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Using System Dynamics Modelling and Communication Strategies for a Resilient and Smart City in Vietnam

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Abstract

This study reports on a case study using a systems thinking approach, system dynamics modeling tools and communication strategies in dealing with a complex disaster management issue in Haiphong, a vulnerable coastal city in northern Vietnam. Desktop studies together with a number of interactive workshops were organized that provided inputs for developing a big picture of the current situation using Vensim software. Bayesian network modeling was then used to identify systemic interventions aiming at achieving the final goal of a disaster ready, resilient and smart city. A number of communication strategies have been formulated and implemented. Initial evident successes of the interventions are discussed in this article.

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Keywords

system dynamics modeling; systems thinking; communication strategies and tools; disaster risk reduction; resilient city

1. Introduction

We are living in an interconnected world. There is a high need to seek sustainable solutions to environmental challenges (Ho, Law, & Lim, 2017). Vietnam is ranked among the top five countries worst affected by climate change ("World Bank", 2011). The long coastline, low lying area and complex river systems of the Red River Delta (RRD) (Northern Vietnam) expose it to various consequences of climate change, including erosion, typhoon, sea level rise, flooding, and extreme weather events, etc. (Le, Nguyen, & Shibayama, 2014; Nguyen & Shaw 2010; Takagi, Thao, Esteban, Mikami, & Ca, 2015; "World Bank", 2011). As a coastal city in the RRD, Haiphong is highly vulnerable to these risks ("Disaster Preparedness and Resilience: Vietnam", 2016).

A previous study by Le and Ha (2016) revealed that dealing with disaster risks towards a resilient city is a highly complex issue. This complexity is also reflected in the national strategy for natural disaster prevention, response, and mitigation to 2020 (Vietnamese Government, 2007). Besides building capacity for local organizations, businesses, and communities in response to the uncertain risks, a holistic approach is required to utilize and strengthen public-private partnerships (PPP) for synergic efforts in disaster risk reduction (DRR). In addition, communication strategies through an awareness campaign were also defined as critical to raising awareness of both public and private sectors and thus stronger collaboration in the disaster preparedness and responses (Le & Ha, 2016).

Traditional problem-solving approaches with a top-down and linear vision have been proven inappropriate, leading to various failures and unsustainable outcomes (Bosch, Nguyen, & Ha, 2014; Ha, Bosch, & Nguyen, 2015a, 2016; Vester, 2007). In terms of project management, the traditional approach using the logframe matrix has recently been criticized due to its rigidity and supply-driven approach where no learning occurs (Fujita, 2010). Acceptance of a soft systems approach in project management and evaluation has been growing. Pollack (2007) criticizes the conventional hard paradigm regarding its over-emphasis on control using reductionist techniques in which the project manager is considered as an expert, with no requirement for participation. In contrast, the soft systems approach emphasizes learning and social processes, requiring participation from local beneficiaries and stakeholders.

Systems thinking and system dynamics have recently been proven their effectiveness and validity in addressing complex problems in a variety of contexts around the world (Bosch et al., 2014; Bosch, Nguyen, Ha, & Banson, 2015; Maani & Canava, 2007), including Vietnam (Ha et al., 2015b, 2016; Nguyen, Graham, Ross, Maani, & Bosch, 2012; Trinh, Ha, Bosch, & Nguyen, 2015). However, little research has been carried out using the systems thinking approach and system dynamics modeling tools in the field of disaster preparedness.

Therefore, this study was conducted using system dynamics modeling together with a comprehensive communication strategy via a media campaign and partnerships to aim at a resilient and smart city through improved knowledge, awareness, capacity and shared vision among local government organizations, businesses, and community members. In which, local businesses are the primary target group due to a large number of enterprises in the bustling city (Le & Ha, 2016).

The paper describes process steps in configuring the 'big picture' of the current situation in the research area using a systems approach, followed by the identification of strategic actions and/or systemic interventions to achieve the goal, including communication strategies. The conclusion section highlights key findings of this research and recommendations for future research and application.

2. Methodology

The study was carried out in Haiphong, a coastal and vulnerable city located in the Red River Delta of northern Vietnam during 2015-2017. A desktop study for understanding the current situation was conducted based on existing information from a previous baseline survey in 2014 ("PWA", 2014) and secondary data from relevant departments and organizations. Those include the Vietnam Chamber of Commerce and Industry (VCCI) – Haiphong chapter, Haiphong Alliance for Cooperatives and Enterprises, and Departments of Planning and Investment, Statistics, Agriculture and Rural Development, and Natural Resources and Environment, and some active projects of non-profit organizations in the area.

A number of dialogues, focus group discussions, and workshops were organized to obtain inputs from representatives of the local organizations and relevant stakeholders with the support of user-friendly system dynamics modeling tools. Results of these activities together with the desktop studies were used to develop a causal loop diagram and/or a systems model of the project using Vensim® software ("Vensim 6.1.", 2011). The model depicted the current situation, highlighting causal relations and patterns of relationships among different factors (key issues identified by the stakeholders) that influence the achievement level of the end goal (disaster ready) Haiphong city. It also revealed leverage points for systemic interventions and which stakeholders could be involved in each intervention. NeticaTM software (Norsys, 2013) was used to identify systemic interventions and/or strategic actions and test future scenarios and measure impact through sensitivity analysis and modeling. The sensitivity analysis involved discussions of the participants regarding (1) the current state of each factor (system node and/or variable) within the systems model that were indicated in probability of occurrence; and (2) influence levels of the influencing factors on their dependent nodes, and eventually the target node.

3. Results and discussions

3.1. Configuring the 'big picture' of the current situation

This section provides an overall picture of the current situation by outlining a number of interrelated areas and factors in relation to disaster risk management based on all available information from the desktop study and results of interactive activities with the key local partners and stakeholders. Inputs from the above activities helped to identify key variables for developing a systems model using Vensim® software ("Vensim 6.1.", 2011) that represents the ***'big picture'*** of the context, patterns of causal relationships and interplays amongst the factors. The rich picture also helps to see potential stakeholders involved and what interventions should be taken to achieve the end goal of "disaster ready" (Figure 1).

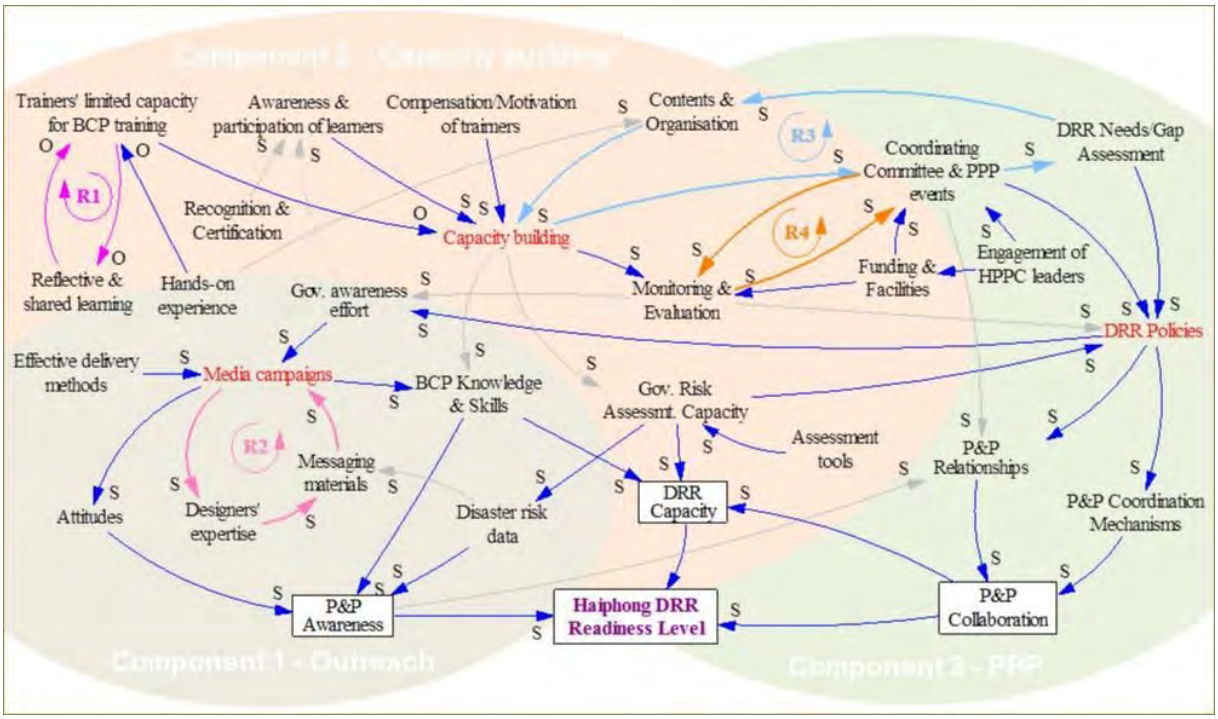

Figure 1. Casual loop diagram (CLD) modeling for understanding thecurrent situation of disaster risk management in Haiphong. Notes: S – samedirection; O – Opposite direction; R – Reinforcing feedback loop; Red variablesrepresent potential levers for systemic interventions; DRR – Disaster RiskReduction; P&P – Public & Private; BCP – Business Continuity Plan.

The systems model reveals that the ***three expected outcomes*** (improved public and private awareness, enhanced capacity, and strengthened public and private collaboration) are influenced by various factors that are interlinked. Interventions to achieve a certain output do influence other factors within the system and eventually affect the achievement of the goal. For example, "engagement of HPPC/local government leaders" in establishing a coordinating committee is critical to improve public-private relationships and coordination mechanisms for achieving Outcome 3 (increased public and private collaboration) (Figure 1). The involvement of local government leaders is also important to influence the disaster risk reduction (DRR) policies. It, therefore, influences the local "government's awareness effort" via "media campaigns", leading to improved public awareness, understanding and thereby adequate actions (Outcome 1). As a result, the improved awareness would motivate members of both public and private sectors to participate in DRR capacity building that contributes to achieving Outcome 2 of the project (Figure 1). The content of training on Business Continuity Planning (BCP) were agreed by the stakeholders to use for both public and private organizations and businesses due to its generic nature.

There are three important "***leverage points for systemic interventions***" (red variables, Figure 1) in achieving the expected outcomes and the end goal. Interventions taken to change the current status of these variables (i.e. effective campaigns, capacity building and DRR policies) would enable to achieve the goal through joint efforts of public, private and non-profit sectors.

The "capacity building" used in the above model implies both business risk reduction (BRR) or business continuity planning (BCP) training for enterprises and enhancing the capacity of government officials in relation to DRR preparedness and management. To improve the effectiveness of the BCP training, eight domestic trainers together with key partners, via focus group discussions, defined four key factors that together determine training quality. Those include (1) trainers' capacity; (2) training content and organization of training; (3) awareness and motivation of local businesses; and (4) compensation/motivation of trainers. According to the participants, their "hands-on experience" through a pilot development of some complete BCP strategies at businesses in Haiphong and "reflective and shared learning" are critical to improve their "BCP" training ability, and to develop and adjust appropriate content relevant to the context of Haiphong (Figure 1).

The developed systems model could be regarded as an effective "***communication tool***" to facilitate the stakeholders in identifying areas of potential interventions and discussing their roles and responsibilities for coordinated actions. The model provided a strong basis for defining systemic interventions to achieve the defined goal.

3.2. Defining Systemic Interventions Towards Achieving the Goal

Based on the developed systems model of the project (Figure 1), Bayesian belief network (BBN) modeling using NeticaTM software (Norsys, 2013) was conducted to support defining systemic interventions for achieving the overall goal of a disaster resilient city.

Figure 2.1 reveals the current situation of disaster risk management in Haiphong without interventions (initial state). The interrelationships amongst the factors and their impact levels were identified via group discussions and workshops with representatives of key stakeholders. Three levers for systemic interventions include "media campaigns", "capacity building" and "DRR policies" that represent key places of interventions for achieving the three expected outcomes.

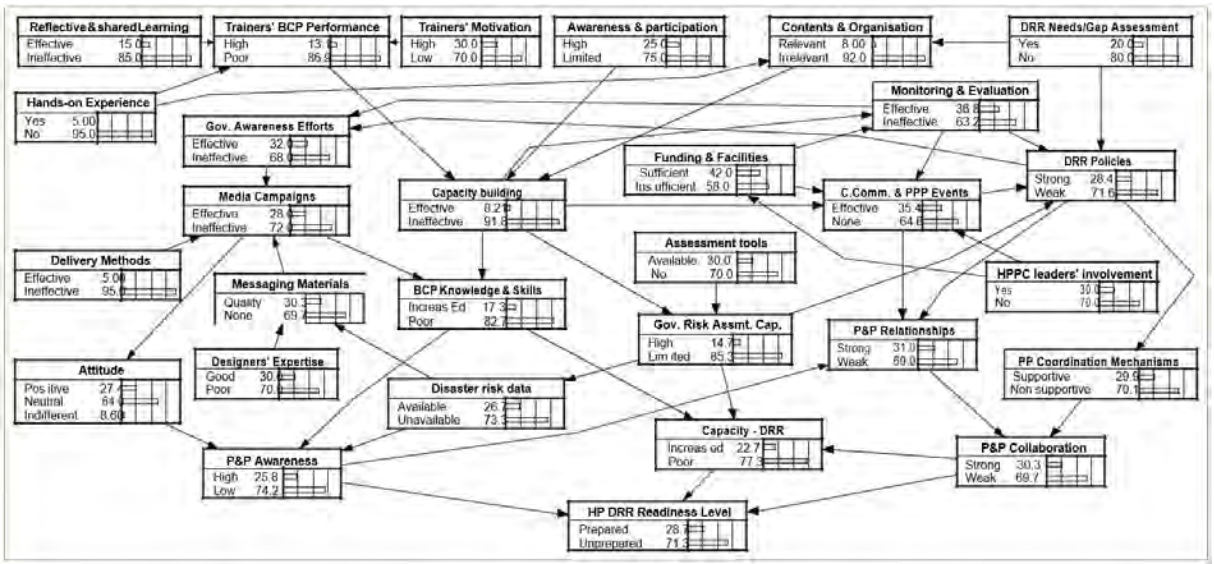

Figure 2. Bayesian Belief Network (BBN) model for the current situation of disaster risk management in Haiphong. Notes: Yellow variable represents the final goal; Green variables represent sub-goals (expected outcomes); Red variables represent leverage points for systemic interventions; Dark variables represent systemic interventions.

Currently, the probability for Haiphong to be prepared for disasters is relatively low at 28.7% (Figure 2). Sensitivity analysis and testing of future scenarios were conducted to define systemic interventions (dark boxes, Figure 3). The combined actions focusing on the systemic interventions bring the probability of Haiphong's readiness level to 81.1% (Figure 3).

A recent stakeholder consultation workshop was organized for representatives of public, private and non-profit partners in the city to reflect on the implemented activities and provide feedback on the progress and performance.

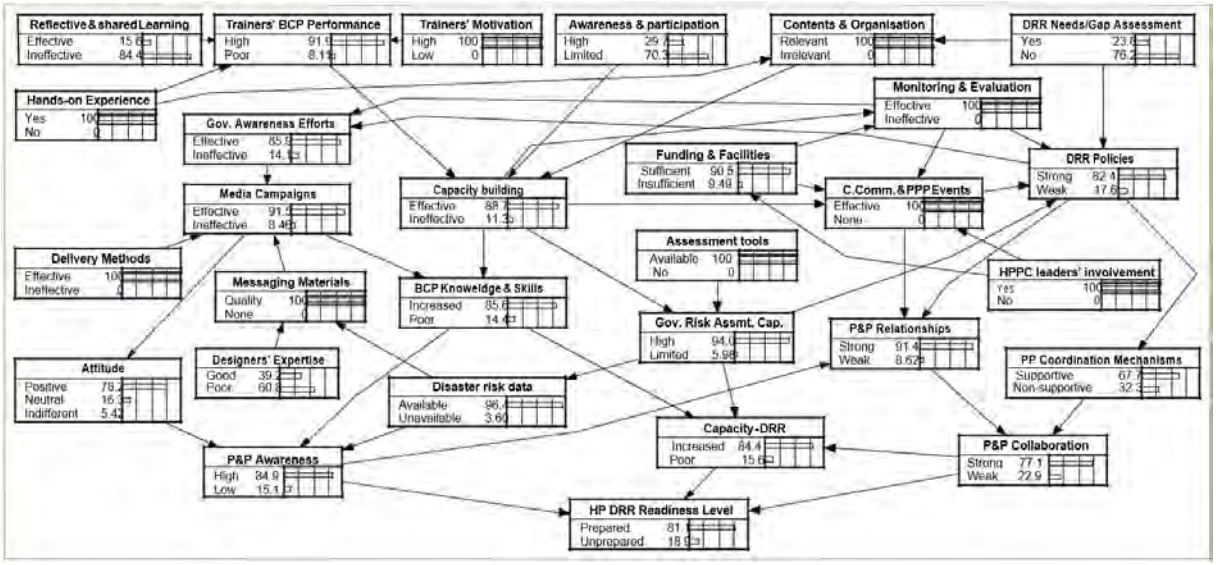

Figure 3. BayesianBelief Network (BBN) modeling for defining systemic interventions to achievethe end goal of disaster resilience. Notes: Yellow variable represents thegoal; Green variables represent sub-goals (expected outcomes); Red variablesrepresent leverage points for systemic interventions; Dark variables representsystemic interventions.temi

Figure 4. Ameeting among the working group of public, private and non-profit sectors fordiscussions on establishing a PPP coordinating committee for DRR

Positive outcomes have been gained through the exciting workshop. However, it turned out that it took longer time than expected to establish a formal and operational PPP coordinating committee. Stronger commitment among the committee members is needed. In addition, influence and support from the local government, as well as a shared vision among participating members, are required. This would take a certain period of time when the awareness campaign takes full effect on the local community. Results of this study are consistent with findings of Ha (2014) who established that transformative learning (that is the change in perception and thus actions) may require several cycles of actions and reflections. In this present study, immediate actions such as organizing PPP events and mainstreaming new DRR initiatives into the existing action plans of the local government should be maintained to make sure the initiatives are aligned with the local priorities and needs.

4. Conclusion

This study has presented the effectiveness of the systems approach, system dynamics modeling tools and communication strategies in coping with complexity in disaster risk management of Haiphong, Vietnam. The approach and tools enabled the research team and participating members to have a better understanding of the current situation. It also showed the interplays among various factors, and areas that require coordinated efforts among the stakeholders for joint planning and execution of the identified systemic interventions to achieve the end goal. Compared to the traditional project management approach, the new approach was proven more time and cost- effective.

In addition, the higher impact would be expected through implementing the nine identified systemic interventions (dark boxes, Figure 2).

Furthermore, diverse forms of communication strategies have been identified and implemented with initial success. The approaches and strategies employed in this study are expected to be adopted in other contexts in dealing with complexity in the changing world of intertwined human and natural factors.

5. Acknowledgment

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