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IMPROVING RESILIENCE CAPACITIES IN A HAZARDSCAPE OTSUCHI, JAPAN

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Abstract

The project aims at contributing to integrated emergency planning in hazardscapes. The research takes the case of tsunami scape of Otsuchi, a town in the Iwate prefecture of Japan. Learning from the 3/11 disaster about the dependency of decisions that affect the nature of recovery has led to the formation of a methodology and guiding principles for the integration of emergency and contemporary planning. To enhance the effectiveness of preparedness, systemic dependencies of socio-technical factors have been examined based on the disaster resilience capital model of(Sakurai et al, 2016). The aim is to attain community resilience that mitigates and improves the capacity of dealing with returning disasters in the region. The method and principles are tested in the urban design of Otsuchi that envisions its urban renewal through the concepts and principles of social memory, identity revival, co-designing and wellbeing.

Keywords: Emergency planning, community resilience, reconstruction, recovery, preparedness, hazardscape, Otsuchi, Japan

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1 Introduction

The realization of the urgency for a risk-informed sustainable development (GM. Atlas, Ch3) is evident from the global approach towards development and disaster recovery as cited in (UNDRR, 2019). While the geographies of these disasters (GM. Atlas, Ch4) have diverse, multilayered, and multisectoral contexts of exposures, vulnerabilities, coping capacities and risks as cited in the urban risk assessment report of (Dickson et al., 2012). The advancement in technology and a better awareness of risks encumbered with the rising and challenging process of disaster recovery has abled to continually amend the position, scope, and process of addressing the various stages of the disaster cycle. Nevertheless, gaps and divergence in the governance (GM. Atlas, Ch6), planning, implementation (Miyake, 2014) and personal conduct (FUKUSHIMA, 2017) in the reconstruction processes have shown to be incapable of stimulating or increasing the resilience of the disaster reconstructed areas (King et al., 2013).

In today's times, when urban systems are more connected (GM. Atlas, Ch3), interacting and dependent upon the natural world, it has multiplied the scenarios of risk and cascading impacts. Moreover, since the nature of the hazards (stressors and shocks) (GM. Atlas, Ch4) is changing in terms of rate, frequency, intensity, geographical spread, subsequent risks have laden over the growing challenges of decision-making(Renschler et al., 2010). The reverse research methodology (GM. Atlas, Ch6) and the multidisciplinary workshop at Otsuchi (GM. Atlas, Ch5) in the

aftermath of the 3rd March 2011 Great Eastern Japan Earthquake and tsunami (mentioned as 3/11 or GEJE tsunami henceforth) pointed this aspect of the reconstruction process which has been explained through the graphic in figure-1. Further (King et al., 2013)have also cited "understanding post-disaster resilience at the community level offers insight into the real needs of disaster-affected communities and the operational opportunities to proactively stimulate recovery and re-engage relief, recovery and development" which was similarly felt at Otsuchi.

The figure-1 below explains further that even though both top-down and bottoms up processes worked towards reaching the common focus of reconstruction, the recovery at Otsuchi was not effective as the decisions taken in the direction of recovery were delayed, insufficient, and ineffective in certain contexts.

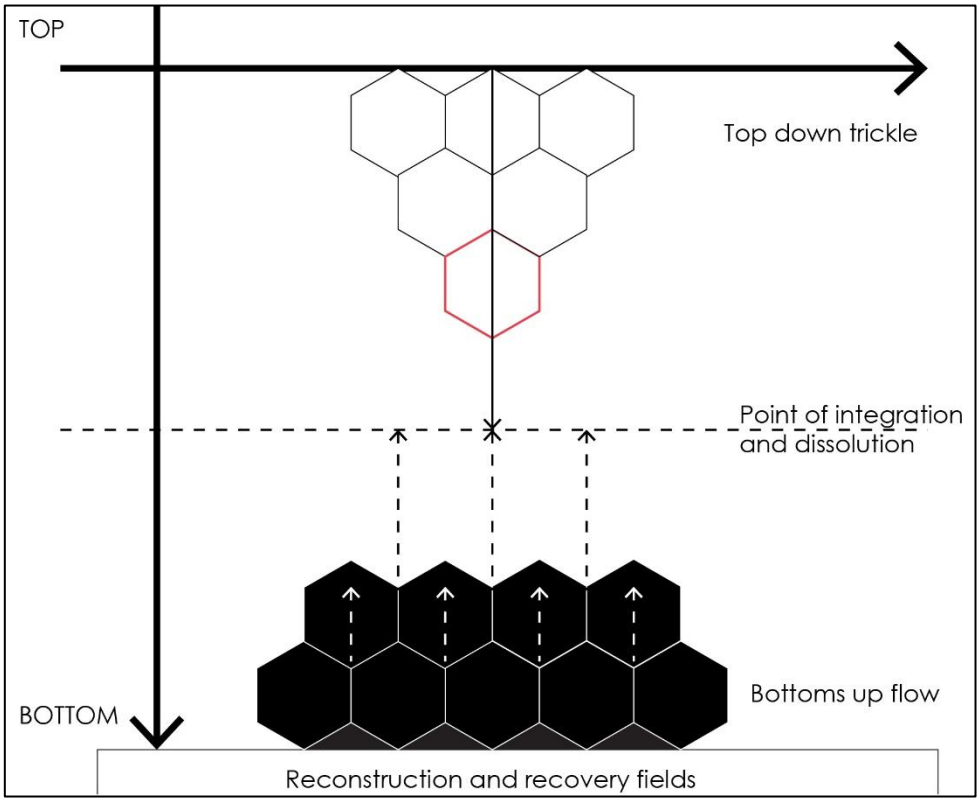

Figure 1- Decision-making lacking consensus

This incapability of decisions to be directive towards achieving a holistic recovery drives the research focus, and this paper to examine the aspect that highlight, define, delineate and restructure the approaches towards reconstruction processes and strategies for a region prone to tsunamis. Tsunami though uncertain event in impact but certain in occurrence disrupt the normalcy of daily lives. Disasters of this scale are extreme and to know its reach within the disaster cycle requires research in-depth of aspects that influence the disaster cycle which has been the focus of the research.

"Disasters threaten development, just as development creates disaster risk" (UNISDR, 2015) dealing with this nature of disaster demands for emergent, effective and long-lasting recovery possibilities that this paper investigates. In doing so, "the scope of spatial planning under the influence of the disaster cycle in a region, vulnerable to natural hazards" has been enquired, that forms the decree for the main research

question. While the grasp of disaster recovery as a concept has become better and shares common ground with development as cited by (Paton & Johnston, 2017) "development is a process by which vulnerabilities are reduced and capacities are increased", vulnerabilities and capacities being retributive to disaster recovery, yet the process towards achieving development in the prone areas is still ineffective. This is due to many factors like limited local awareness and monotony in preparedness methods, delayed planning and implementation process, lack of consensus in decision making and physical rebuilding ascribed to the reconstruction process(March & Kornakova, 2017). To understand these factors in-depth, the research focus is to mitigate the impact of the disaster within all dimensions of the disruption study in case of tsunamis specifically.

1.1 Research Methodology

The research outlined for the project has been based on the book DRM – a design research methodology (Blessing & Chakrabarti, 2009). Though practically the order of study was reverse of the actual mentioned, for readers knowledge, in this research there is an addition of extra descriptive stage before the four main stages are:

1. Research and observation
2. Descriptive study I
3. Prescriptive study
4. Descriptive study II

Each stage is subdivided into sections that are based on the sequence of the analysis carried out for the project elucidated under each section. The focus of the research being integrative (all the domains involved in planning), therefore carried out 'the scientific way' makes the methodology real. Theoretically, the research methodology can be classified as reverse research methodology, with the design proposed during the workshop to understand the context and the kind of research required to be carried out which resulted in the formulation of the problem field and research question. This method of research was beneficial to understand the context, its problems and their limitations in administering them which necessitated a "bottoms-up" research methodology, wherein the research and analysis carried out shifted from micro to macro and vice versa. This has resulted in making the project more realistic and site-specific. The outline of the research methodology has been explained in detail in the atlas (GM. Atlas, Ch5).

1.2 Research aim

Discourse within disaster and planning (GM. Atlas, Ch3) has realized that the society needs to be resilient to the changes occurring within the urban environments which is reflected in the goal of the Sendai Framework for disaster risk reduction(UNDRR, 2019; Opitz-Stapleton et al., 2019). Understanding the complicated and complex interlinkages between the human systems and the natural environments in a hazardscape has been considered impertinent for a holistic recovery.

Within the recovery phase, planning involves decisions that form the role of governance and collective actions that lie under the domain of urban planning. These decisions particularly relate to land use, system dynamics, human activities and

natural systems in a hazard-prone region that need to be prepared, adapt and transform. To understand this need to mobilize inhabitants and land-use, it is important to understand the drivers that influence them and to do so, it is necessary to explain why resilience is required and what influence does the hazardscape portray.

Resilience, within the disaster studies, is the ability to cope, adapt and at times breakwater transform to a better state in the aftermath of a disaster(Davoudi et al., 2012). However, since the 3/11 disaster happened after a span of 57 years in the Tohoku coast in Japan, the preparedness and later reconstruction activities carried out at many of its coastlines showed slow and limited nature of human recovery and more towards the rebuilding of physical protective structures. Understanding the nature of hazardscape (GM. Atlas, Ch4) and the resultant response has been considered vital to the recovery and reconstruction processes.

Adopted from (Khan, 2012) hazardscape is defined as, a 'scape' that is exposed to frequent and intensified disasters and that results in physical susceptibility of the place as well as the human environment but together also affect the capacities of the communities. They are called so since they are not human-induced or triggered but are cyclic and erratic and impact the built as well as the unbuilt environments for example earthquakes, tsunami's, landslides, volcanic eruptions. When planning for a hazardscape it is essential to consider principles like wellbeing, prosperity, peace, poverty reduction and environmental sustainability as these in time shape the nation's vulnerabilities, degree of exposure and capacities of coping to disasters. The figure-2 below explains this attribute of the hazardscape. The response of the hazardscapes considers all phases of planning until the next hazard. Both hazardscape and response impact and create a field of risks that fluctuate based on their capacities of resilience that also act in a cyclic manner and vary depending on the socio-cultural context.

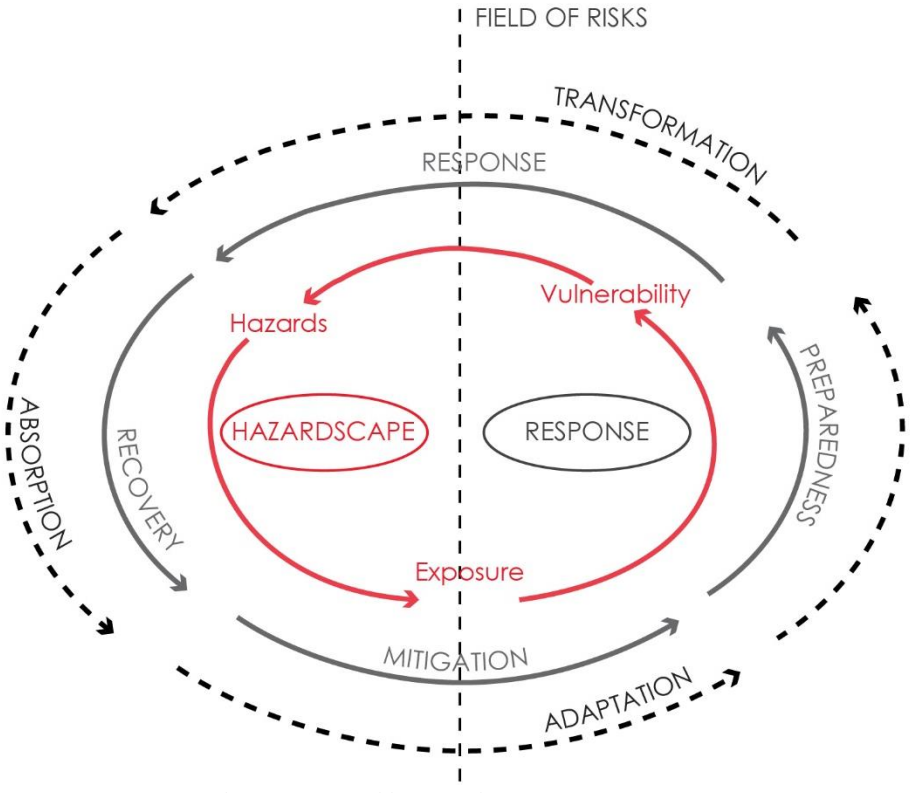

Figure 2-Resilience in Hazardscape

For the scope of this project tsunami frequent scape of Otsuchi in Iwate prefecture of Japan is used as a testing ground. Though the quantum of hazards in the region is multivariant, due attention has been given to overlaying and cascading disaster scenarios caused due to tsunami within the region. A disaster like a tsunami occurs in an imperfect cycle for which planning occurs throughout the disaster cycle in phases of preparation, mitigation, response, or recovery as seen in the above figure. However, theories of urban planning "demonstrate that a sustained, evidence-based, and integrated long-term action is fundamental to successful planning outcomes and that poorly coordinated and planned recovery can lead to long-term risks that could have been avoided"(March, Kornakova, & Leon, 2017).

Therefore, the aim of the project is to achieve methods and strategies that have long-term impacts while researching the interdependencies of decision making involved in the reconstruction processes. The goal of the research is to accomplish holistic recovery of Otsuchi that safeguards futures across generations. Consequently, the hypothesis, "if the population in the hazard-scape is prepared enough, such that the impact or the severity of the event amounts to very less human loss. This subsequently reduces psychological trauma resulting in a better-coping capacity to adapt and transform during and post-disaster, which can then result in a faster and resilient recovery of the community and the environment". To mitigate the impact of tsunami in its entirety, the research question focuses on the possibilities of managing both humans as well as the systems that provide critical services during the disaster cycle. Hence, the research question formed is;

How to mobilize inhabitants and land-use through spatial design and planning to achieve community resilience in a hazard-scape?

The research methodology (GM. Atlas, Ch6) institutes formulating three domains for research- operational, performance and Spatio-temporal (GM. Atlas, Ch6) to understand the efficiency, extents and effectiveness respectively of the recovery process. These domains are based on the theories and analysis methods followed within the analytical framework. A model of dependencies is assembled based on the theory (GM. Atlas, Ch5) that assist in the decision-making process for reconstruction, adopts system dependencies based on the resilience indicators from the performance domain, guides the elements of the Spatio-temporal domain and mobilizes based on the operational domain. The chosen research methods (GM. Atlas, Ch6) are aimed at understanding Otsuchi's contextual vulnerability, degree of exposure, nature of tsunami at its coast, community perception of tsunami, evolution of resilience indicators and the policies, strategies, processes addressed by the government to effectuate preparedness. The morphogenesis (GM. Atlas, Ch7) and governance analysis of Otsuchi in Tohoku region conclude key findings that become basis to select tools and propose for strategies (GM. Atlas, Ch7) in the direction of preparedness for future tsunamis.

2 Japanese hazardscape

Japan is a country that is frequent to natural hazards of earthquakes and tsunamis. This is because it lies in the pacific ring of fire and on the confluence of three tectonic plates i.e. the Pacific Plate, the Philippine Sea Plate, the Eurasian plate. Tsunami occurs when along the subduction zone the North American plate that connects with the pacific plate up-thrust and subsides as seen in the figure-3. The area is the densest in

terms of seismic activity and the Sanriku coast has endured many such destructive tsunamis throughout history (GM. Atlas, Ch4).

On 3rd March 2011, a 9M earthquake shook the Tohoku region of northeast Japan resulting in a massive tsunami to strike the region. But the impact of the disaster expedited when it got exposed to the urbanised areas of Fukushima, Miyagi and Iwate prefectures triggering cascading disasters like nuclear crisis and fires that contaminated and spread like wildfires for days continuous. Prior to this, Japan was considered a model country in the field of tsunami preparedness and resilience. The extensive tsunami defence system that was based on structural and non-structural protective measures, emergency management that was supported by prompt warning systems and the notion of tsunami resistant cities had been conceptualised post the 1896 Meiji Great Sanriku earthquake-tsunami whose impact was the equivalent of 3.11.

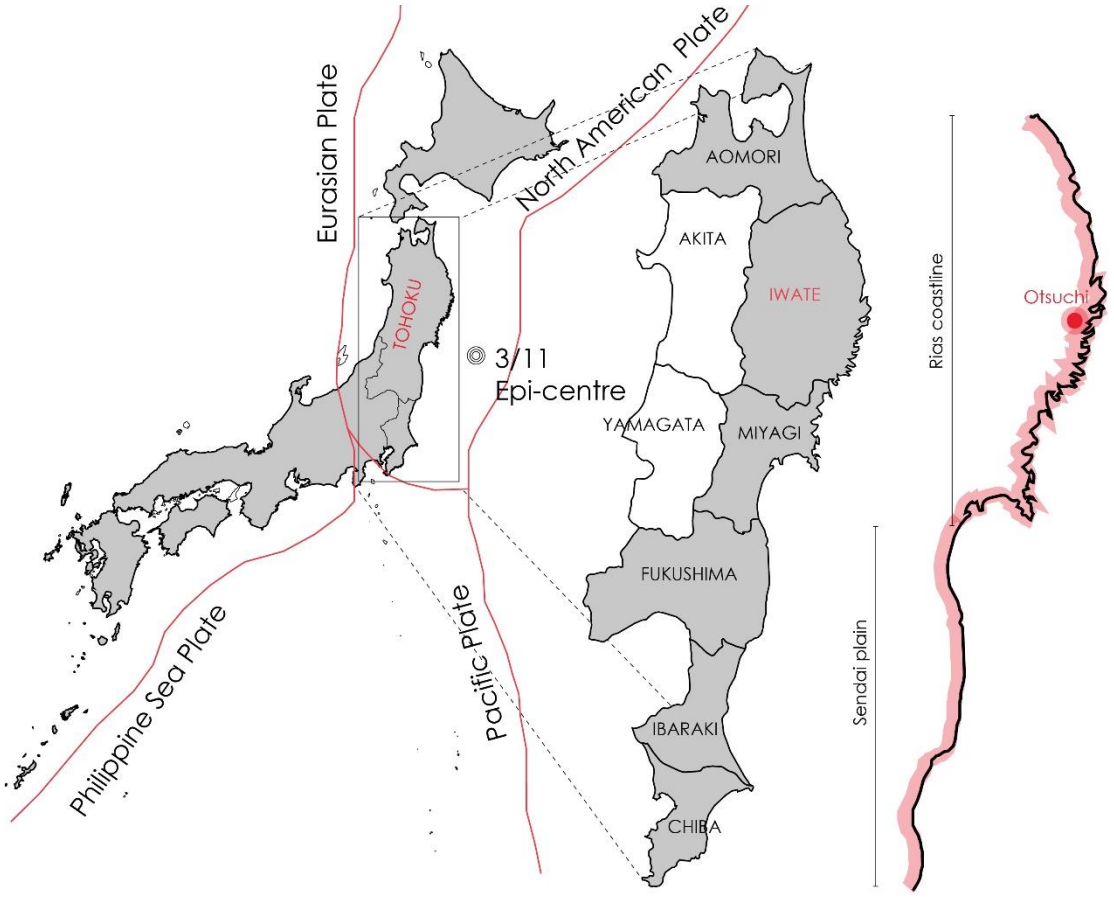

Figure 3- Effect of 3.11 on the Japanese Tohoku coast

The Tohoku coast has unique geography and topography with the coastline in the shape of a necklace along the Sanriku coast, with cities of Kesennuma, Ofunato, Kamaishi and Miyako as the base for many smaller fishing villages and industries see figure-4. The Japanese fishery law gives these villages exclusive rights to function autonomously with its own fishing ground and port for landing, processing and distribution. While the communities in these fishing villages have enjoyed exclusive rights to the rich resources of the sea, social services and amenities are not evenly distributed (Miyake, 2014). Therefore the 3.11 disaster and its impact were differently

felt and in particular at the villages of Iwate and Miyagi, where the density of ports is far higher than the national average.

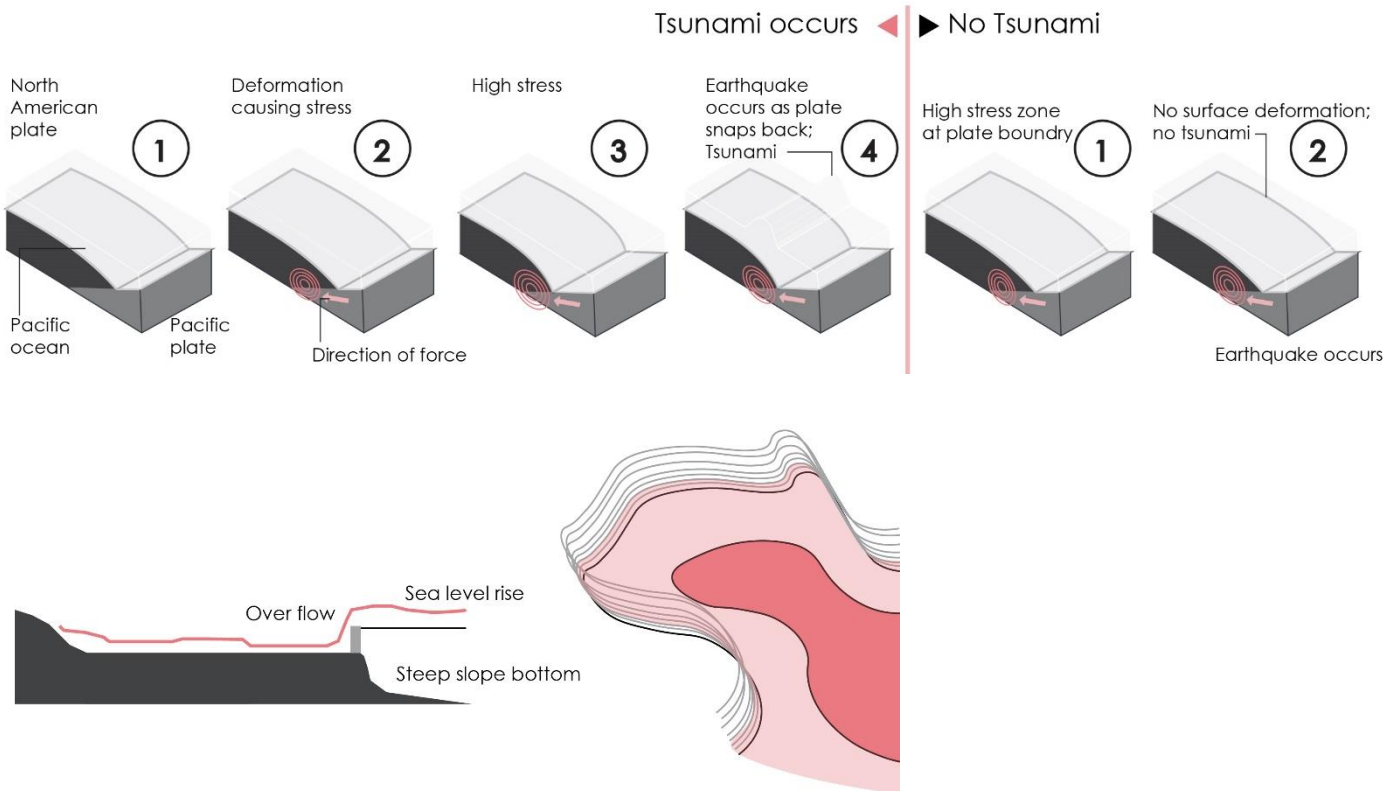

Figure 4- Earthquake and tsunami behaviour at Otsuchi, Japan

The Great Eastern Japan earthquake tsunami that struck the Sanriku coast on 11th March 2011 was the most destructive of all times for these Tohoku coastal communities. The loss estimates to be 22,626 persons killed or missing nationwide (of which 15,534 are confirmed deaths), 107,000 buildings collapsed, and another 111,000 partially collapsed (National Police Agency, 2011). The economic damage itself cost up to 16.9trillion Japanese yen.

The regional areas of Japan which include Tohoku and the non-metropolitan areas have been shrinking since the post-war period due to national consensus on economic expansion for regional development which was prompted by the top-down political, bureaucratic and corporate elites cited by (Machimura, 2002) and cited by (Cho, 2014). Consequently, the socio-economic vitality of Japan has decreased and weakened. While the national population is on the decline(Jung Soon-dol, Park Hyun-joo, 2011) the disaster of 3.11 has exposed the vulnerability of Japan's socio-political systems(Cho, 2014) too. The paper has understood this critical aspect in its fundamental stages. This has contributed and enhanced the research methodology by driving bottoms up research and evaluating several contemporaries practises, service dependencies, transportations, emergency measures, economic proliferation with respect to the local to national governance decision exchanges.

3 Community resilience, hazardscape and preparedness

Within the hazardscape where the magnitude of exposure, vulnerability and risks are multiplying, human capacities to cope and adapt to the change also veer. While it is observed that the landscapes that are frequent to the seismic hazards, communities living there possess abilities to cope and adapt to the frequent hazards. As (Gaillard, 2007)mentions factors such as natural condition, intrinsic social condition, geographic condition and rehabilitation policies vary in time and space and from one disaster to another which influences the coping capacities of these traditional societies. These coping capacities of the hazard susceptive communities are termed as inherent resilience capacities that can be identified in their cultures, lifestyle, religion and their perception of recovering from the disaster. This is reflected in the areas around the pacific ring of fire that have high seismic activity (Pamela Forward, 2017), in this case at Japan (GM. Atlas, Ch7).

3.1 Resilience in the hazardscape

Urbanisation consequences have shaped the socio-spatial structure of these traditional societies (GM. Atlas, Ch7, sensitivity analysis). This has henceforth affected the coping capacity of these resilient societies. As King says "A resilience-based approach in emergency operations has the ability to improve operations, stimulate recovery, ensure effective exit and transition mechanisms and leave sustainable solutions for rehabilitation; offering the ability to increase coherence between relief, recovery and development" (King et al., 2013). It is therefore realised that to cope to the urban problems of these communities in the tsunami escape the resilience stimulators need to be enhanced which can then cater to the sustenance of these communities for future such tsunami events. Therefore, for being sufficiently prepared, resilience improving factors needed to be identified and resilience need to be mainstreamed within all planning activities of the hazardscape.

Literature reviews into the application of resilience in practice globally are carried forward by the disaster risk reduction (DRR), that lends itself to co-existence thinking. It does so by conceptualizing its constituent policies, strategies and practices intended to manage risk arising from interactions between people, environment and hazards (Twigg, 2015)as cited by (Paton & Johnston, 2017). The reviewed frameworks for resilience by (Bosetti, Munshey, & Ivanovic, 2016; Sharifi, 2016)and as explained in (GM. Atlas, Ch5) analysed the association of these capacities with the livelihood capitals at the community level, which form the constituent elements of a hazardscape. Therefore, it was realised that application of resilience should be practised in governance of decision making within the hazardscape.

3.2 Community resilience indicators

Community-based approach as defined by (Longstaff et.al., 2010) describes attributes of resilience as resource robustness (performance, redundancy, diversity) and adaptive capacities(institutional memory, innovative learning, connectedness). This is further elaborated in work of Bene et. al (2012) as mentioned by (Mueller, Spangler, & Alexander, 2013) that undertakes all forms of resilience capacities-absorptive, adaptive and transformative, these operate at multiple levels but mutually enhance the condition of coping capacities in the hazardscape. This forced to

identifying the different indicators of resilience that are decision-oriented. As mentioned, prioritized response by community resilience indicators in an integrated way can contribute to enhancing community collective action as well as building community capitals. These are further influenced by both internal community capitals as well as external factors. Influencing these capitals effectively and efficiently guides stability and recovery in a sustainable manner(King et al., 2013), therefore the identified indicators- called as 'critical capitals' undertake human, physical, political, economic, social and natural capitals. These capitals offer dimensions that can continually improve the ability of response to meet the real needs of the affected communities and are described as;

Economic capital – It denotes the financial resources, industrial setups, market economies of the community to achieve their civic and social standards. It addresses the community's accessibility, reliability and inclusiveness of formal saving and credit systems that can cope, absorb and speed up recovery processes. Economic capital at community level is identified within the patterns and trends that contribute to generation of income at both macros as well as micro levels. Investments in this sector throughout the disaster cycle provides stability for sustenance for the community.

Physical capital – This form the basic spatial structure that undertakes the built fabric, infrastructure accessibility, forms of service and utilities that enable sustenance of the communities by providing protection, security, safety and enhances wellbeing. It includes transportation, communication, power, shelter, water systems, health facilities, markets and productive assets. While many of the physical capital is beyond the control of the individual and households, redundancies that allow alternative systems to function can be incorporated. Within the hazardscape, these can be critical infrastructures and public goods that need immediate recovery and functioning to bring functional normalcy back in the community.

Social capital – Community resilience is steered greatly by the capacity dependence of the social capital through the collective actions, collaborations, self-organisation and its association with the governance as well as the informal sectors outside the community. It undertakes individual or organization empowered by social connections that have strong perceptions of local embeddedness, self-regulating moral codes and norms, reciprocity and trust. Research by (Aldrich & Meyer, 2015) highlights the importance of this capital in disaster survival and recovery that has been the main goal of the research undertaken towards holistic recovery.

Political capital – It undertakes the responsibility of decision making that is based on power relationships at the different governance levels. Political capital influences the nature of community participation through the process of policy formulation and implementation. Decision-making bodies include both formal as well as traditional authorities that involve mayor, municipality officials, community leader, religious heads, and other sector officials that have influence over the community's participation. This capital undertakes the responsibility and accountability for recovery during the pre and post-disaster stages and that can change the course of recovery by linking with the outside.

Human capital – It forms the community's skills, knowledge, health and abilities that individuals, households, institutions and municipalities use to cope, adapt and transform to changing social, economic and environmental conditions. This capital is

key to innovation and determining the resilience shift that can effectively and efficiently change the resilience capacity building for collective responses in the wake of disaster. The demographic, socio-economic and quality of social services contribute to gaining insight into the level of human capital. Influence from this capital changes the dynamics of interdependence between capitals.

Natural capital – It is the availability of natural resources within the community's environment that forms the essential stock through which the supplies for livelihood are derived. These are the biodiversity elements and the ecosystems services that provide a condition for a community to localize and settle. Possessing natural resources and maintaining a sustainable livelihood is essential to community resilience.

As understood from the resilience measurement framework and approach analysis by(ODI & CoP, 2016), capacities of these critical capitals influence changes in people's resilience and alter the nature of recovery and reconstruction from short term to long-term and vice versa. Thus, the research leads to formulation of the theoretical framework derived from the conceptual community resilience model of (Mueller et al., 2013), integrated with the aspects of the hazardscape(Crozier & Willis, 2009) and based on Bene's three types of resilience capacities see figure-2- absorptive, adaptive and transformative which is explained in detail in (GM. Atlas, Ch5). This theoretical framework lays the foundation for the research of the decision roadmap, action plan, analytical tools and planning approach to improve resilience in hazardscape.

3.3 Translating community resilience from theories

Communities across the world depend upon modern systems over which they have very little control such as electricity, computerised systems, daily supplies and services, transport infrastructure and communication systems. The ability of these systems to return to a functioning state after a tsunami has a direct impact on the community to respond, recover and prepare again for future tsunami. The critical capitals undertake these Spatio-temporal aspects and form the building blocks of the community resilience as they take into factor these different community assets, capacities and the social dimensions that collectively influence community resilience in the hazardscape.

The theoretical framework in figure-3 below reinforces community resilience theories in the hazardscape based on the identified critical capitals and their resilience influence on community's capacities and actions. It cultivates response and reaction to the disturbance that leans to either positive or negative reconstruction and recovery outcomes. Critical capitals govern the nature of resilience in the community while being interdependent on each other. This understanding of interdependencies between critical capitals also proposed analysis into the need for an integrated approach of decision making. The framework has been extracted from the conceptual community resilience model of (Mueller et al., 2013) that is adapted from Frankenberger et al. (2012), DFID (2011a), TANGO (2008), and CARE (2002) and has been integrated with the hazardscape for a range of reconstruction outcomes. The framework simplifies the actual model to adapt to resilience attributes in the hazardscape of Japan and identify the factors that influence decisions and actions of reconstruction.

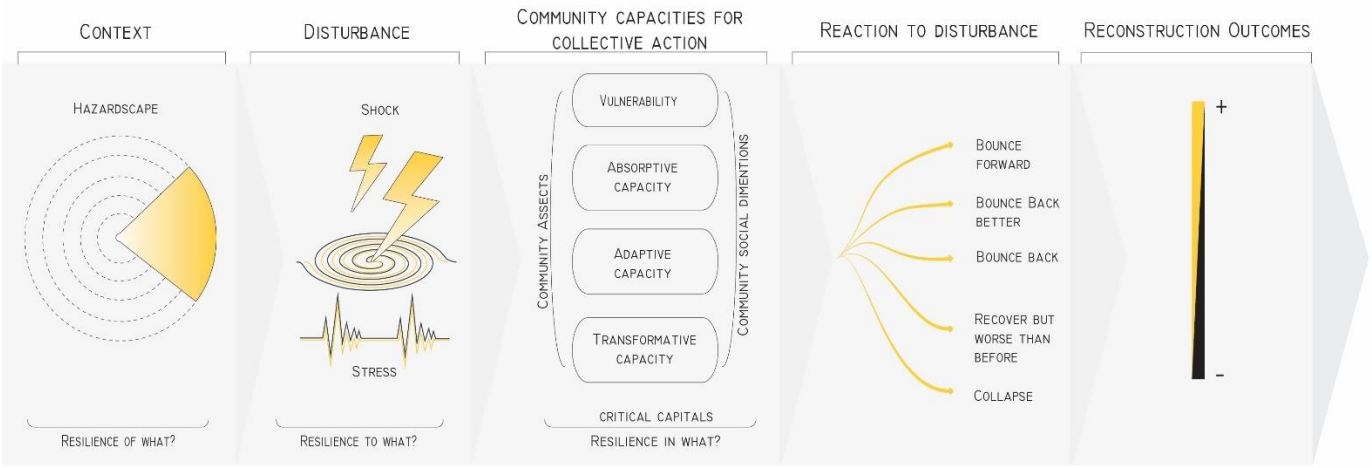

Figure 5- Theoretical framework

3.4 Community resilience into actions and decisions

Community resilience has been researched and addressed in the contexts of diverse disaster scenarios ranging from certain to uncertain, periodic to irregular and seismic to climatic disasters while being focused at multiple levels of city, urban and community. A deliberate choice has been made for the case of Otsuchi, Japan to examine the actions, decisions and the scope of planning based on the nature of the hazardscape and exiting levels of operation and implementation. This allows resilience thinking and supports long-term planning for all critical capitals while taking into consideration global as well as local processes.

Within the domain of governance, decisions, actions and condition of critical capitals need to be assessed within space and time. Scales of processes, the occurrence of the phenomena and change in sustainability parameters that contribute to influencing and improving the resilience capacities as mentioned in (Weichselgartner & Kelman, 2015) guides the operational domain. This operationalization of resilience is based on the mentioned factors that are described below;

Impact range – The uncertain and irregular behaviour of tsunami sets the context for community resilience in the hazardscape. As the regions around the pacific ring of fire are seismic activity prone tsunami in the region have occurred of varied magnitude, intensities causing risks at multiple levels and sectors. These impacts of the tsunami have been categories into different categories depending on the level of disruption created.

Threshold capacity – This capacity is relative to the resilience capacities that deals with the response to the tsunami under the different operational domain. To achieve community resilience the threshold capacity acts at multiple levels of the operational domain but for effective and efficient implementation threshold capacities need to become emergent as well as strategic for a complete recovery.

Community resilience (CR) framework – Literature reviews of CR focused on its measurement and operationalization. The study concluded with the understanding

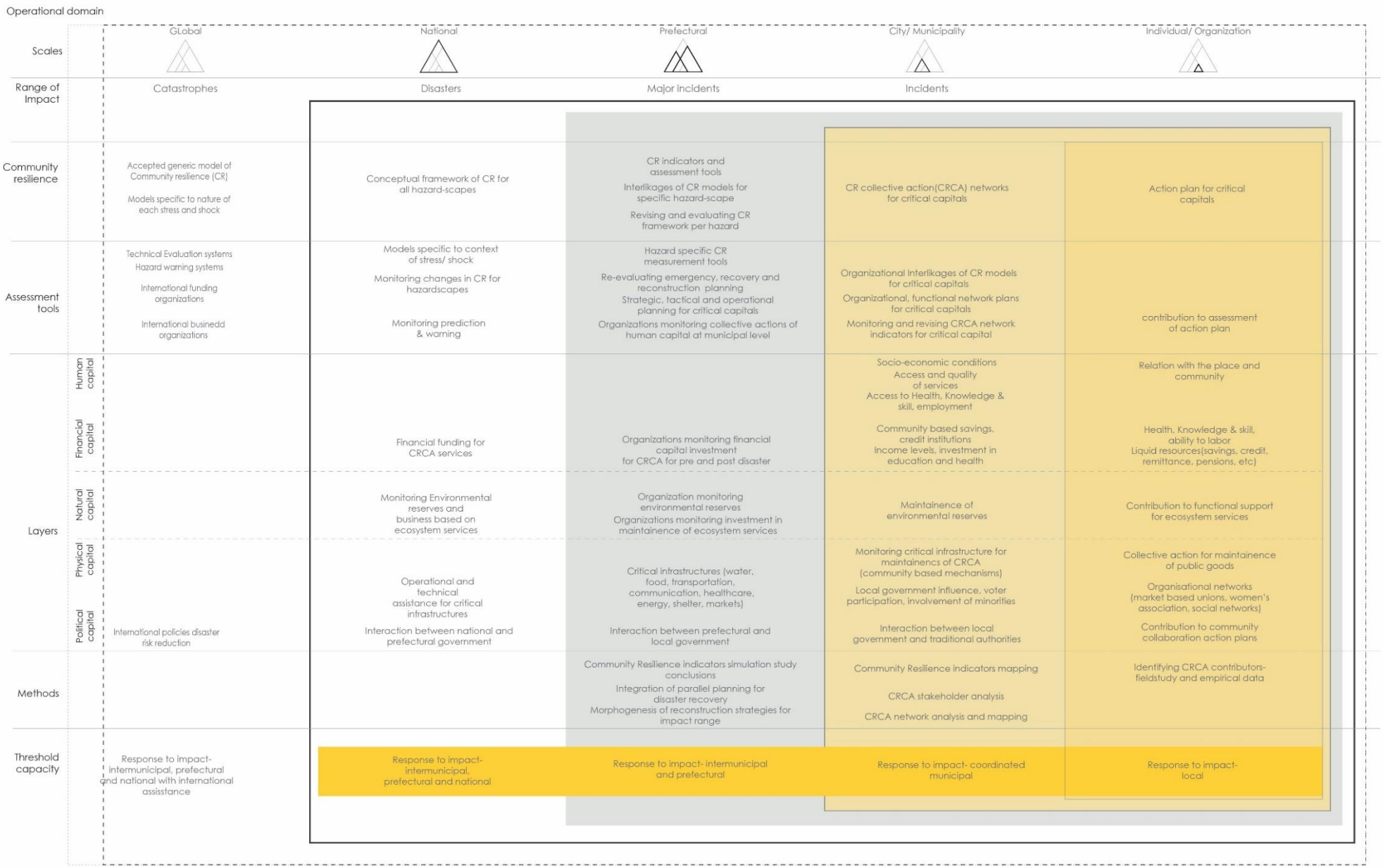

Figure 6- Decision roadmap

that CR cannot be measured and compared but can be enhanced based on certain changes in the operationalization of the critical capitals. This understanding guided towards making CR frameworks that operate at multilevel and guides socio-temporal factors of critical capitals.

CR enhancement tools – To enhance and improve CR in the operational domain, toolkits that are based on computational models such as GIS mapping, risk simulators, vulnerability models, casual-loop models can be developed which monitors changes in the hazardscape. Further, these toolkits can create awareness and enhance social networks that supplement preparedness activities throughout the disaster cycle and across all age groups.

Critical capitals – These selected CR indicators that are influenced by decisions and actions of the lower levels in the operational domain have the capacity to stimulate and enhance community resilience. They operate at multiple levels in the spatial scales and show temporal factors that change the resilience capacities of the hazardscape.

Methods –For the operationalization of CR, it was realized that a complete transformation within the planning of recovery and reconstruction(Alexander, 2013) is required that is emergent of the hazardscape and strategically influences the critical capitals. This understanding guided research into the planning activities, actions and decisions of recovery that was investigated through capital dependencies, sensitivity analysis and design fiction of the tsunami scape of Otsuchi. The analysis leads to reformation within the planning methodologies specifically for the hazardscape and the design of principles that when implemented enhances community resilience.

4 Theory and analysis

Understanding and identification of community resilience stimulators in the form of critical capitals in the hazardscape leads on to research into the field of preparedness and the forms of planning necessary within a hazardscape. The reverse methodological approach is observed clearly herewith as research to attain community resilience (operational) through the critical capital (performative) is assessed based on the state of preparedness (Spatio-temporal) and the approach towards being prepared throughout the disaster cycle (GM. Atlas, Ch5).

4.1 Understanding being 'prepared enough'

In the hazardscape, due to the frequent nature of disasters, it is essential to be prepared. When we are prepared, responses are timelier and more effective, resulting in reduced human, economic and environmental consequences. The process of preparedness is a continuous process that requires action, investment, participation, collaboration and political commitment at all levels and times for it to sustain (World Health Organisation, 2017). The focus of preparedness in this paper has been towards tsunami (of extreme scenario). By understanding the scope of the measures required to be prepared for a tsunami, the tsunami's that are not catastrophic can also be mitigated.

To understand preparedness, it is important to consider the spatio-temporal domain in which it is implemented and the methods for its intervention. To execute this, it is necessary to assess the current or the pre-state of the hazardscape. The action-decision flow chart takes into consideration this requirement for preparedness through decisions and designs for principles mentioned below to achieve a holistic recovery.

1. To safeguard, maintain and restore the health and wellbeing of the communities which is in unison with the hypothesis considered for the project.
2. Decisions and activities governing the critical capitals should be participatory, inclusive and collaborative with multi sectors and comprise of measures that are all short-term and long-term specific.
3. To achieve preparedness, the commitment required from the political, social and economic sectors should be enduring and persistent.
4. To invest in preparing it costs time and money, but investment in health, safety, security and development makes it sustainable.
5. By preparing, it helps in building the resilience of the systems which is utmost important to achieve a better future of the hazardscape.
6. The measures undertaken for preparedness should be integrative with the approaches of recovery, reduction and mitigation that are observed throughout the disaster cycle.

Preparedness for emergencies depends upon a complex, multidimensional process that is difficult to operationalize if even a single element is missed which is also in the case of non-emergency or post-disaster reconstruction stage(King et al., 2013). In order to be prepared enough, relevant, accurate and timely knowledge and awareness of the communities in the hazardscape is essential. Social capital plays a vital role in sharing, transmitting and networking across all the critical capitals (Mueller et al., 2013). This helps in circulating and generating capacities for collective action that prepares and mitigates the impact of tsunami and parallelly develops relative perception of risk. This perception of risk helps in mobilizing the resources and changing attitudes of the inhabitants of the hazardscape to become sufficiently prepared while strengthening resilience capacities.

4.2 Capital model for community resilience

While critical capitals are essential for the sustenance of the community. It was also realised that taking critical decisions in the event of the disaster considering pre-disaster stage, warning stage and post-disaster stage is also crucial. Otherwise, it holds no value to be prepared. To understand this aspect associated with the critical capitals the capital model for disaster resilience by (Sakurai et al., 2016) was referred. Their capital model deals with the relationship between organization and the pathway of returning to business as usual as speedily as possible.

Extracted from that model the conceptual capital model developed is a manifestation of the preparedness phase when plans are drawn intending to mitigate damage from a disaster situation by making people, facilities and organisations robust. But plans are effective only in the cases of anticipated situations. Unexpected calamities require an adaptable capability that recognizes new opportunities in any given situation (Dynes et al. 1976; Mintzberg et al. 1985) as mentioned in the paper. The disaster 3.11 and the delayed reconstruction process clearly points planning for recovery should be effective as well as efficient. Their capital model uses the empirical

data of 3.11 in a system dynamics model and visualises the model results as a simulation.

Taking evidence from this and asserting that resilience is the ability to recover capital effectively and efficiently, relative to the magnitude of the disaster. The capital model developed is based on the performance domain and community resilience indicators mentioned above- the critical capitals. One form of capital causes changes in another form through a capital conversion and creation system. The capital model demonstrated the critical role of enhancing the resilience capacities of systems. Once a form of capital is destroyed, factors within the community trigger changes in another form of capitals to take actions necessary for capital creation.

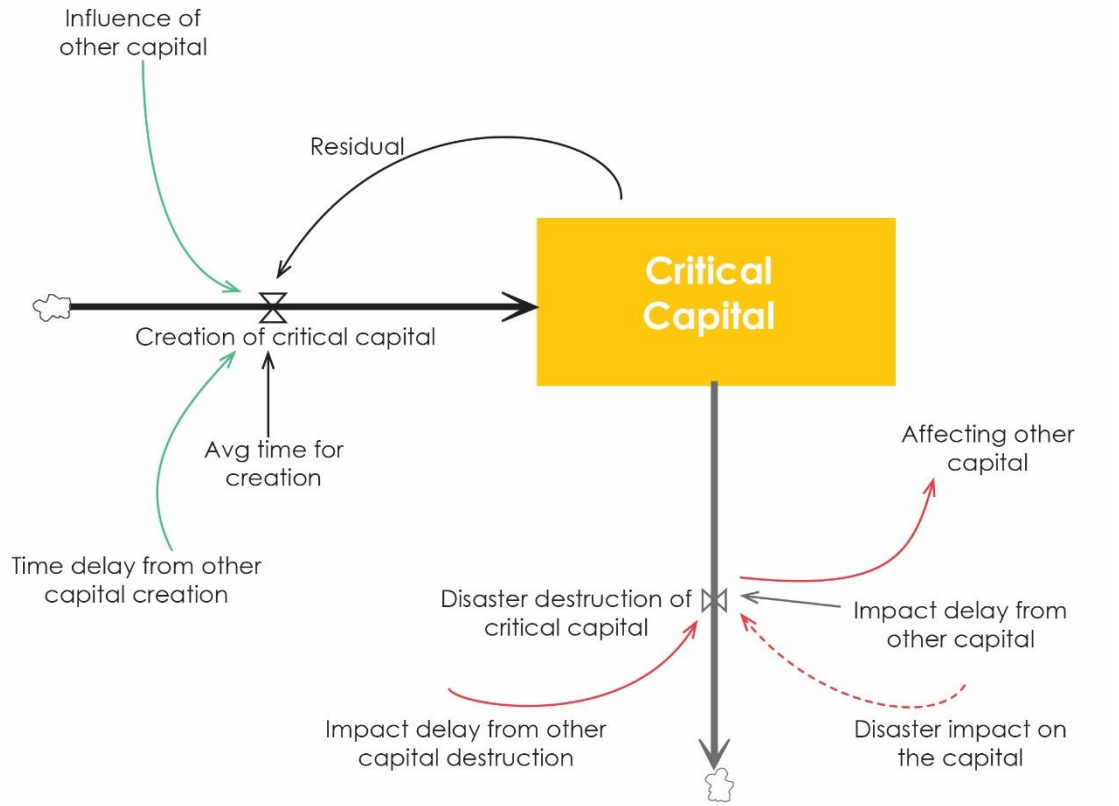

Figure 7-Concept critical capital model derived

In the above concept, critical capitals model the bold arrows directed towards and away from the critical capital indicate the creation and destruction of the capital. The green arrows show the time parameter and the influence of decision taken on other capital that impacts the creation of this capital. Similarly, the red arrows show the impact of other capitals on the destruction of this capital while indicating the other capital that gets triggered due to this change. The black arrows are delays and self-formation time arrows that impact the critical capital.

This concept critical capital model served as a basis for developing the causal structure and simulation behaviour of the dependencies within the six critical capitals. Another key aspect of this model is the Spatio-temporal outlook. Planning activities that need to be strategic yet emergent for the hazardscape are understood. This helps in taking necessary planning decisions within the critical capital network during

emergencies. The model explores the existing recovery and reconstruction activities at Otsuchi inclusive of all the delays and impacts of certain decision making during the 3/11 stage. The impact is explored further to assess the reconstruction plan and therefore to propose a new urban renewal plan for Otsuchi. The simulations are processed over a span of 5 years based on the planning principles. The model so developed is conceptual in form but can be further explored through the Vensim software for realistic results.

The causal structure of the system dynamics that indicate the dependencies between the different critical capitals is the key to understanding the importance of time and as criteria that influences the dependencies and changes the recovery of a community. This model helps further in actualizing the decisions under the design for preparedness to factor in contingencies from the other capitals. The Spatio-temporal vision that it guides is critical in planning for the hazardscape. Integration of emergent and strategic decisions indicate a specific typology of planning that supports such time-dependent decision making.

4.3 Developing a planning typology for the hazardscape

As understood from the earlier sections within the recovery and reconstruction in the hazardscape there is a lack of perception of what kind of decisions should be made and when? Dealing with the uncertain environments of the hazardscape the decisions need to be immediate and effective. This requires the knowledge of the hazard, the resilience capacities of the exposed and vulnerable capitals in the hazardscape while also necessitating the effective, emergent and strategic planning within the recovery process. By emergent, it means the strategies that are specific to the hazardscape and which further in the planning stage can be strategically improvised(Wiechmann, 2007). In this way planning for the short term as well as a long term can be made possible. These could be influenced through polices and design considerations that are sensitive and vital for the sustenance of the hazardscape.

For effectuating preparedness to a satisfactory level in the hazardscape, planning guidelines should be specific and emergent to the nature of the hazardscape and strategic in its process to mitigate and transform to become prepared for the next tsunami. This emergent and strategic nature of planning and the realization of emergency in crisis, as well as long-term planning post-disaster, leads to the formulation of this planning typology that is symbiotic of the hazardscape and evolutionary in approach that integrates within the other forms of planning within its near future. The graphic below extracted from (Alexander, 2013) explains the different stages within the emergency planning that can be modified and integrated with other forms of planning, therefore, realizing an 'integrated emergency planning' typology in the hazardscape.

By introducing integrated emergency planning typology in the hazardscape;

1. It attends to the need of long-term aspect of planning in the recovery and reconstruction processes.
2. It caters to the immediate and yet continual recovery process and strategy that evolves and improvises based on the necessities of the hazardscape post-disaster.

3. It provides decision synergy between the scales in the operational domain that effectuates planning ahead and planning post-disaster by arranging a necessary assessment of the various critical capitals that form the performance domains.

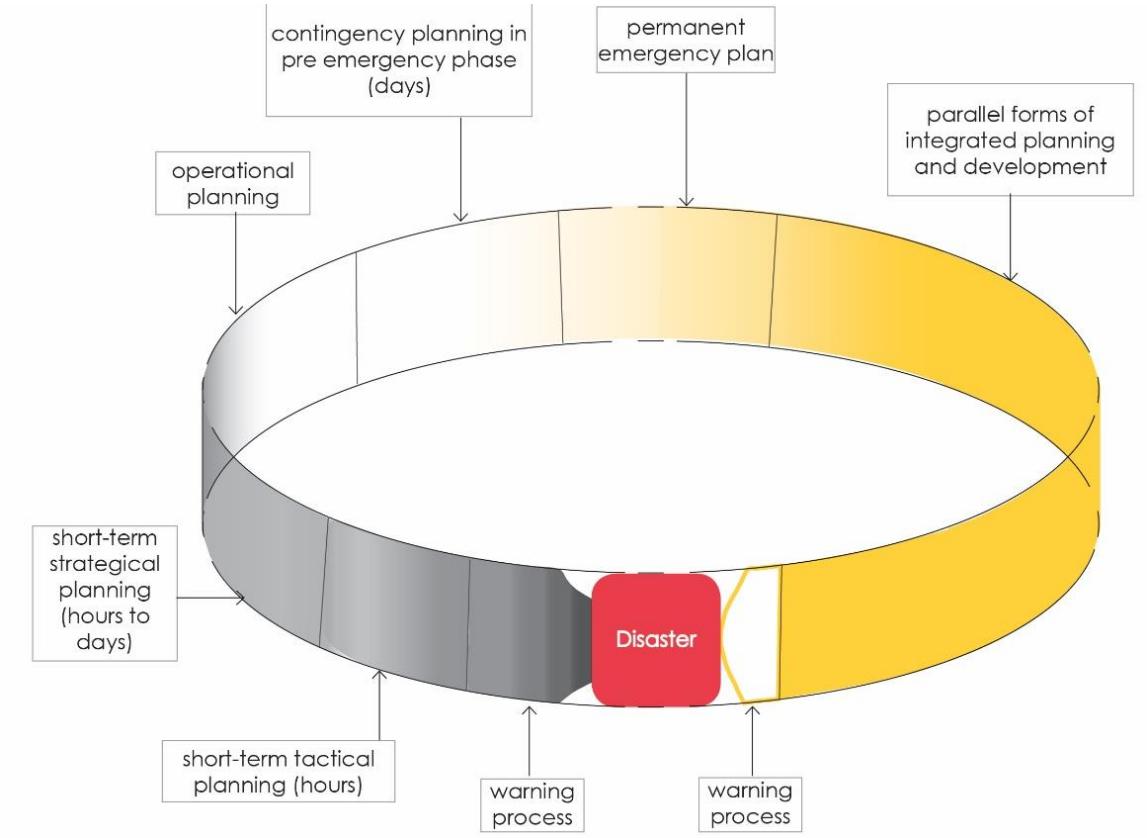

Figure 8 – Integrated Emergency Planning

4. The core principle of emergency planning is to reduce the likelihood of the lives being lost which is also the considered hypothesis for the project. While this aspect is essential to improve the resilience capacities in the hazardscape, it is also crucial to reduce damage to the environment (built and unbuilt) that caters to an efficient recovery. Since emergency planning is the foundation for this motivation, proposing this planning in a long-term way creates decision clarity, resource maximization, risk analysis, contingency planning, and faster in reaching normalcy(Alexander, 2013).
5. Planning is a continuous process and for a hazardscape more so due to its frequent changing nature. By making integrated emergency planning specific it supports community resilience.
6. While emergency planning takes care of the crisis situation, by adopting its principles of leadership role, participation and collaboration, engagement strategy, the preparation that are also the requisite aspects to achieve community resilience, exercising it for the hazardscape implicate for a better recovery.

7. The main aspect of emergency planning is getting results which are based on certain improvisations based on the outlook of the disaster, which characteristically changes many dependencies within the risk impacts.
8. Within a disaster situation, through many kinds of literature, it was also understood that to make decisions it was essential to be flexible, trustworthy yet also be accountable for the decisions taken to meet extraordinary circumstances with limited resources which can be adopted as a positive attribute of this planning typology.
9. Finally, as emergency planning is inclusive and accessible to all, consideration has been specifically given to the tsunami hazardscape, but its principles can be transferable for other hazardscapes which can be explored further.

5 Integrated Emergency planning (IEP) methodology

The integrated emergency planning cycle elaborates on the different stages of action and decision making that are integral for planning within the recovery and reconstruction process. These stages are critical for they change the course of recovery. Formulation and integration of the planning domains have been done based on the simulation results of the conceptual capital model and resilience enhancement of the critical capitals on site. The stages involved in the planning cycle commence with the emergency response that is spread over a few hours and days within which health of the affected population is significant for long-term resilience building. Stages following assess the damage and the scope of reconstruction required to be carried out.

5.1 IEP planning strategies

The actions listed against each of the planning stages are based on the collective capacities of the community as well as the influence of the political capital. The literature reviews pointed out the dependency of decision making limited to the political capital which has been altered in these approaches. The current political system in Japan shows a transition from top-down to being integrative of bottom-up approaches. This has been factored within the planning approaches by means of highlighting the decentralized state of the political capital. This results in reducing the complexity of risk during the crisis. The scope of work within each phase is Spatio-temporal in dimension and therefore result in contributing towards spatial design of the approaches into strategies depending on the relative capacities of the hazardscape.

The integration of long-term planning aspects does put pressures on the forms of planning towards timely action, but time is the critical element. The approach to planning therefore also takes into factor exercising these decision-making capacities of the political capital by proposing a directive for collaboration and exercising decision making that transcends across the operational domains. The principles of these planning approaches are integrated by running through the capital model to know if all the dependencies are met and if not which critical capitals need to be influenced.

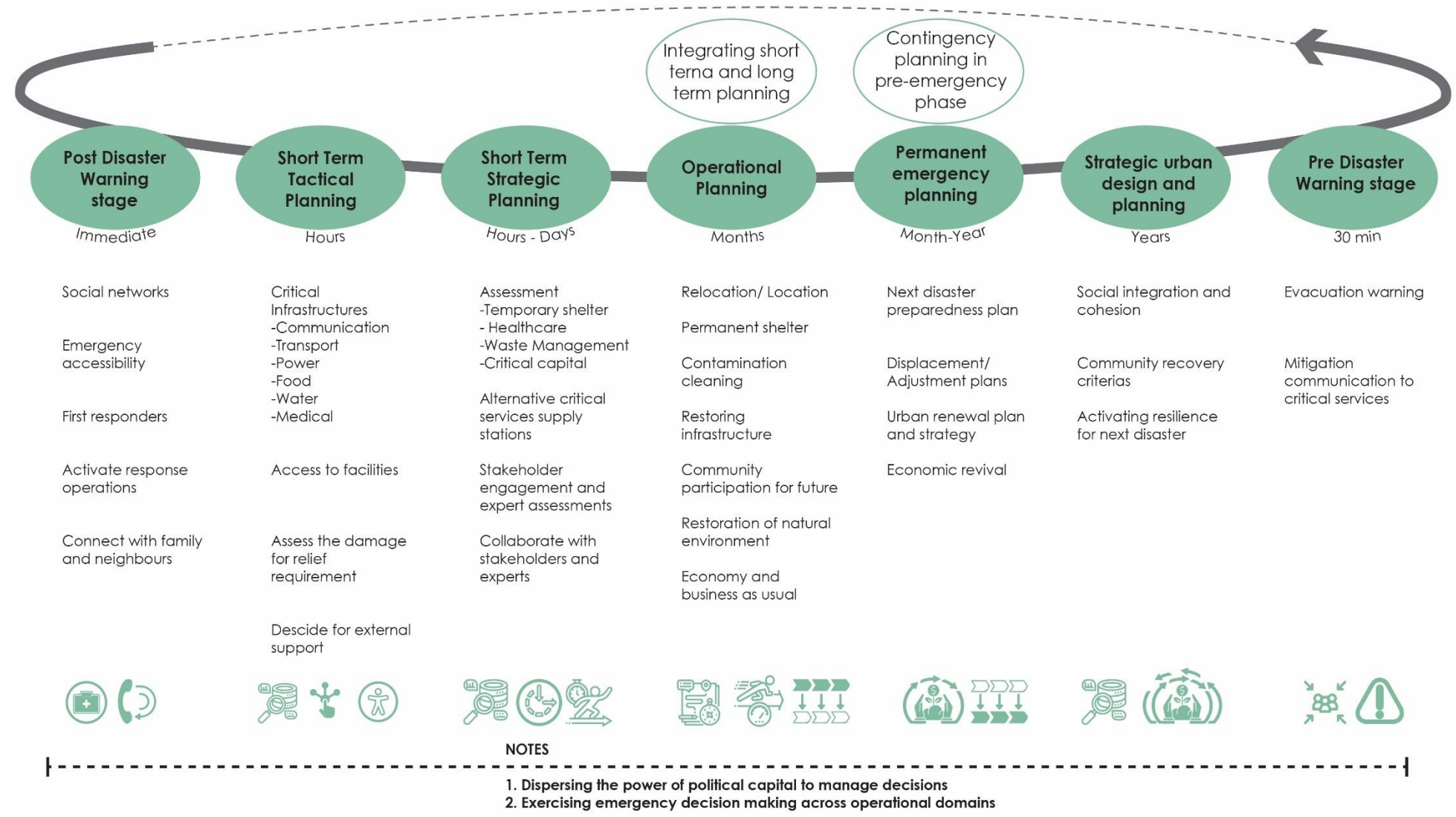

Figure 9- Integrated emergency planning stages

5.2 Roadmap for planning approaches

To implement these planning approaches in a formal way a roadmap for implementation was made based on the 3.11 impact that guides about the time investments within the planning fields. A 5-year timeline for planning and implementation is considered based on the contingencies. While this helps to know the effectiveness of the plan, the flexibility aspect within encourages to improvise if the need arises. Based on the timeline certain attributes for the critical capital model and urban design of Otsuchi were derived;

1. Alternate accessibility to critical services after the disaster
2. IEP planning results in less likelihood of loss to human and social capital
3. Decentralized political capital and exercise of IMP supports efficient decision making
4. Decisions in the event of a disaster will be based on empirical and rational possibilities of the available data backups.
5. Recovery and reconstruction activities will be based on an assessment of the hazardscape for its futuristic potentials.
6. The design for Otsuchi should be vital, sensitive, site-specific and futuristically sustained.

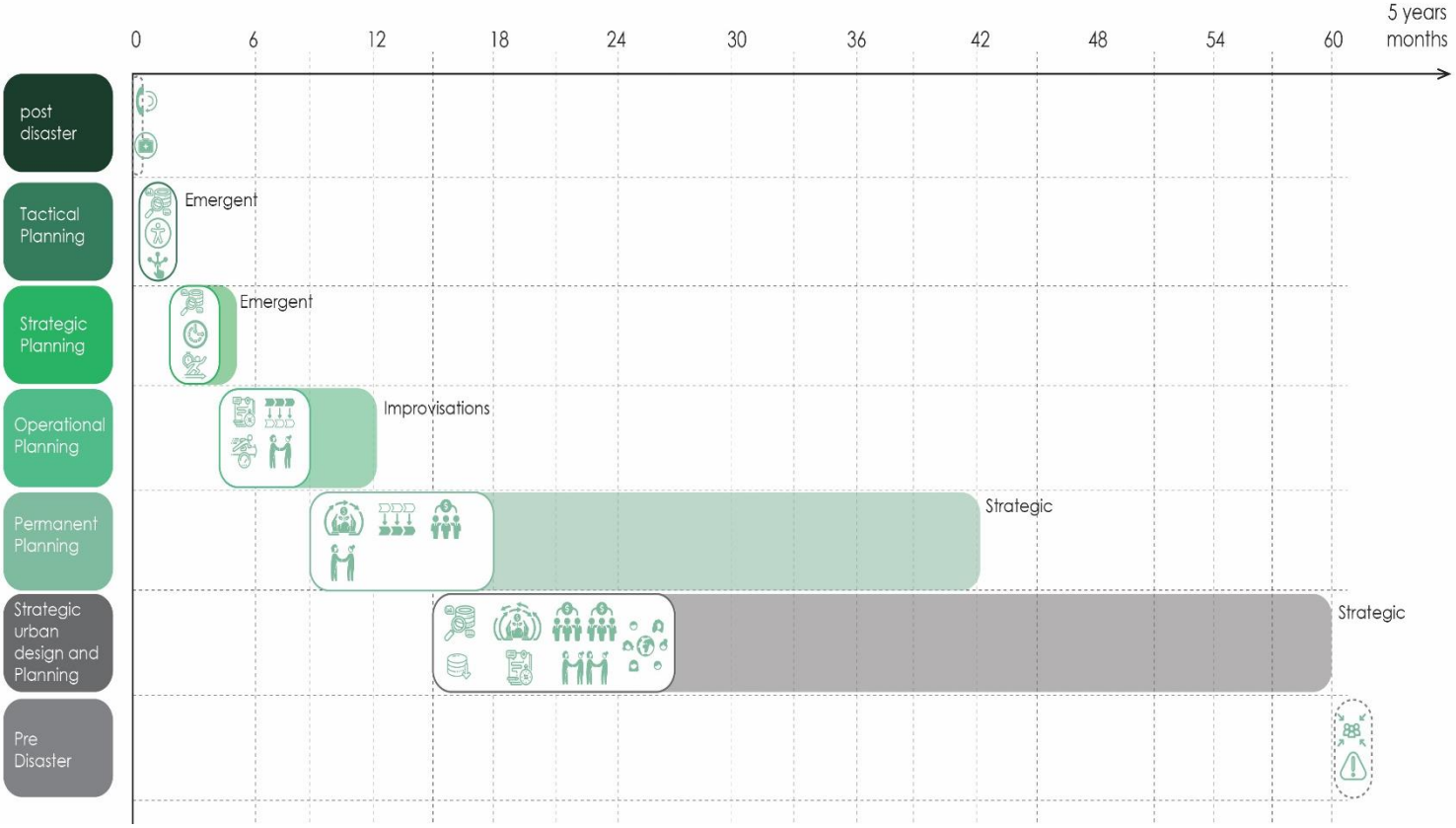

Figure 10- IEP roadmap for recovery (5-year plan)

5.3 Principles of Integrated emergency planning

Integrating strategies and processes within the framework of the integrated emergency planning requires to define principles that are specific to the hazardscape and particularly to the fishing communities of the Ria's coastline of Tohoku. These

principles support the decision-making and the time-dependent actions required during the recovery and reconstruction processes. The principles mentioned are categorized based on the balance of the 4Ps model which are people (resilience), planet (wellbeing), prosperity(feasibility) and project (damage/impact). These principles are explained in detail in (GM atlas, Ch-9).

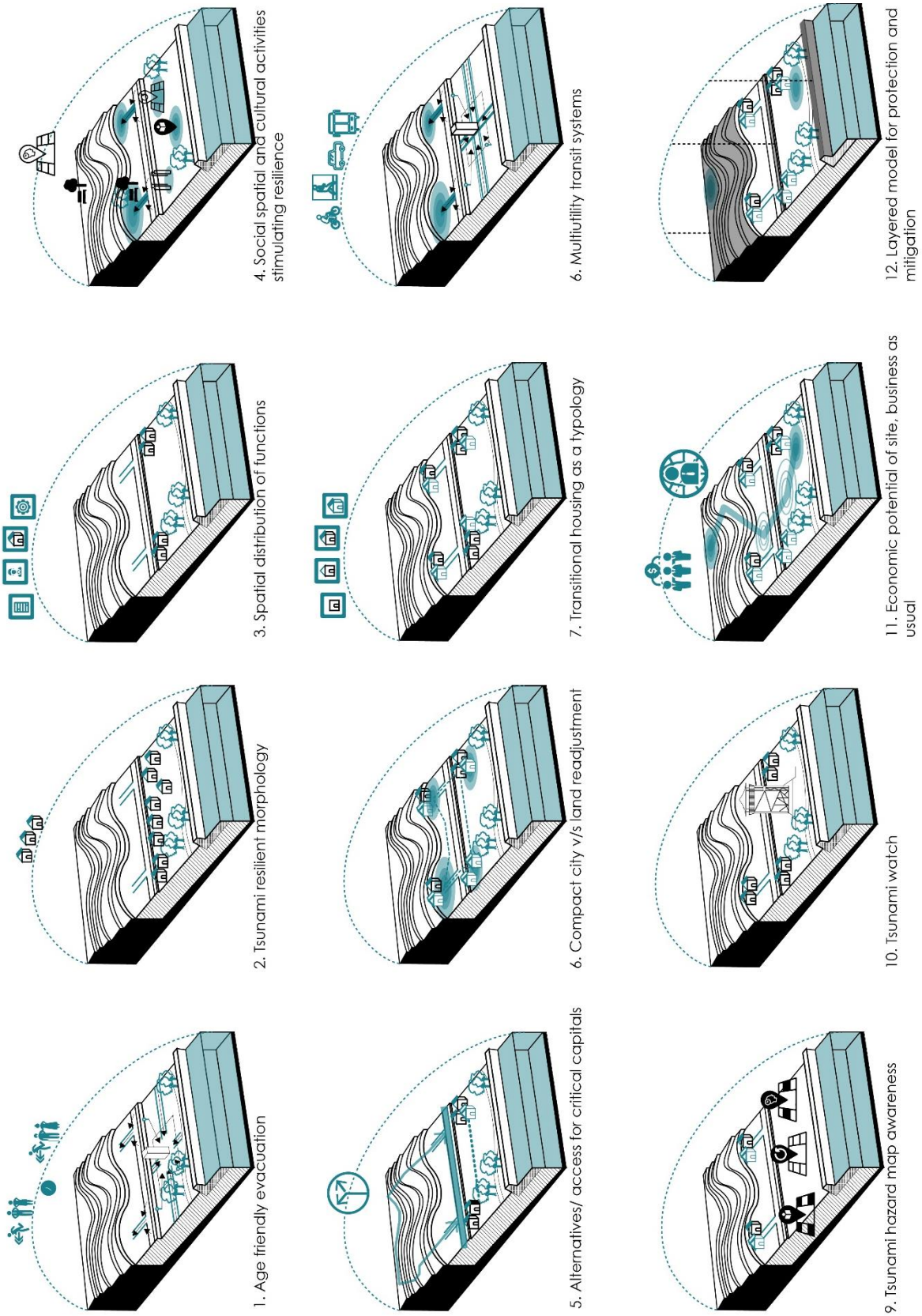

Figure 11- Integrated emergency planning principles

6 Applicability of results in Otsuchi

In the context of Otsuchi, based on the sensitivity analysis and the enhancement of critical capitals on-site (GM atlas, Ch-10) the new development/ renewal plan for Otsuchi was desired that is different from the current reconstruction plans. The 'design fiction' forms a strategy to understand and effectively prepare, mitigate and reduce the impact while planning for the post-disaster recovery measures. As it was realized through theories, preparedness is a continuous process, so the design strategy mapped the resilience conditions of Otsuchi prior to 3.11 and the reconstructed resilience conditions post 3.11. In doing so changes based on the developed planning methodology of IEP and the support tool of the conceptual critical capital model were integrated, and relative interventions were planned.

6.1 Sensitivity analysis and Otsuchi's vulnerability to 3.11

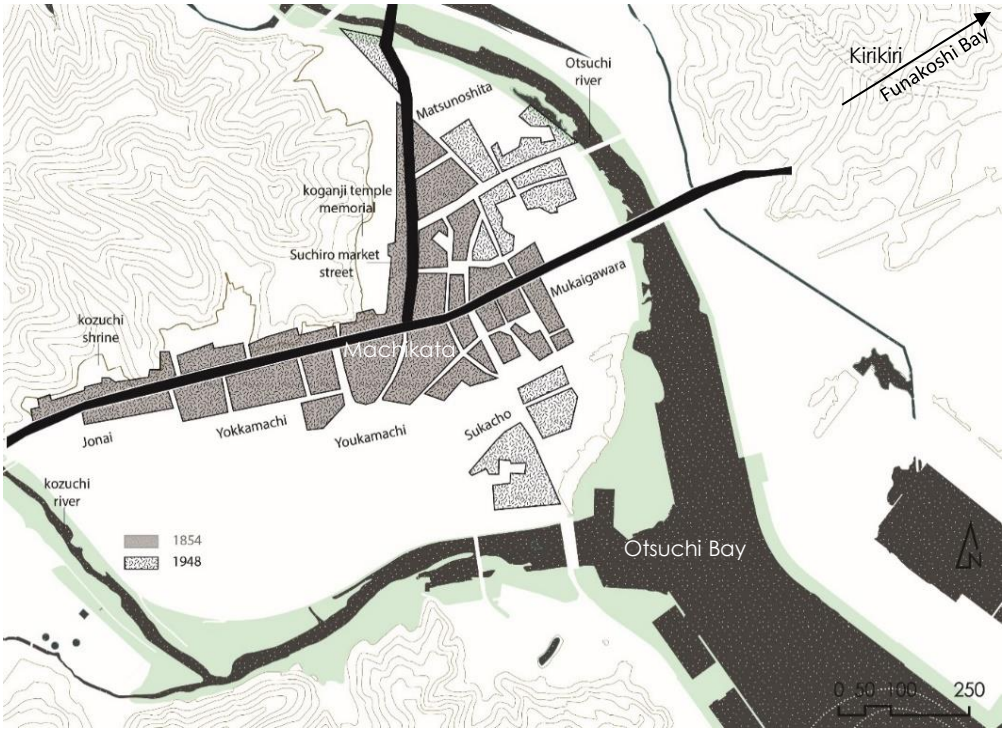

Figure 12- Historic old town of Otsuchi in1854- before 1896 The Great Meiji Sanriku tsunami and of 1948- before 1960 Chile Tsunami

The fishing village of Otsuchi located 50km north of Rikuzen-Takata on the Sanriku coastline in the Iwate prefecture and has had a history of being susceptible to the onslaught of the tsunami as seen from the historic old city map shown in figure-12 below. The orientation of Otsuchi village is typical of the ria coast i.e. steep and narrow bays. It is nestled between the mountains and faces two bays: Funakoshi bay and Otsuchi bay. The urban area of this town is located on an alluvial plain between the Otsuchi River (approximately 27.6 km long) and the Kozuchi River(Kume, Mori, Kitano, Sumi, & Nishida, 2018). Otsuchi prior to 3.11 was home to 16,000 people. The local economy of the town catered to the service sector with a significant contribution from

the fishing industries that farmed sticklebacks, salmon, scallops, seaweeds and other fish processing industries (Esteban, Akiyama, Chen, Ikeda, & Mino, 2016).

Post 3.11, 52% of the residential area was submerged underwater and 1,284 lives were lost. Furthermore, the fire that was propelled by the tsunami aggravated the conditions for three days. All emergency facilities from the fire department, police station, medical or healthcare facilities, administrative buildings of the town hall and district office buildings were all devastated as all were located in the downtown area of Otsuchi. To make situation worse the government was paralysed as many municipal officials including the mayor, directors lost their lives.

The sensitivity analysis (GM atlas, Ch-7)with respect to the historic contexts, that provides insights into the evolution of these dynamic social vulnerabilities and their socio-spatial and temporal relations. The results of the analysis conclude that;

1 Historically the coastal communities of Japan were resilient to the nature of tsunami and adapted themselves to the changing nature of the hazardscape by reflecting on the damage in their own traditional ways, that also resulted in stronger social connectivity. But with the development of tsunami science and the investments done in protective infrastructures, the change in frequency of disasters due to mitigation of the smaller disasters through the physical infrastructures created blind faith of the communities about the infrastructures in place.
2 The social memory of the disasters does not last more than 10years as seen from past events. The community symbols for actions during tsunami does not hold importance in today's times.
3 Intense tsunami events of 9M (repeat period of 500 years) that causes a greater impact on the living conditions acts as turnkey and lasts longer in recovery as well as social memory.
4 The political system, top-down governance methodology changes the course of disaster impact. Both preparedness, as well as the recovery stages, are crucial for mitigation of the impact.
5 For a total recovery(if it's possible), all stages of the disaster cycle (mitigation, preparedness, response, and recovery) should contribute in improving the resilience of the communities in the Sanriku coast.
6 All the activities and decisions directed towards a complete recovery should be symbiotic of its environments.

It is critical to understand here that by losing the decision-making officials in the event of tsunami the scope of reconstruction and recovery was affected drastically. By losing the pragmatic and rational decision-maker in the crisis it affects the response required for the emergency relief aid that further delayed the process of achieving normalcy. The analysis of decision making in the pre and post-disaster stage has been the focus for the sensitivity analysis in addition to mapping change in resilience within the critical capitals. The design fiction (GM atlas, Ch-10)examines this further in the Spatio-temporal scale and proposes for a new recovery model in case of a 50-100-year tsunami event.

6.2 Design fiction as a strategy

The analysis from the strategy and the dependency model of the critical capital through the principles of integrated emergency planning support the new vision for Otsuchi which is 'Kaizen Otsuchi'.

Figure 14- Otsuchi before 3.11

Figure 13- Otsuchi post 3.11

Kaizen means continuous improvement. The vision for Otsuchi realises the potential of Otsuchi for its inhabitants within the Tohoku region. This drives the vision for the revival of Otsuchi town, its identity with the place and the lost heritage due to 3.11 to form a safe and sustained community that is prepared enough.

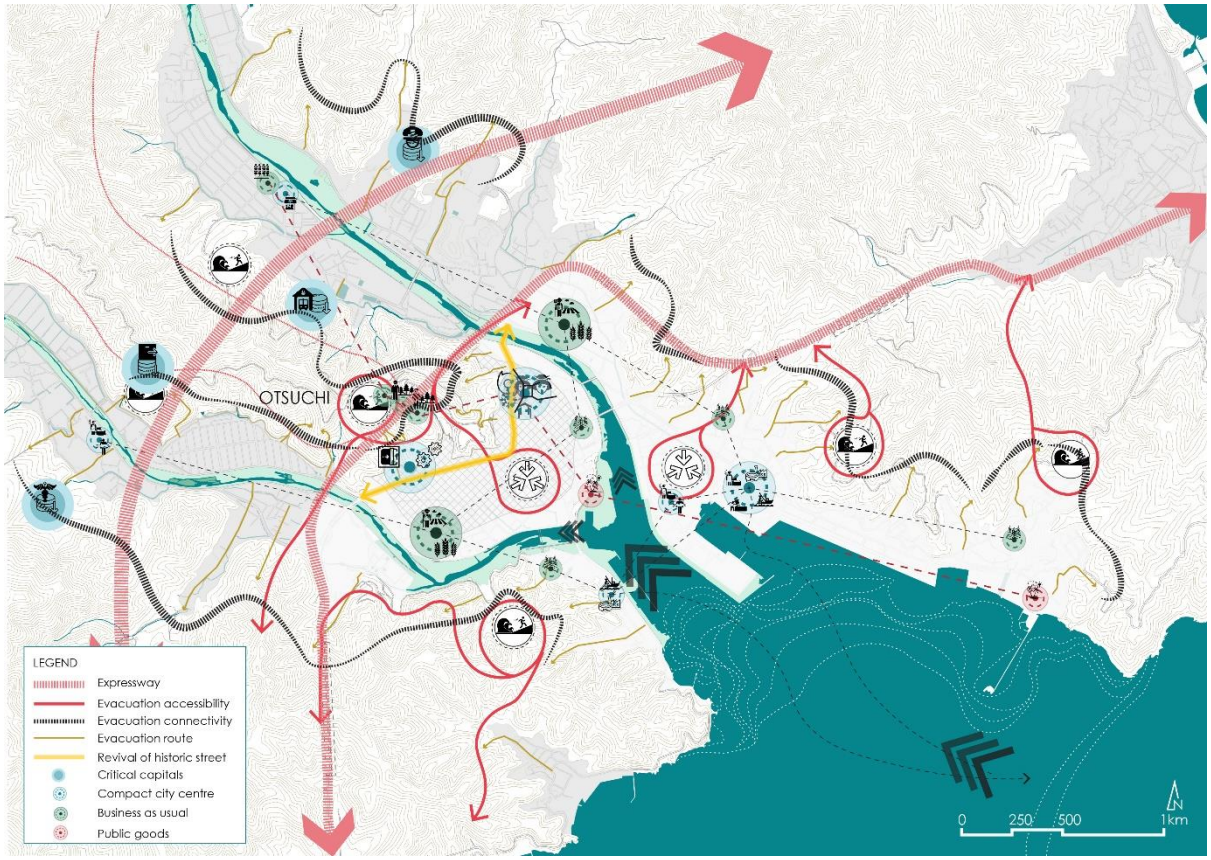

Figure 15- Vision for Kaizen Otsuchi

The map above highlights the vision goals identified for Otsuchi's renewal which are discussed in detail in the atlas (GM atlas, Ch-10);

1. Accessibility to critical services even during a disaster
2. Retained connection with the land and sea, hence no sea wall till 15 years
3. Regulate coastal zoning measures
4. Stimulate collaborative business as usual projects
5. Revitalise the downtown
6. Revive Otsuchi's natural heritage

6.3 Revival and Renewal of Otsuchi

The urban renewal design of Otsuchi (GM atlas, Ch-10) relies on its potential as a site for historic and natural treasures while embracing the nature of frequent disaster like conditions. With this ideology for the communities living in Otsuchi, important design considerations were made for its holistic recovery.

1. The downtown area of Otsuchi shall adhere to the coastal regulations for zoning. The area near the bay moth will not be habituated and will be used for multifunctional use of economic production, recreation and biodiversity.
2. The physical protective barriers such as dykes, flood gates at the bay mouth and breakwater will be rebuilt in harmony with the prevailing ecosystems of the area.
3. Railway connectivity shall be restored at the same place with due consideration given to the feasibility of rerouting. While additional highway connectivity shall be built behind the inundated areas for alternative access during disasters.
4. The downtown areas considered unhabitable shall be relocated in the new city's fabric with due consideration to the sentimentality of the people and rational of the place. In addition, compact and concentric planning of functions and activities shall be managed for the town's proliferation.
5. Evacuation routes and centres (horizontal and vertical) will be accessible in the event of the disaster through the urban morphology and tsunami resilient designs.
6. Evacuation designs for steps and ramps to reach the evacuation centres shall respect all age groups and post-disaster map the demographics for spaces contributing to sharing typology.
7. The natural and social elements like freshwater springs, tsunami stones etc will be used in the city fabric as evacuation directions and will be made aware to people through hazards maps and media.
8. Old heritage structure sites damaged in 3.11 shall be co-designed based on concepts of social memory and cultural remembrance.
9. The economic potentials of the land shall be dealt with business as a usual model and holistic research in the sector of contingency planning.
10. The old historic town road shall be revived with distributed amenities and residential spaces around.

11. After the disaster, the land will be redesigned for readjustment based on priority without delays. This shall be done in addition to the assessment for compact city planning and relocation.

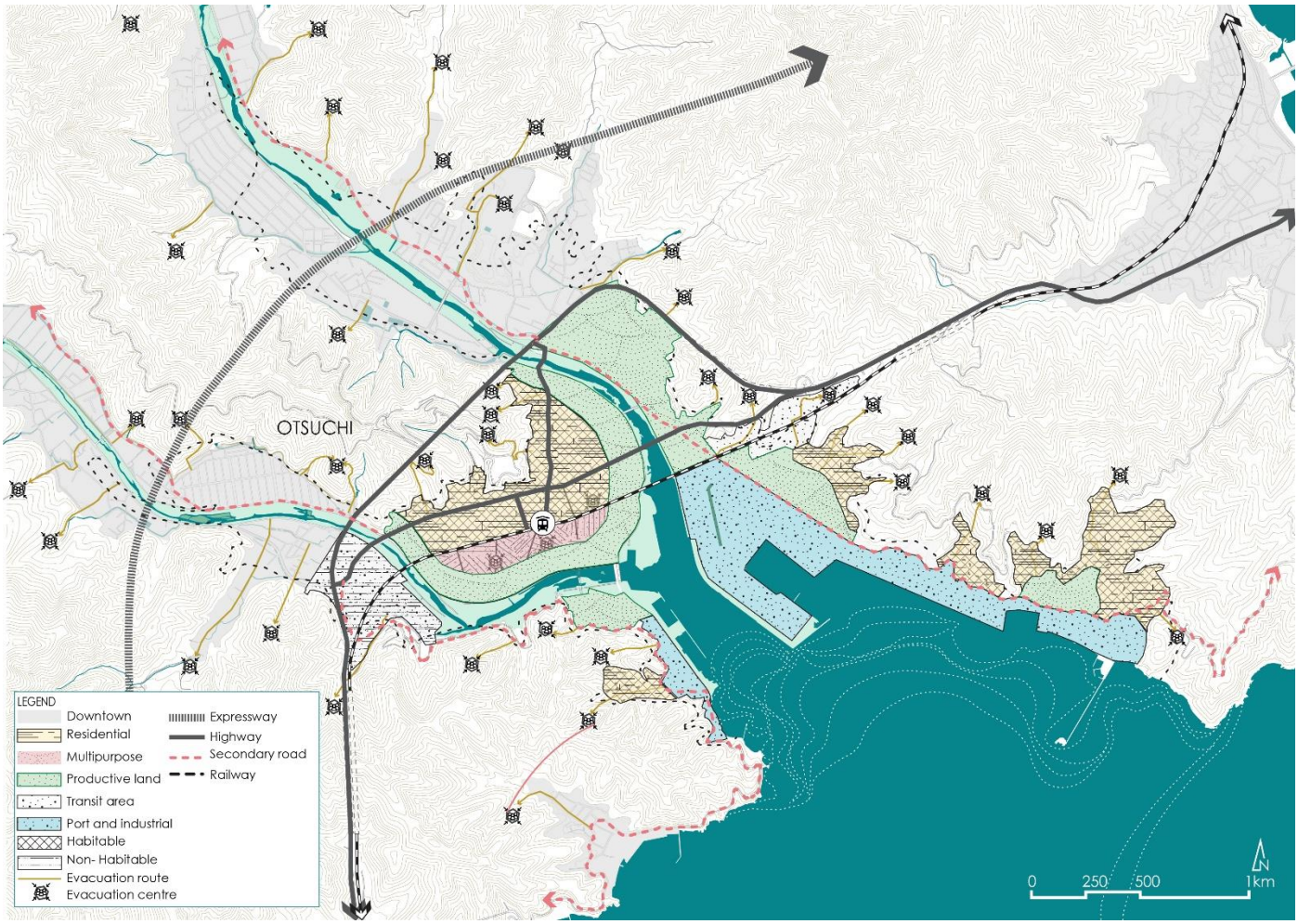

Figure 16- Renewal of Otsuchi

6.4 Critical capital model of dependencies

Based on the site analysis and the assessment of the capital model for 3.11, a new model was developed that considered the dependencies of the urban renewal plan and assists in making dependency conclusions that can assist in the spatial placement of critical services. The model also helps to simulate the result based on the changes in the resilience capacities of Otsuchi due to the decisions made in the new urban plan. This helps in assimilating the aspects of decision making that because they are spatial in nature also result in changing the resilience for a longer-term.

The model considers political capital and the social capital only to have a network with the outside of Otsuchi. This helps us in understanding the community parameters (self-contained) that contribute to the resultant dependencies. While decisions are made at the town level by the mayor who is the political capital. The decentralized political system and the exercising the directives of emergency help in taking better decisions even with limited resource availability in the event of the disaster.

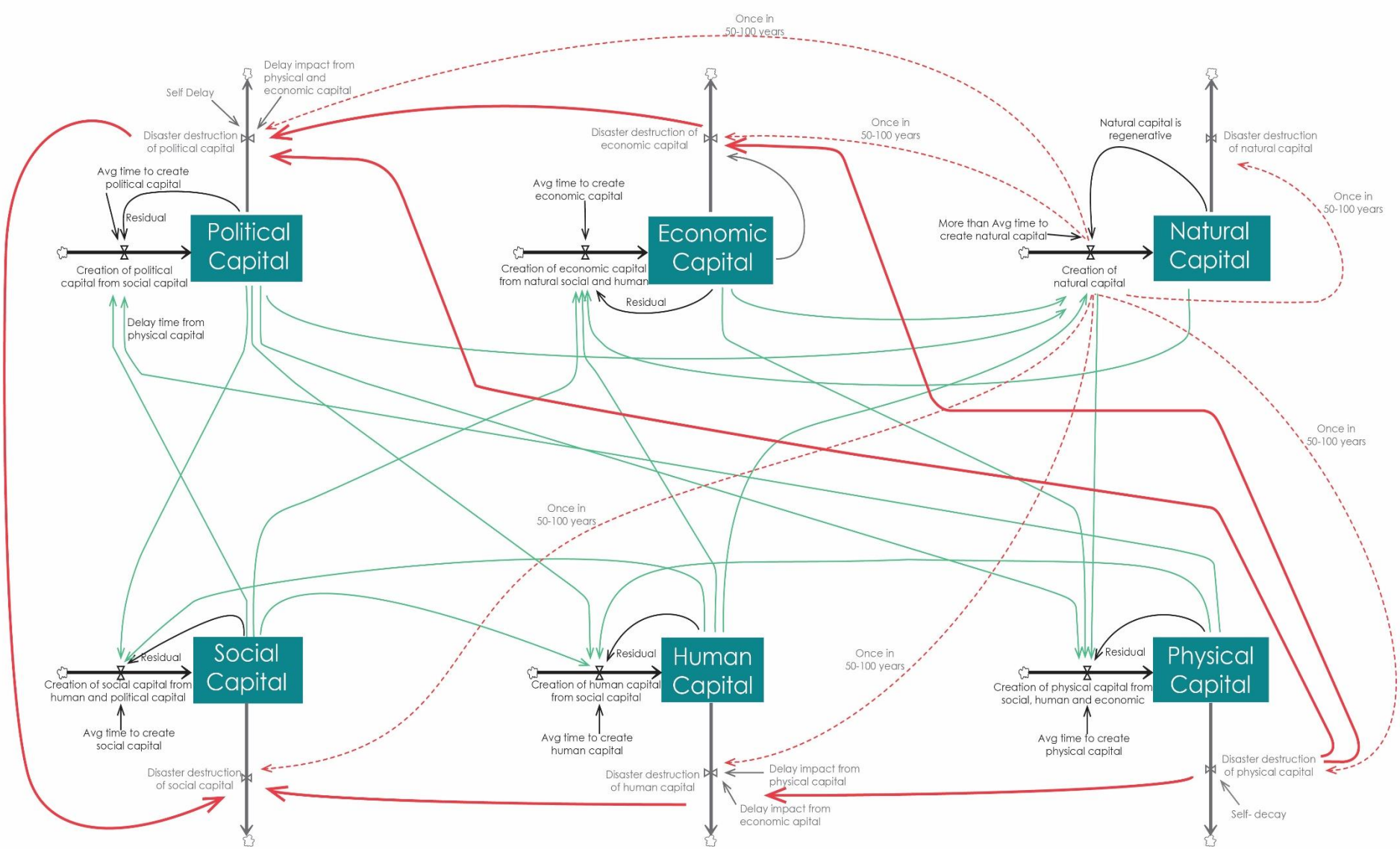

Figure 17- Critical capital dependencies based on the renewed plan

6.5 Simulated resilience of recovered Otsuchi's

Based on the renewed urban design of Otsuchi and the altered state of critical capitals, simulation for the same impact as that of the 3.11 with 9M of earthquake-tsunami is carried out. The results show not much difference for the physical, social and natural capitals but due to resilience improvement of the political, human and financial capitals there is less deflection in the state of the capitals, conclusively the impact felt is reduced. Due to the resilience thinking for a sustained recovery, strategies for livelihoods have a long-term impact. It is not known now if this also changes the demographic configuration of Otsuchi from the ageing and shrinking society to a balanced state, but it does strategies towards achieving that state without compromising the heritage and future of Otsuchi.

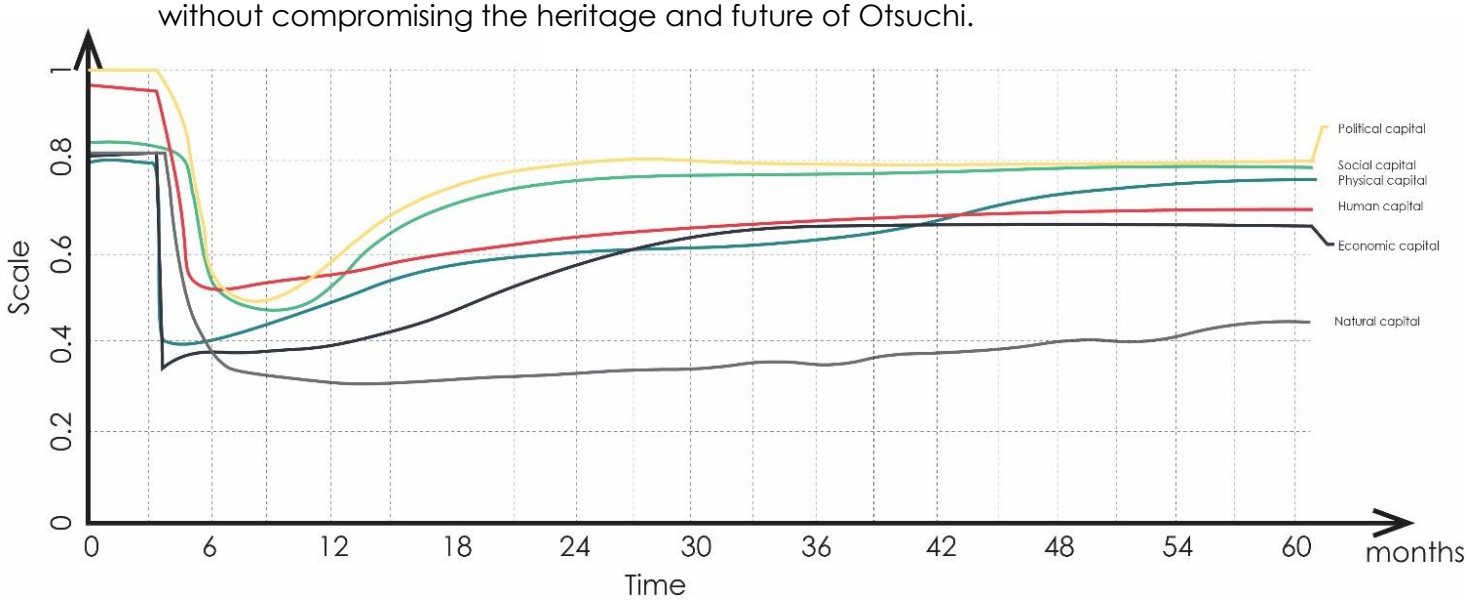

Figure 18- Evolution of resilience in critical capitals

7 Discussions and conclusions

Effectiveness of integrating emergency and forms of planning

Within the changing scope of the hazardscape, it was realized that to influence the resilience capacities the planning strategy must be emergent of the historic, societal and political norms but also strategic in realizing the outcomes of the disaster risk reduction at Otsuchi. This prepares Otsuchi for a holistic and resilient future.

Post reconstruction is an opportunity for a better chance. Planning in the crisis situation within the emergency phases is crucial. Applying emergent methods that are contextual towards the cultures is key to being sensitive in the initial stages. This develops better mutual understandings within the domains and critical capitals. Time is also very important to improvise certain aspects that are adverse and unfavourable, like construction of sea walls. In time, introducing strategic planning that is collaborative and that integrates with these improvised and flexible emergent strategies further controls the form of resilience in the societies within the hazardscape.

Project insights and conclusions

This section of the reflection highlights the drivers for the workability of the project, direction for the research, collaborations of specific approaches considered for integrative thinking that the project required. These aspects not just affect the planning and design but also provide leverage to take decisions in emergent situations, navigate a course of reconstruction process while adapting to the policies principles of the site.

1. Reverse research methodology

The project has been conceived based on the outcomes of the workshops between the multidisciplinary students from Japan and the Netherlands. The understandings developed from the methods of scoping for the reconstruction of Otsuchi delineates the scope for the project. This approach while being inventive follows a reverse research methodology that is bottoms up, based on the recovery requirements generated by the site while realizing the ground reality and accordingly shifts from the lower scales to the upper scales of research frameworks. Particularly in the beginning it was realized that the reconstruction measures are neither holistic and nor long term in aspects, but by following this methodological approach the gaps in the proposals also came into focus. This clarifies the corresponding research, approaches, proposals and developments within the project.

2. Multidisciplinary influence

Collaboration in a multidisciplinary setting provided grip about the engineering aspects giving insight about the tsunami science, the deltaic morphologies and other peripheral urban sciences thereby presenting the holistic dimensions of the reconstruction processes. The physical nature of reconstruction was identified to have superseded all other aspects of reconstruction measures. While the majority of the town was left to dwindle the negative aspects of the tsunami and society shrinkage, the delayed aspect of planning resulted in conditions becoming worse. The scoping exercises done through the lens of the balance of 4Ps, proposed the desired nature for the reconstruction and considering them as a hypothesis the research question was formulated.

3. The longevity of reconstruction processes

Research into the physical reconstruction measures revealed the superficial nature of the recovery measures being accelerated that is not thought for long term outcomes of the coastal community. The economy is leverage for humanity to thrive and flourish. As the potential of the post-tsunami scape was not understood fully. Reconstruction and recovery measures are seen to be nothing other than a resource overuse. To deal with hazardscapes decisions need to be emergent only in the crisis situations, post that stage for holistic recovery strategic actions is required that have a long-term perspective that is sensitive and contribute to the specificities of the location.

4. Socio-technical barriers to decision making

Crisis situation needs emergent decisions that are improvised strategically and reduce the possibility of further cascading impact of risks. This understanding adds a tremendous development to fill the gap for the decision making within the

emergencies with guidance for long-term recovery measures. The socio-technical elements within the hazardscape having Spatio-temporal risk are evaluated based on the disaster resilience model developed in the research. This guides the decision making for the post-disaster reconstruction.

5. Spatial nature of risks

In the hazardscape, the nature of risk is frequent, certain, intensifying and sometimes cascading, that creates huge systemic failures and therefore disrupt quicker return to normalcy. This aspect of risk can be mitigated based on the spatial nature of the socio-technical elements. This realization is to a larger extent also reflected in the post new urban design for the town of Otsuchi.

6. The idea of holistic recovery

While the initial inference for recovery and reconstruction was to have a safe and resilient community. The underlying driver that essentially make the community resilient like the certainty of disaster, aspects of preparedness overprotective, sustainable values and validity of measures for a cross-generational benefit triggered guidelines and strategies for the project to become both integrated and yet holistic in nature. This outcome, therefore, aligns itself to the identity, behaviour and community aspect of Otsuchi which was aspired as the main criteria for reconstruction of Otsuchi in the workshop as well titled "Revival of Otsuchi treasures" incorporated in the atlas.

7. Resilience intrinsic of hazardscape

The key aspect that cumulatively shaped the project is the understanding of resilience in this context. This realization triggered the nature of critical thinking that developed for the site based on the conditions of feasibility, resilience capacities, damage proportions, the wellbeing of the society and the integrative design strategy. The progression of resilience from concept, to community resilience becoming a scale for integration that is driven by the social capital developed a mature understanding of the possibilities to change resilience capacities. This observation in addition to literature reviews about the different frameworks in place for resilience qualified for considering it for the assessment within the performance domain which is reflected in the simulation studies of the various capitals based on the urban design.

8. A radical way of interlinking spatial, technical and social factors

The development of the project based on the research methodology also conceived into forming connections between the social, spatial and technical factors that was a missed in the recovery and reconstruction strategies. With these three factors interlinked such that spatial dependencies based on technical factors resulting in social changes help in forming strategies that can be relied upon and are radical. The project understands the need for this interlinkage for an effective and efficient recovery and drives the design to conclude similarly.

9. Creation of sharable communities and societal reformation

In its initial research stages, the project realized the urbanization consequences in Japan, though the outlook of the project was not directed towards shrinkage, ageing and resource stagnation, the developed vision and strategies take into factor these

contexts. The results cannot be known immediately but contemplating the scenario based on the simulated outcome, it can be said that stimulating and improving resilience in the hazardscape has the capability of also changing the demographic context making it sharable, symbiotic and sustained.

8 Limitations

Language barrier

Though the information was in abundance it was inaccessible mostly otherwise requires a lot of struggle with translations. This knowledge barrier many times could have discouraged to access much of the important information for the projects. In this case it was too time-consuming.

Rehearsed information

The field visit though was informative and provided diverse information on many disciplines, yet it was too structured and felt rehearsed. It was too sensitized that restricted rational thinking. Furthermore, due to this factual information about the site and the societal conditions of the people specific to the site was greatly missed in mapping. This detail of the site could have resulted in a much richer outcome for observations of economic land use and diversity of potentials for the design while being sensitive to Otsuchi only. The randomness of site surveys and might have changed the outlook of the designs for the downtown area.

Limited workshop time
The overall time spent at the site did not factor to observe and feel what living in Otsuchi could be like for the inhabitants. This was greatly felt while designing for the downtown area.

9 Further research

While the products developed within the process of the project are complete and reliable.

For a more qualitative and quantitative results, the capital model can be simulated for definitive outcomes for which the conceptual model can be run through the VENSIM software. The outcome can be elaborated for many scenarios and can be used as a starting point for further research into capital model dependencies within collective domains of organizations.

Research points out that the spatial planning levels require information regarding the implementation of the decisions for the capitals. This requires research within the capitals for the scenarios under the pressures of feasibility, contingency and temporality while also having societal consensus.

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