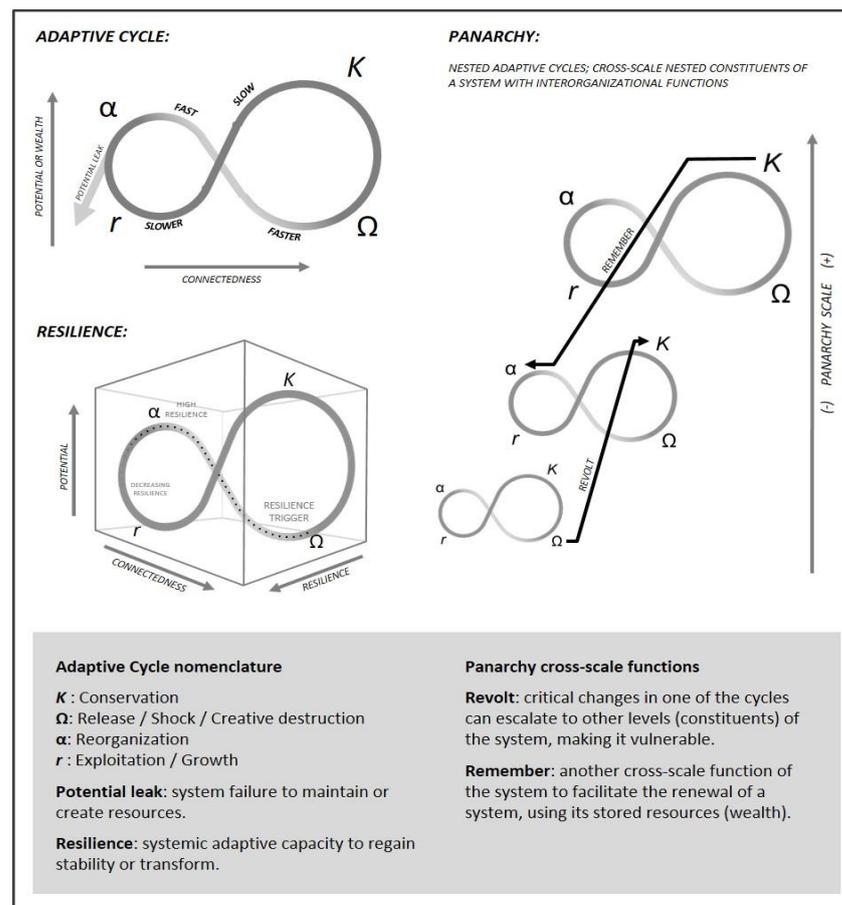


Figure 1. Description of the main components of an adaptive cycle and a panarchy. Omega events (Ω) may escalate throughout the different levels of the panarchy. Once resilience mechanisms are triggered throughout a panarchy, the remember function will cross over the different adaptive cycle niches to aid in the reorganization stage (α), by providing previous knowledge that could lead the system to enhance its responses, leading the way to new paths of growth (r). Source: author's elaboration producing a synthesis of figures and interpretations from various sources [9–11,20,21,45].

Also concerning resilience cycles, the course between the reorganization (α) and growth (r) stages poses several other challenges. It is a point where a system and/or its constituents can learn (or not) from their resilience experiences. Less organized systems are affected by potential leaks—the loss of resources, opportunities, and capacity to ensure wealth in the coming stages of conservation in socio-ecological systems (future K or K_2) [21].

When an adaptive cycle is subjected to potential leaks in its α -to- r course, the regular pathway of resilience as a mechanism to regain stability is altered, with iterative transformations that may generate less organized conditions, hampering future conservation stages (K_2), hence affecting the system's capacity to generate and store resources or useful assets and capital needed to tolerate future destabilizing events. Thus, adaptive cycles may represent regular and contradictory patterns of behavior, of groups or individuals within a system—these being flexible, efficient, constitutive, transformational, connected, adaptable, and so on [9,21].

Moreover, multiple adaptive cycles conform nested arrays of entities, portraying the relations between the constituents of a system and their dynamic functions, together conforming the notion of panarchy—"interlinked (and) never-ending adaptive cycles of growth, accumulation, restructuring, and renewal" [45] (p. 392). In other words, it is possible to speak of the notion of panarchy as a scalar relation of various adaptive cycles—or else, the notion of the "system as a whole" seen from its multiple components and entities working together.

In a panarchy, some adaptive cycles may contribute to the critical functions of a system, while others may influence the behavior of critical niches. Think for instance of social-revolts, from burgeoning grassroots that finally escalate to governance spheres, followed by the changing of the structure of societal organization and finally the restructuring of the conditions of the economy and/or democracy (for instance). Consequently, a panarchy (or total system) collapse may occur when adaptive cycles that hold a critical role in the system become maladaptive [45], escalating through revolt and remember functions as shown in Figure 1. The resilience cycle—from Ω to r —may end in the re-establishment of many of the previous stability thresholds, or else abruptly transform the system in a new one or contribute to its degradation.

1.3. Adaptation and Identification of Social Components in the SES Theoretical Model

The urban dimension from the SES perspective is recognized as a primarily social and human-dominated portion of a system [28]. This, in consideration of the aforementioned model, could be seen as a conglomeration of human-origin adaptive cycles, which could represent agency factors, institutionalization, governance, the conformation of assets and capital, and so forth [46].

The social components of urban resilience [47] can be framed in the adaptive cycle model, recognizing a stage of triggering resilience (Ω), high resilience (α), and decreasing resilience (r). This suggests a focus on networking social entities and their agency, ranging from urban dwellers and their organized community actions, scaling throughout other more complex institutions of government and economic activity [48], which would finally contribute in shaping the built environment and rising the concept of resilience in territorial governance [49] (Figure 2).

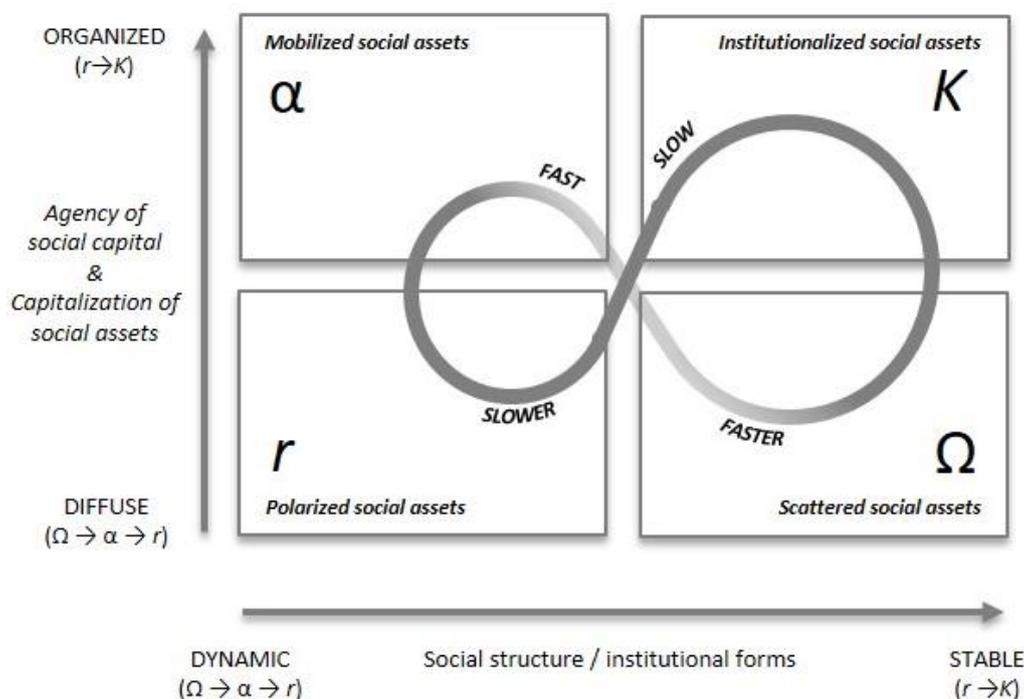


Figure 2. A model of interactions of social assets and the conformation of social capital. The figure represents an adjustment of an adaptive cycle model to reflect on the behavior of social networks within socio-ecological systems [48]. Source: author's elaboration adapted from the original schemes by [25,46].

A triggering event such as an earthquake (Ω) may disrupt the social network stability (previous K), scattering social assets among the affected stakeholders. Towards the reorganization stage (α), the mobilization of social assets may result in emergent properties from existing stakeholders as well as the rise of new groups and actions to deal with the

(post)catastrophe situation. In the following growth (r) stage, existent or emergent social assets may be maintained, transformed, or else disappear while the system builds a path towards a new conservation stage (K_2). Therefore, social assets may appear as polarized forces to either regain lost social stability or build new social arrangements, before they appear as institutionalized assets and capitals (at the next K stage).

In this model, recovery and reconstruction procedures following a shock are not framed in predetermined temporal margins, yet are defined within the same resilience cycle, mainly developing throughout the reorganization (α) and growth (r) course. Once the resilience cycle closes, the model hypothetically transitions to a new conservation stage (K or K_2), expecting the conclusion of recovery and reconstruction events. Table 1 highlights the main components that define our interpreted notion of the social dimension in urban resilience.

Table 1. Framework of urban stakeholders and social assets in recovery and reconstruction for assessing the social dimension of urban resilience. Source: author's elaboration based on [48–50].

Post-Disaster Recovery & Reconstruction Scenario Socially Performed Urban Resilience ($\Omega \rightarrow \alpha \rightarrow r$)		
Urban Stakeholders	Interactive Social Assets in Network Relations	Recovery & Reconstruction ($\Omega \rightarrow \alpha \rightarrow r \rightarrow K$)
Official government agents and local regulatory institutions	Collective actions and information share [49]	Expected multi-level and interorganizational governance [50]
Community organizations or institutions	Capacity to communicate Capacity to organize Capacity to instruct Capacity to execute	Capitalization of social assets as recovery and reconstruction responsive actions

As interpreted from Figure 2 and Table 1, the evolutionary behavior of social components in the adaptive cycle model also recognizes different stages of network dynamics. Complementary to this, Adger [48] suggests assessing these in terms of networking and highly dynamic interactions, as expected in the resilience cycle (Ω to later α or early r stage), or else bounded relations as in the final growth and conservation stages (final r to new K stage). The loss or gain of social cohesion and organization capacities in these respects should consider a close observation on the role of decision-making, which involves the agency of urban stakeholders and their actions in terms of defining agreements or governance.

Understanding how transformative, adaptive, and maladaptive behaviors affect the very same conditions of social entities could help us later understand how desired or undesired thresholds of urban resilience escalate to other levels in the socio-ecological panarchy. Urban phenomena such as post-disaster fragmentation and segregation, for instance, may drive urban systems to adopt undesirable evolutionary patterns as sprawl or pollution, which may escalate to damages to the natural ecosystem components within the socio-ecological panarchy [51–54].

2. Methods and Materials

SES Chronological Analysis Adaptation—Timeline Analysis Model

Evolutionary behavior, as presented by the aforementioned SES model of adaptive cycles and panarchy, may occur on variable timespans. However, the timeline set by the “ K - Ω - α - r ” course is not determined to fixed intervals, considering its holistic notion of time. Yet, as purposeful as this holistic notion may be for exploring theoretical builds [55], it could become more challenging to grasp indicators of longitudinal and spatial control—especially when it comes to assessing portions of a vast ecosystem of both human and natural origins. More specifically in the case of the urban domain as mentioned earlier, the study of social components requires a revision of the adequate timespans that correspond

to the networking social components in our case study, required for the reliability and replicability of our longitudinal case study [56].

In short, the method is set on a timeline or chronological analysis model, where the K - Ω - α - r phases are identified as categories of temporal evolution, becoming our main categories to situate and assess recapitulated events that relate to decision-making and agency. In other words, this model allows the positioning of blocks of data regarding the recovery events in target, within the transformative behavior sequence (K - Ω - α - r), represented as a timeline, which in our case study occur during the first and second years of the reconstruction process. This specific time-universe span observes the rather quick enactment of the official reconstruction program, the rapid and visible changes in the built urban environment, and changes in the regulatory landscape.

Timeline research models or methodologies are not a common venture in urban resilience studies. In fact, our main references regarding the use of such techniques belong to the studies of information science, nursing, psychology, and other fields which present these instruments as longitudinal qualitative methodologies [57,58].

The empirical data in the following section consist of our own reconstitution of recovery and reconstruction events from early 2010 to late 2012 using ethnographic and participant-observation techniques [59,60], corresponding to the empirical research and main findings of the Fondecyt project, N°11140181, sponsored by the “Agencia Nacional de Investigación y Desarrollo (Ex CONICYT)”. For the sake of capturing these events in an objective way, this body of data is also triangulated with other local research and press sources published on the same time period and context of the case. Likewise, the portrayal of these events is based on descriptive and process coding techniques of qualitative analysis [61], identifying urban stakeholders and interactions in the form of social and/or institutional agency and decision-making. The results are later presented in terms of social cohesion and organization.

Another purpose of this particular research model is to capture the multiple networking relationships of the diverse entities that took part in this reconstruction process and their consequences. It is expected that these notions may help us to increase an understanding of the involved entities which are both assets and capitals that interacts in the form of organizations of people and institutions. Moreover, we intend to recreate the conditions of the enactment of resilience—at the observed Ω - α phases—and the enhancement, debilitation, or re-creation of the resilience mechanism to sustain (or not) future crises (Ω)—at the observed α - r phases, developing a new conservation (K_2) stage.

To facilitate the interpretation of the analysis, a graphic timeline of these findings is presented, including the stages of triggering resilience (Ω), high resilience (α), and decreasing resilience (r), indicating past and future stages of conservation (K_1 and K_2).

3. Results and Discussion

On 27 February 2010, Talca was hit by an 8.8 Richter-scale earthquake, the most destructive disaster in its modern history. Before the earthquake (K_1 in Figure 3), Talca’s central areas were known for their socio-economic and cultural diversity [62]. Many of the families that lived in the city center were also long-time residents, who inherited the large-sized adobe houses and urban life traditions from their ancestors, who came to settle between 1950 and 1970, under different socio-economic circumstances. In the coming decades, most of these houses would be used for local services and minor workshops, with saddlers, seamstresses, and other merchants doing their businesses, also renting rooms to students in some cases. Thus, even just before 2010, social networks in the older inner-city neighborhoods were characterized by these conditions, which allowed a relatively stable life for less affluent families—in most cases free from mortgage debts.

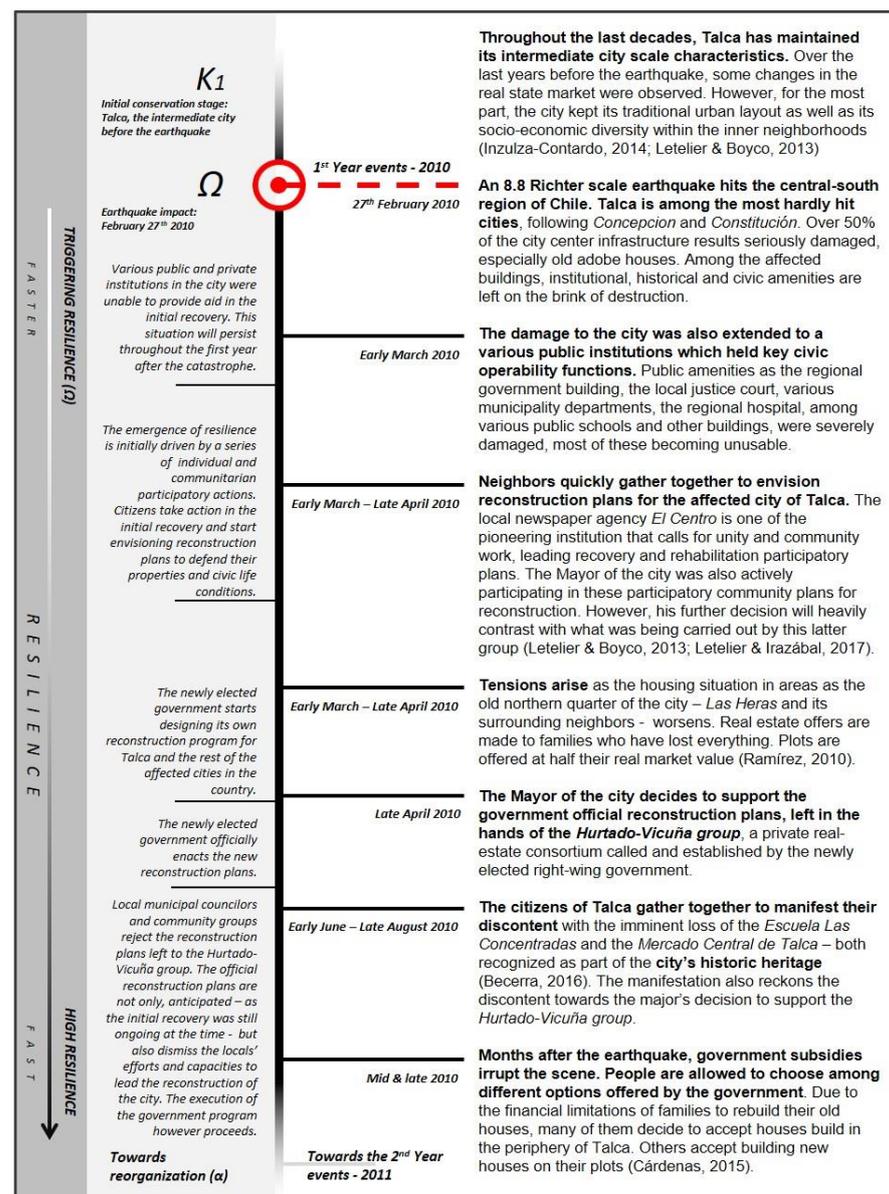


Figure 3. A timeline-analysis model of the post-earthquake Talca. Events of the first year, mobilized and networking social assets. The first-year actions are characterized by the contrast between official government, the diminished presence of local regulatory institutions, and the emergence of collective reconstruction plans outlined by highly organized neighbors. Source: author's elaboration.

Nevertheless, Talca's historic center was already undergoing a complex process of decay right before the 27-F earthquake. The fabric of its commerce, culture, and services was showing signs of deterioration. On the other hand, the regeneration of these urban amenities and the peripheral sprawl of the city had been showing burgeoning signs of new urban transformations to come, yet incipient at the time. In parallel, urban regeneration subsidies were also an active institutional mechanism at the time, endorsed by the local Municipality and the Ministry of Housing and Urbanism (original acronym MINVU) to tackle the perceived decline of the city.

3.1. First and Second Year Events: The Emergence of Collective Reconstruction Plans

After the impact (Ω in Figure 3) over 70% of the infrastructure in the city center was affected. The earthquake event also coincided with the last days of the summer holiday season. By March 2010, the city would already start its regular activities once again. Yet as

expected, most of these were interrupted. The destruction of adobe houses were among the most iconic pictures of the earthquake impact (constituting our first observed events in the timeline graph in Figure 3).

These dwellings coexisted with other important social and civic institutions, also showing patterns of commercial and cultural diversity [63]. Most of these buildings were left on the brink of destruction, like the main regional hospital, historic schools, the regional government building and the local court of justice, plus most of the commercial and other tertiary activities located in central areas.

The alteration of Talca's historic center, which held the main urban amenities—and still does nowadays—had a profound effect on the city's civic livelihood. Not only were people's daily lives shattered, but also a great deal of institutions that would safeguard civic affairs at the time were severely damaged too.

However, weeks after the impact, and although much of the civic institutions of the city were affected, people started to organize a response to the disaster. The neighbors of Talca sought to reunite as an active community and regain confidence among themselves [63,64]. Reports of fellow citizen meetings carried by the local newspaper "El Centro" remain as evidence of this quick agency move. The Mayor of the city, municipality councilors, and the National Union of Architects answered the call as well. These emergent actors and institutions quickly organized and envisioned their own reconstruction plans (see the events from early March to late April in Figure 3).

Furthermore, a no lesser event would follow these efforts: the establishment of the newly elected national government in March 2010 [65]. The reconstruction plans of the new political coalition included the participation of multiple private groups with well-known careers in the real-estate business. In the case of Talca, it was the Hurtado Vicuña group who answered the call, sponsored by the Ministry of Housing and Urbanism (MINVU). After two months of communitarian work—considered here as an important event with regard to the mobilization of social assets in the early phase of triggering resilience (Ω) and the subsequent reorganization stage (α)—the Mayor instituted the Hurtado Vicuña group as the new unit in charge of Talca's reconstruction [66–68].

The announcement was received with skepticism from the community-led reconstruction group and especially from those who had lost their homes in the old city center. Many people already felt the pressure from real-estate groups who were offering to purchase damaged or demolished adobe houses for half their value [67]. Municipal councilors also rejected the new measure, calling for a reconsideration of the plans they had made with locals [62,68]. These were the first signs of fracture among the urban stakeholders in the process of reconstruction, conditioning much of the inter-organizational conflicts that would characterize the reorganization stage (α), as seen in the last events observed in Figure 3.

Just before the end of the first year, housing recovery subsidies irrupted in the scene, setting the character of most of the reconstruction process that would follow (see the first events in Figure 4). People were allowed to choose between different subsidy options offered by the government. Since these subsidies would partially finance the process of housing recovery and reconstruction—if we consider the important financial limitations of the affected neighbors to rebuild their homes—a considerable number of 500 residents accepted being transferred to new dwellings built in the (new) periphery of Talca [64–71]. Others instead accepted the building of new houses in their centric plots, yet at a fraction of their original size and with an alleged inferior construction quality. Throughout the second year, the irruption of more subsidies for housing recovery and reconstruction would mark the beginning of profound socio-spatial transformations in the older city core, as found in the neighborhood of Las Heras, located in the historic northern quarter of the city [70].

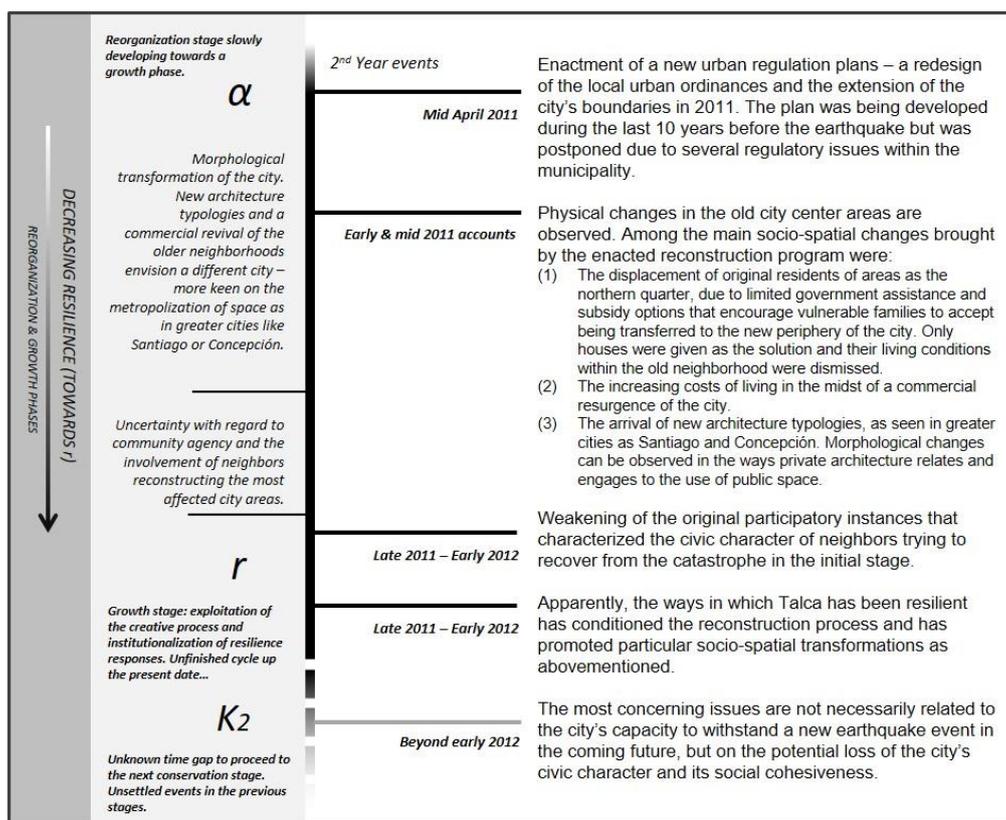


Figure 4. A timeline- analysis model of post-earthquake Talca. Events of the second year are characterized by the institutionalization of government reconstruction plans and a sustained loss of communitarian agency, regarded as a social inter-organizational issue. Source: author's elaboration.

Later on, the construction of basic dwellings at the periphery of the city and the displacement of neighbors from their original homes in the city center would contrast with the construction of new multi-story private housing projects, rapidly replacing the wrecked adobe houses. These changes also came along with the arrival of new commercial typologies that had an impact on the perception of public spaces [71].

Additionally, a new regulatory masterplan in the city of Talca—a plan that took almost 10 years to develop due to several issues concerning its regulation—was quickly deployed in late 2011, allowing the peripheral expansion of the city to double its size, facilitating the sprawl phenomenon [72]. Meanwhile, the actively organized groups that envisioned their own reconstruction plans were frustrated and confused with the subsidies-based housing reconstruction process offered by the state, which proceeded on its own terms (towards *r* in Figure 4).

In summary, the phase of reconstruction until the end of the second year (from *α* to *r* in Figure 4) showed dissimilar stages of progress, in terms of rehabilitating the livelihood of areas such as the historic neighborhoods and the increasing residential sprawl found in the new peripheries of Talca [69].

3.2. Polarization in the Context of Reconstruction

Scattered, mobilized, and polarized social assets can be identified in the reconstitution of the events of the first two years after the 27-F earthquake. Figure 5 is a scheme of the evolutionary trajectory of the interactions of the identified assets. The immediate recovery of Talca, besides dealing with the physical and psychological consequences of the disaster impact, faced the significant damage of the civic regulatory entities. Although the impairment of these civic buildings and their functions would not have an immediate effect on the initial recovery phase, their absence and partial involvement during the initial stages of resilience (from Ω to α) would be clearly noticed, as observed throughout Figures 3–5.

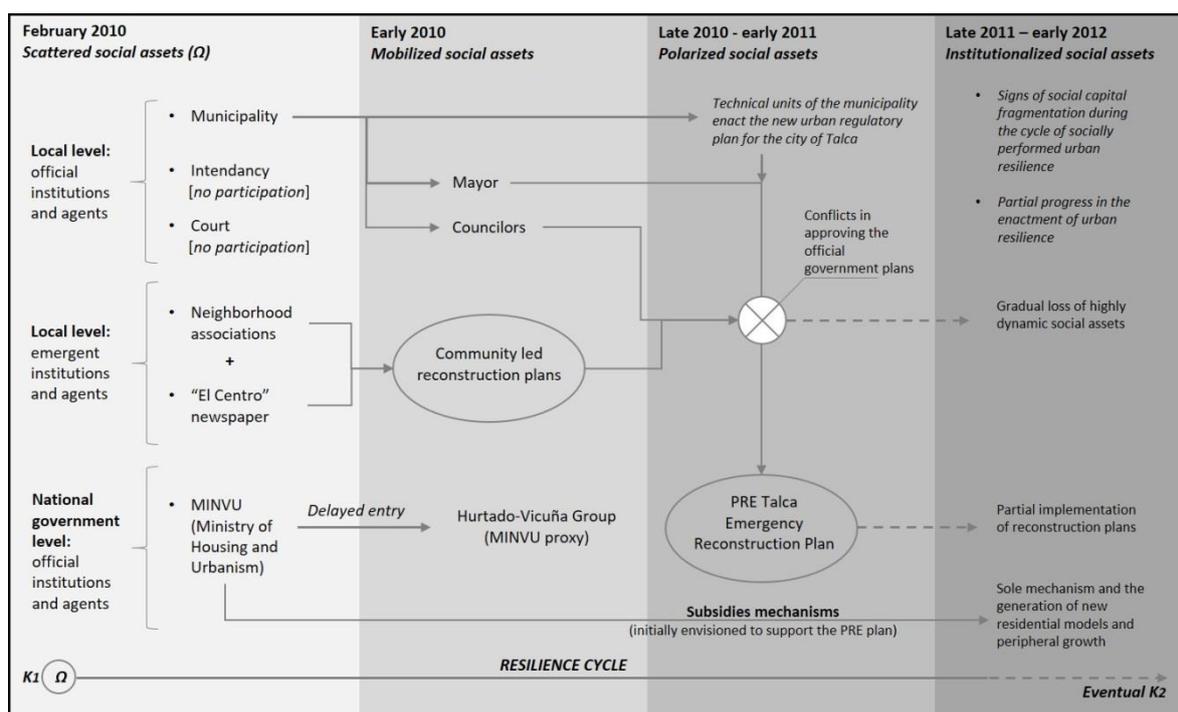


Figure 5. Interrelation of social assets and network performance in the process of urban resilience in Talca, from early 2010 to early 2012. Source: author's elaboration.

Additionally, only a partial segment of the Municipality of Talca would take part in the reconstruction plans led by local citizens, which started with the gathering of neighbors answering the call of the newspaper agency El Centro. Moreover, the involvement of Municipality-related authorities would show a much more fragmented scenario of governance towards the decreasing resilience stage and the growth phase (r), as found in Figure 4; Figure 5.

Additionally, the delayed actions of the Ministry of Housing and Urbanism (MINVU) and the entry of the Hurtado Vicuña group caused undesired effects in the local network of urban stakeholders, observed in Figure 5, from February 2010 until early 2012. The Talca Reconstruction Masterplan (original acronym PRETALCA) stagnated in its efforts to generate a consensus and recognize the emergent collective actions of gathered neighbors in Talca.

In parallel, the subsidies strategy would continue as planned, leaving behind the community-networking process of reconstruction.

Further on, the polarization of social assets would be characterized by conflicts in the approval of the official reconstruction plan, losing the opportunity to incorporate this emergent collective progress. This gradual loss of collective community participation and the partial implementation of reconstruction strategies revealed signs of fragmented social assets and capital in the late stages of the social dimension of urban resilience (early 2012, in Figure 5), also constituting a loss of opportunities to innovate governance and/or enhance the role of public institutions with regard to resilience management [46]. All in all, patterns of a proper performance of urban resilience were effectively present in the observed social dimension, yet these were apparently hampered by institutional inter-organizational conflicts. Apparently, the defragmented municipality plus other key institutional agents such as the MINVU were seemingly problematic in these regards, due to their obstinacy and lack of attention to the communitarian process [65,66].

The aftermath of the 27-F earthquake in Talca until early 2012, as observed in the timeline-analysis model, would show resilience in terms of recognizing a recovery and on-going reconstruction process. However, the terms in which the reconstruction program was carried out revealed inter-organizational conflicts between local institutional efforts and government plans to emphasize regeneration and revitalization programs [69]. Addition-

ally, there was a lack of attention to the territorial dimensions of community cohesiveness, memory, and identity, causing the loss of capitalization of social assets in the reconstruction process [73].

Up to this point, the most dramatic situation in terms of reconstruction progress was the almost nonexistent attention to the civic and social life structures that characterized the city before the disaster in the latter stages of the urban resilience cycle [72]. This situation is possible to observe in Figure 5 which summarizes how the community in Talca and the social dimension lost effectiveness with social assets that were “scattered”, “mobilized”, “polarized”, and “institutionalized” as identified one by one in the four reconstruction stages.

The efforts to describe the social components in urban resilience as described in the theoretical section of this article are instructive. However, it is necessary to build a more solid methodological framework for these matters.

4. Conclusions

Late research on the Talca case has placed attention on recovery and reconstruction processes, revealing shattered communities, real-estate opportunism, and institutional mismatches paving the way to a new era of urban transformation in this intermediate-scale city [74–76]. However, highlighting lessons from these events has been an elusive task in local urban planning research. The importance of the Talca case concerns the representation of intermediate cities facing risks of natural hazards [77]. There are reasons to believe that the evolution of these cases in recovery and reconstruction cycles could either maintain or hamper their inherent opportunities in terms of urban sustainability [78]; however, the city scale is crucial to maintain better urban transformations on the way to sustainability and resilience.

Transformative conditions entrenching sprawl and uncontrolled growth, whilst developing urban exclusionary phenomena—in the form of maladaptive niches—may escalate their impact towards the rest of the socio-ecological panarchy. The concerning role of urban planning in understanding these evolutionary patterns indeed requires methodological and empirical attention [79,80].

Engaging in the understanding of resilience from a socio-ecological perspective allows us not only to address the relevance of the stated issues, but moreover focus on the consequences of these actions and their significance and impact in the coming future. Aside from reframing the events covered from 2010 to 2012, the presented timeline analysis model is also an effort to orient other future strengths and/or weaknesses in the face of events of similar or worse magnitude that will inescapably occur. The identification and characterization of the social dimension in urban resilience [32] must be positioned as an essential requirement in any process of reconstruction, ex-ante and ex-post, as strategies for preparing for these events and assessing programs afterwards.

In this sense, this work adds further inputs to observe and evaluate reconstruction processes from an action-research perspective that includes urban resilience as a continuity, where physical and social indicators are required to understand how communities can confront natural disasters. Previous research on 27-F in Talca have described the physical damage and the social reactions of the affected inhabitants; but few insights have articulated these dimensions (physical and social) in discussing components of urban resilience.

Nevertheless, it is important to recognize the limitations of this experimental research and its methodology, especially when considering other aggregated physical and social factors belonging to the natural, spatial, urban planning, and socio-economic systems of the city. Indeed, replicability may create some issues in defining other time-spans and units of analysis. Even the very same case of Talca holds other several socio-spatial singularities that could be added to this temporal-linear model and may have not been identified in our study.

With regard to the presentation of results, the initial reconstruction developments (2010–2012) explain many of the issues regarding the complexity of the unfinished reconstruction progression. These issues are related, in part, to inter-organizational issues among urban stakeholders, revealing signs of maladaptive cycle successions in the process of urban

resilience and the loss of social capital—through social potential leaks in the reorganization (α) to growth (r) phases—corresponding to stages of high and decreasing resilience.

In short, a meaningful understanding of urban resilience not only would help us to better understand urban transformations in intermediate-scale cities such as Talca, but also drive desirable conditions for the future of Talca. Among these required conditions it is important to include an analysis of the pre-reconstruction phases of urban growth to understand how the city was shaped by specific regulations and economical dependences.

Overall, we insist that our experimental model requires further applications on related previous and present case studies of urban transformation to achieve a bigger universality of the method in terms of post-earthquake reconstruction in other intermediate urban-settings which can be organized in a timeline for contributing to a resilience cycle as empirical theory or action-research. In this sense, the timeline-analysis model includes resilience as part of an evolutionary behavior of socio-ecological systems where the urban dimension can be represented. The adaptive cycle model not only serves the purpose of a theoretical framework for assessing the social dimension in urban resilience, but also allows us to include this knowledge to further understand evolutionary patterns throughout other human and natural domains of the socio-ecological system.

Currently, urban resilience has become a key term to confront social and natural disasters around the globe. Furthermore, urban resilience is part of a more complex socio-ecological system and an evolutionary concept that is far from its conservative definition, as discussed recently by scholars who have included “three constitutive elements of resilience in planning: adaptive capacity, self-organization, and transformability” [80] (p. 6). Moreover, by increasing recent case studies from other countries of post-earthquake reconstruction including different territories such as coastal zones [81,82], the universality of the method will increase; and a good start is including other global seismic territories within the “Pacific Fire Belt”, with similar natural hazards such as earthquakes, tsunamis, or landslides, as registered in Chile. Thus, cases like Talca are relevant for planning, as the observed conflicts of institutional inter-organization [83,84], the stagnation of mobilized social assets, and the potential loss of communitarian capital could possibly impact the ecosystem sphere, which is also relevant to other intermediate cities with similar post reconstruction processes [85]. The observation of these effects should be considered for further research involving both socio-ecological studies and urban planning and practice.

The loss of the civic environment in Talca’s historic city, the weakening of neighborhood networks, in contrast with the real estate redevelopment of the central area, would lead to an important civic risk in terms of the generated resilience mechanism, and this may affect in the future development of this city and its capacity to sustain other crises, either natural or human in nature. Although we are aware that such review is only the beginning of a decades-long urban reconstruction process in Talca, it is essential to understand how fast we need to act in our territories to provide better conditions of urban resilience.

Finally, it is important to promote more longitudinal research as a next step to apply for the medium and long term in Talca and other similar intermediate cities with global seismic territories affected by natural events such as earthquakes, tsunamis, or landslides. Even more nowadays as territories around the world are modifying rapidly from recent crises such as the 18-O social revolts in Chile and the COVID-19 pandemic across the entire globe. Thus, it is crucial to reinforce urban resilience in terms of both ground theory and action research to replicate in urban planning and design briefs.

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