

Evolutionary Learning Laboratories

Diagnosing And Overcoming Complex Or ‘Wicked’ Problems

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Introduction

The continuous growth in population and consumption, the intensity of competition for land, water, and energy, and the over-exploitation of the ecosystem, have affected the global ability to sustain food security and maintain its natural resources [1,2]. Over the years, many promising sustainable development initiatives could not provide sustainable solutions to challenges they intended to address, leading to system management failures. Globalism induces complexity and dealing with its challenges requires a holistic approach to uncover the root causes of complex problems [3,4]. Complex problems are typically defined as those that include the ability to approach them from multiple, sometimes competing, perspectives and which may have multiple possible solutions [5]. Complex problems are also often referred to as ‘wicked problems’ – questions or issues that cannot be answered through simple logical procedures [6]. Additionally, the solution to such problems may result in unintended consequences that require resolution of the new problem resulting in wasteful budget and time [1,2].

A further important contributor to poor outcomes is the fact that many of the ways in which problems are being addressed are simply ‘quick fixes’ or ‘treating the symptoms’. The establishment of a systems based Evolutionary Learning Laboratory (ELLab) has proven to be an innovative and effective approach [7] for dealing with highly complex and multidimensional problems and ensuring that solutions will be found at the level of the root causes.

Why Evolutionary Learning Laboratory?

If we are to grow as a society and address the complex challenges, which are increasingly characterised by uncertainty, ambiguity and competing stakeholder expectations, we need our leaders and key decision makers to be equipped with new and innovative tools and capacities, such as in the ELLabs approach to dealing with issues.

The fundamental philosophy of the ELLab framework lies in systems thinking. It involves stakeholder participation which enables all participants to deliberate on the pertaining issues in a process to identify

the “root causes” through collaborative learning, decision making and actions. Divergent mental models of different stakeholders are gathered, shared and integrated throughout the process to diagnose the whole system and associated issues from a systems perspective. The ELLab, relative to other theoretical frameworks such as action research [8] and adaptive management [9,10], is a more superior framework due to its incorporation of systems thinking tools to help identify leverage points, systemic interventions (solutions) and the fact that simulation of these interventions is possible before actual implementation [9–12]. Through the stakeholders’ workshop, mental models of individual stakeholders are shared and transformed from narrow, personal, and experience-based thinking into one that is more comprehensive within the system, open and reflective to induce more factual and justifiable beliefs and opinions, which leads to the appropriate actions. Furthermore, the approach places a strong emphasis on “true participation”, capacity building and empowerment for participants through a relatively simple guided ELLab process to create a sense of ownership, accountability and thereby resulting in sustainable outcomes with high adoption rate since stakeholders take ownership of their own outcomes [9,10]. Learning to think and act systemically is of significant importance to help companies, organisations, individuals, achieve their goals and directly benefit the economic, environmental and social responsibilities of local and central governments and business institutions in general [13]. This is what the systems-based ELLab has been developed for – an ongoing cyclic process for evolving innovations, continuous co-learning and refinement of the innovative systems tools embedded in the ELLab for dealing with complex issues. The application of ELLab further enables organisations, government departments, companies or NGOs to achieve innovative ways for developing and improving mutual understanding of the diverse mental models of different stakeholders and empower all stakeholders involved to be engaged in a connected journey to achieve accelerated outcomes. Furthermore, it fosters designing strategies and pathways after identifying leverage points to move away from traditional linear thinking that leads to quick fixes and treating the symptoms, which then leads to long lasting systemic solutions.

Establishing The ELLAB Process

The ELLab is a seven step iterative process (Figure 1), as well as a setting, in which a diverse group of participants engage in a cyclical process of thinking, planning, action and reflection for collective learning towards a common good [9,10,14]. With the ELLab, participants engage in well-defined activities, creating a systemic framework and environment where policy makers, managers, local facilitators, members of the community and researchers collaborate and learn together in an ‘experiential laboratory’. This induces the stakeholder’s understanding to address complex multidimensional and multi-stakeholder problems of common interest in a systemic way. The ultimate goal is to achieve coherent actions directed towards sustainable outcomes.

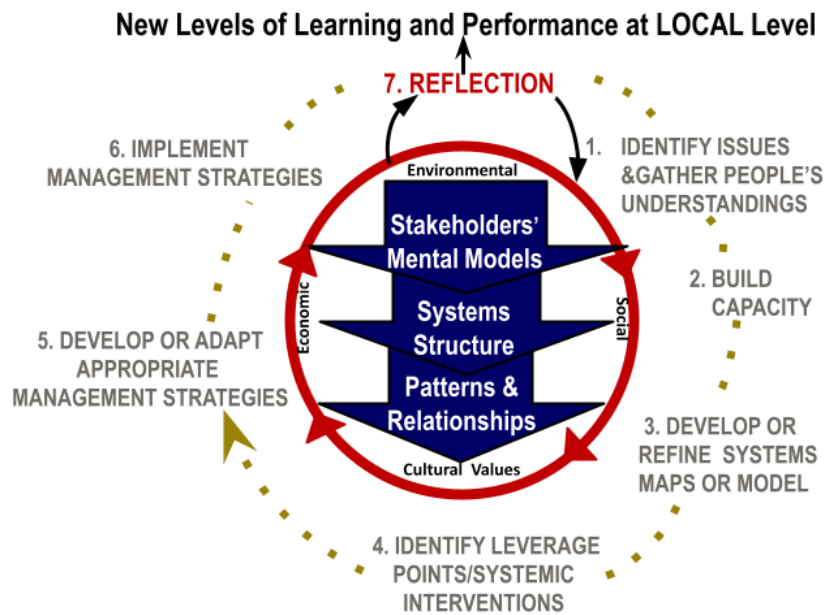


Figure 1: The ELLab Process.

The ELLab process starts at the ‘fourth level of thinking’ – that is Step 1, involving an ‘issue workshop’ with stakeholders to gather their mental models through engagement and exploratory questions. This is carried out by stakeholder focus group discussions to deliberate on the constraints and challenges affecting their complex problems, their impact and to suggest potential new strategies or solutions needed to overcome these challenges or problems.

This is then followed by Step 2, which is the ‘third level of thinking’ through follow-up capacity building sessions during which the participants and relevant stakeholders involved in the workshops learn how to integrate the various mental models into a systems structure using the VENSIM software program ([15]. It is also important to note that capacity building is an integral part of all the steps of the ELLab process.

Once completed, the participants move to Step 3: the ‘second level of thinking’ by interpreting and exploring the model for patterns, their interconnected components, and to analyse the kind of feedback loops, reinforcing loops and balancing loops that exist. This step is aimed at assisting stakeholders to develop an understanding of their interdependency, their role, and their responsibility in the entire system.

These processes lead to Step 4, which provides stakeholders with a better understanding of each other’s mental models and the development of a shared understanding of the issues under consideration. The interpretations would lead to the identification of leverage points for systemic intervention. Leverage points are places within the complex system where a small intervention at a certain point can generate a large impact.

In Step 5, the outcomes are used to develop a refined systems model for the identification of systemic interventions. For this, Bayesian Belief Network (BBN) modelling [16,17] or systems archetypes (derived from the mental model) can be used to identify the systemic interventions and to determine the requirements for implementation of the systemic management strategies and/or systemically based

policies. Additionally, factors that could affect the expected outcomes and finalize the order in which activities should be carried out to ensure cost effectiveness and to maximize impact will be ascertained as well. The BBN models are constructed using the NETICA software [18]. The BBNs are used as a simulation model to test the possible outcomes of different systemic interventions by observing what will happen to the system as a whole when a particular strategy or combination of strategies is implemented: that is, before any time or money is invested in actual implementation.

In Step 6, once the systemic interventions have been identified and an operational plan has been developed, people who are responsible for the different areas of management are to implement the strategies and/or policies that will create the biggest impact. Targets are determined, and monitoring programmes are implemented to measure and/or observe the outcomes of the strategies and policies. In many cases, it only requires an adjustment of existing monitoring programs to comply with the targets set within the process (e.g. to include factors to be measured that were used in the construction of the Bayesian management model).

The ELLab process also adopts an approach called ‘teaching to transfer’ the art of interconnected thinking with stakeholders during the workshop, and it has been seen that some of these stakeholders would influence policy revision and formulation.

In Step 7, because no systems model can ever be completely ‘correct’ in a complex and uncertain world, the only way to manage complexity is by reflecting at regular intervals on the outcomes of the actions and decisions that have been taken to determine how successful or unsuccessful the interventions are and to identify unintended consequences and new barriers that were previously unforeseen.

Note: in our recent work and further development, we have used the Sensitivity Model (SensiMod) software to replace all the software programs and procedures used in steps 3 to 5 above.

An Example Of Applying The ELLAB In City Governance (The Case Of Haiphong City, Vietnam)¹

Government departments are typical examples of how society operates in silos. Complex political, environmental, socio-economic and business-financial issues tend to transcend the jurisdictions and capacities of any single government department (silo), which adds significantly to the difficulties in finding systemic management solutions and developing effective governance plans. The Government of Haiphong City (Vietnam) decided to establish an Evolutionary Learning Laboratory (ELLab) to enhance communication and collaboration between its different departments. This section discusses the application of the ELLab approach to develop a series of management models for dealing with sustainability issues in Haiphong City and to use these to develop an integrated and cross-sectoral strategic governance plan for the City as a whole.

Step 1: Identify issues. Two workshops were conducted with a range of stakeholders to gather their mental models on the key issues and challenges that the Government of Haiphong City (HPC) was facing. The workshop was attended by 30 participants representing all the relevant Departments and Offices in HPC. The challenges included lack of funding, weakness in research and development, conservative thinking of people, environmental pollution, population pressure, low awareness about

¹ This case has been published in detail, see reference: [19]

sustainable development, social issues, bureaucratic administration, lack of skilled human resource, lack of transparency, and poor coordination among government departments.

Step 2: Build capacity. A seminar was then conducted to introduce relevant stakeholders to the key concepts of systems thinking, the ELLab approach and the art of interconnected thinking. Capacity building remains an ongoing process, because of the involvement of stakeholders in subsequent activities during the Bayesian management modelling workshops (step 5 of the ELLab), as well as in future activities. In this way the capacity of stakeholders in understanding and applying the systems thinking concepts and tools used in this project has continuously further developed. This plays an important role in stakeholders taking “ownership” of the models and approach.

In addition (as part of the Cat Ba Biosphere Reserve project, Haiphong City), a two-month systems thinking and associated capacity building program was previously conducted in Australia for a group of ten policy makers, managers, and technical officers from different levels of government, across sections of agencies and an NGO, engaged in different capacities in the management of the CBBR. The process and outcomes of this capacity building program have been reported in another paper [4].

Step 3: Develop a systems model. Based on the outcomes of step 1 above, causal loop modelling [20,21] was used to develop a first draft systems model (Figure 2) of the key issues related to the sustainable development of HPC. Figure 2 shows the interrelationships and dependencies amongst the key components of the system.

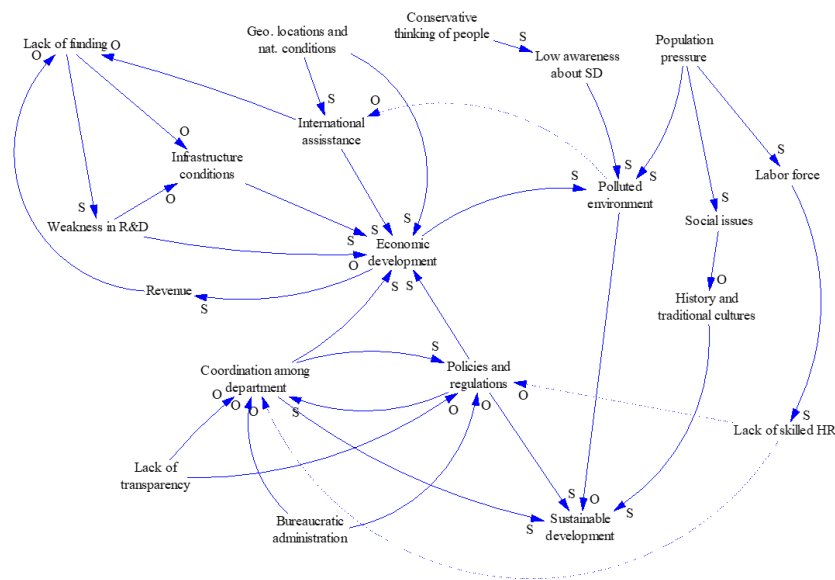


Figure 2: First draft systems model of HPC.

Legend: S (same direction), O (opposite direction)

Figure 2 illustrates the identified interrelationships and interdependencies amongst the vital components of the key issues related to the sustainable development of HPC. The systems model represents a ‘big picture’ of HPC and provides a useful platform for learning, collaboration and decision making for relevant stakeholders including policy makers, researchers, managers, practitioners and local people.

Step 4: Identify leverage points and systemic interventions. A follow up workshop was conducted in Haiphong City with the main objective to identify key leverage points and areas for systemic interventions for sustainability – based on the systems model of the HPC and its associated systems archetypes.

Leverage points are places within a complex system (e.g. a corporation, an economy, a living body, a city, an ecosystem) ‘where a small shift in one thing can produce big changes in everything ... leverage points are points of power’ ([22], p. 1) and the ‘right places in a system where small, well-focused actions can sometimes produce significant, enduring improvements’ ([23], p. 64).

The workshop and discussions in HPC led to the identification of five key leverage points for the sustainable development of HPC. These include sustainable economic development, sustainable environmental management, improvement of people’s livelihoods, enhancement of inter-sectoral collaboration and ‘starting with the young’.

Step 5: Develop action plans. A series of Bayesian models were constructed to develop action plans for the identified leverage areas and systemic interventions. An example of these models is illustrated in Figure 3.

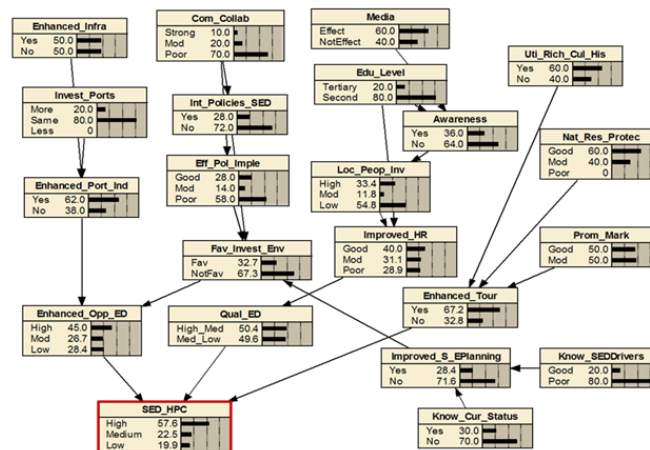


Figure 3: Preliminary BBN model for SED of HPC – current conditions.

Sustainable economic development (SED) of HPC is influenced by four main factors, namely ‘infrastructure’, ‘policy and collaboration’, ‘education’ and ‘tourism’. Under current conditions, the probability for sustainable economic development to be high is 57.6% (Figure 3). Different scenarios (combinations of systemic interventions/management strategies) were tested to determine how an increase in the probability for high SED could be achieved. These included ‘enhanced infrastructure’, more ‘investment in ports’, strong ‘communication and collaboration’, higher ‘education level’, increased ‘awareness’, good ‘protection of natural resources’, effective ‘promotion and marketing’ and a favourable ‘investment environment’ (Figure 4).

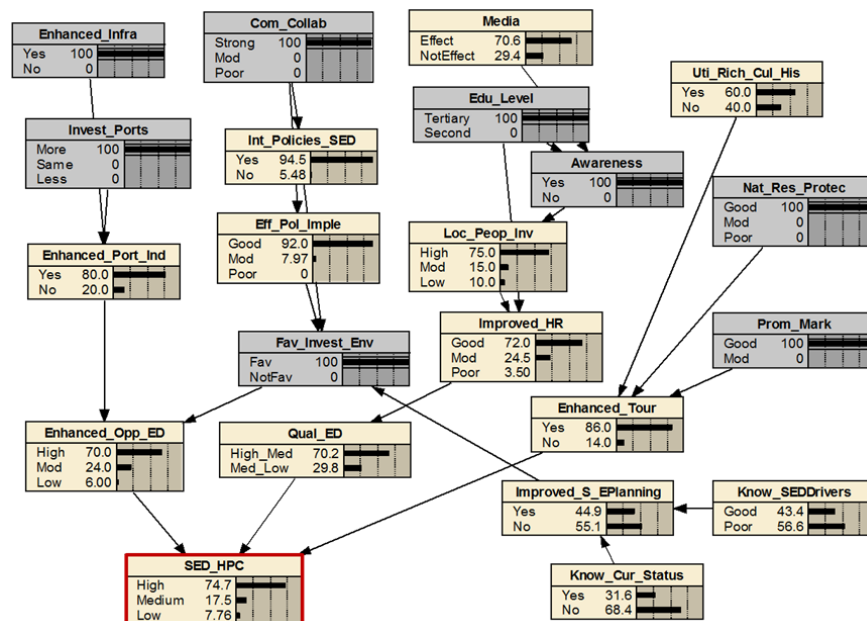


Figure 4: Preliminary BBN model for SED of HPC.

(Systemic interventions in darker shade; goal marked in red)

BBN model for improving livelihoods of people in HP (Leverage point 2)

The sustainable livelihood of people (SLP) in HPC is influenced by various factors, ranging from ‘facilities to enhance quality of life’ to ‘social welfare’, ‘stable markets’, ‘consumer protection’ and ‘living and working environments’. According to the BBN model (Figure 5), the probability for sustainable livelihoods of people in HPC to be high under the current conditions is 45.2%.

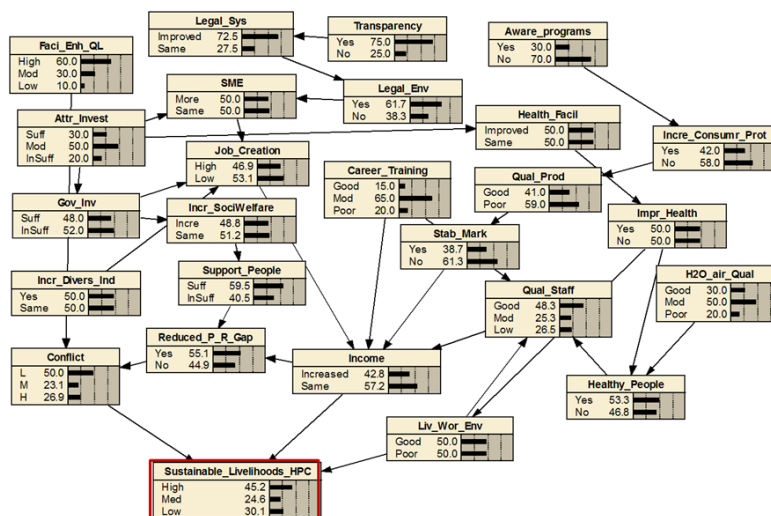


Figure 5: Preliminary BBN model for SLP in HPC – current conditions.

Scenario testing revealed that more ‘facilities to enhance quality of life’, increased ‘awareness programs’, good ‘career training’, improved ‘health facilities’ and good ‘quality staff’ are important factors to increase the probability to achieve high SLP (Figure 6).

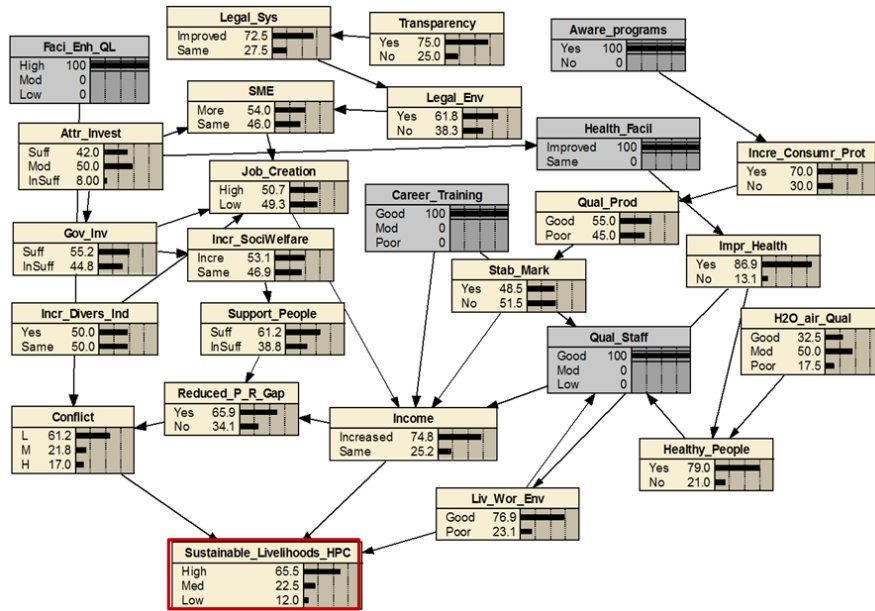


Figure 6: Preliminary BBN model for SLP in HPC – systemic interventions.

BBN model for sustainable environmental management in HPC (Leverage point 3)

Sustainable environmental management (SEM) of HPC is influenced by a number of factors. For example, level of ‘national and international investments’, ‘quality of human resources’, ‘law enforcement’, ‘control of pollution sources’ and ‘economic development pressure’. Under current conditions the probability for sustainable environmental management to be high is only 23.6% (Figure 7).

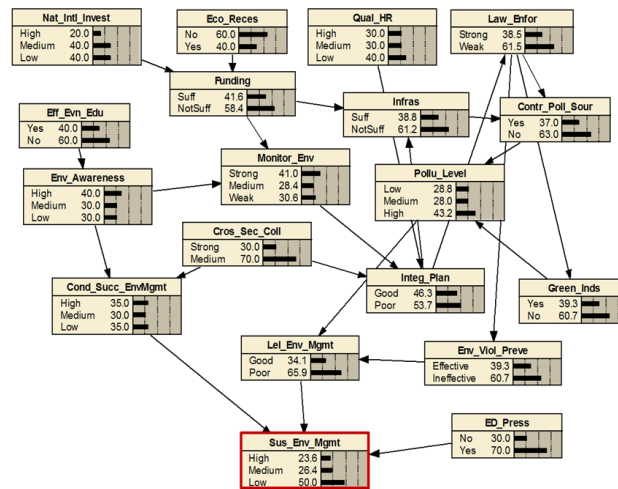


Figure 7: Preliminary BBN model for SEM in HPC – current conditions.

Testing different scenarios (combinations of systemic interventions or management strategies) indicated that strong ‘law enforcement’, ‘effective environment education’, strong ‘cross sectoral collaboration’, more ‘green industries’, effective ‘prevention of environment violations’ and reduced ‘economic development pressure’ are all important factors to increase the probability for SEM to be high (Figure 8).

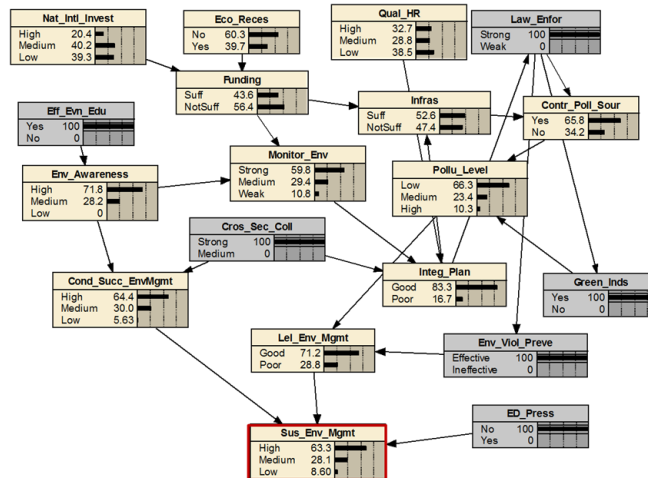


Figure 8: Preliminary BBN model for SEM in HPC – systemic interventions.

Management model for enhancing cross-sectoral collaboration in HPC (Leverage point 4)

Further refinement of the above BBN models is an ongoing process. The next step was to combine the systemic interventions/management strategies into an integrated governance plan for HPC (Figure 9). The model also indicates how continued communication and collaboration (identified leverage point) between the different departments, businesses and others will be needed in order to solve complex issues systemically and to test different policy scenarios to identify where investments and actions will have the biggest effect – we believe this is the *World First* where a whole Government is deliberately using a systems approach towards integrated systemic governance.

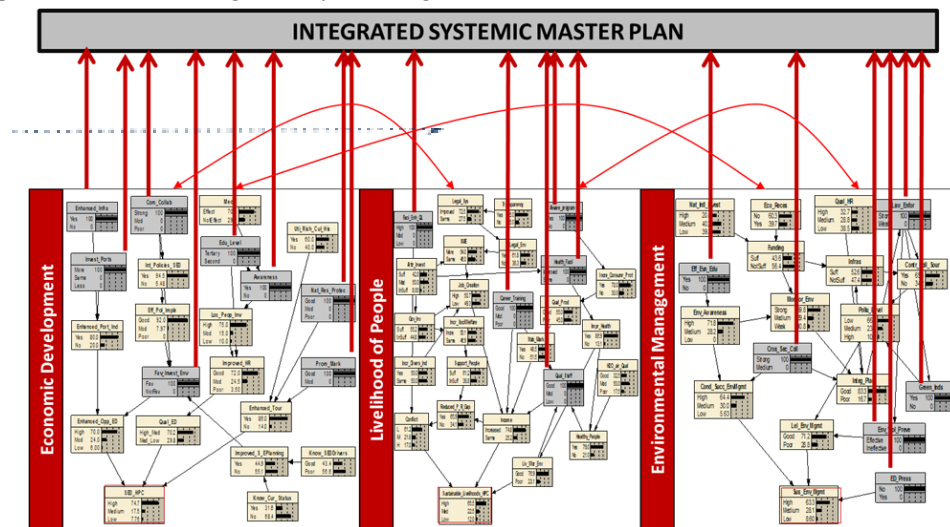


Figure 9: Preliminary management model for integrating the systemic interventions and actions to enhance inter-sectoral collaboration and communication in HPC.

Step 6: Implementation. The BBN management models (Figures 4, 6 and 8) and their associated management strategies have been embedded in a cyclic process, in which the governance strategies and policies were implemented, outcomes are reflected upon (Step 7) and discussions would be held to determine if and what changes will be required over time. This process has established Haiphong as an

ELLab for sustainable development and management of complex issues. The process is illustrated in the following diagram (Figure 10).

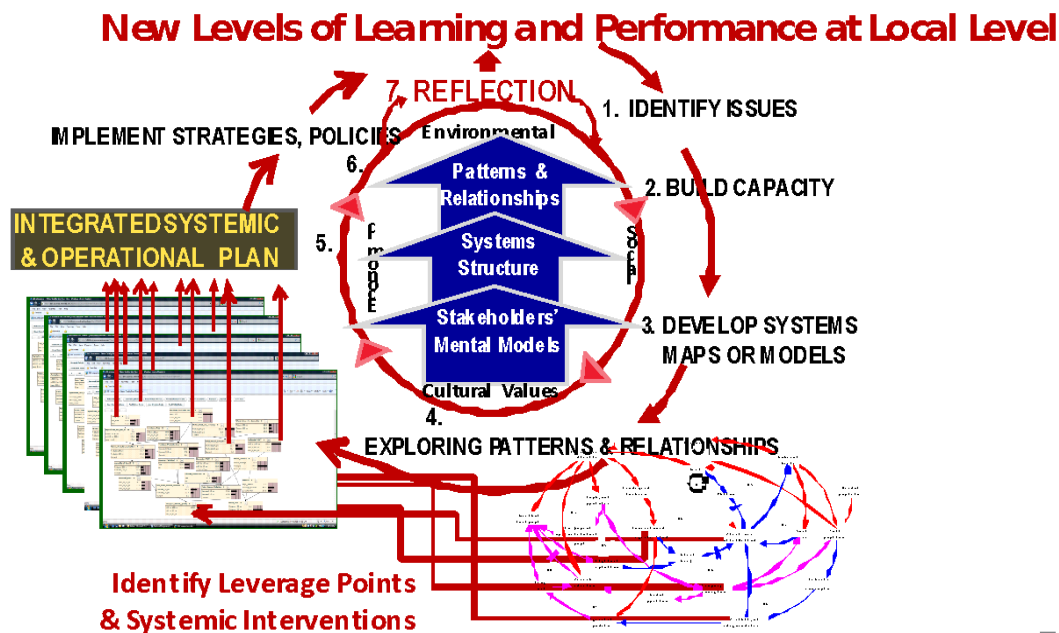


Figure 10: Haiphong ELLab Framework.

Step 7: Reflection. It has been identified in the reflection process that an unintended consequence of the increased investment in the Haiphong port was the increase in large vehicle traffic between Hanoi and Haiphong. An additional new national highway (parallel with the existing national highway no.5) has been constructed to remedy this situation.

In addition, the reaction to Phase 1 of the Ecopolicy program in HPC has been overwhelming. Ecopolicy has been received as a revolutionary new learning tool for “Starting with the Young” to create future leaders that will appreciate the interconnectedness of different components of any system and to take this into account in facing the many difficult issues that are facing their society in a 21st century knowledge society. Reflection on the success of Phase 1 has led to Phase 2 of Ecopolicy, involving the extension of the Ecopolicy program to all high schools and universities in Haiphong. All Government officials in Haiphong also had to implement Ecopolicy in order to raise their awareness of the importance of systems and interconnected thinking, to avoid quick fixes through linear thinking and to learn how systemic solutions to any problem need to be long lasting and sustainable.

Conclusion

Globally effective researchers, as well as existing and future leaders and managers, will need to understand complexity and how to deal with it in multi-stakeholder scenarios. Capacity building and governance using the ELLab in business decision-making process and policy analysis has been proven to

be effective in understanding complex design problems in many fields and contexts. The ELLap approach gives insight into potential system behaviors and identifies leverage points for systemic interventions, which are required to sustain and improve the current quality levels within a system. This approach will help governments, managers, scientists, and decision/policy makers to anticipate the long-term consequences of their decisions and actions, as well as help to avoid any unintended consequences of policies and strategies resulting from a 'silo mentality' and 'organizational myopia'. This approach can serve as a complementary tool for governments and sustainability proponents to diagnose and test the possible outcomes of different policy interventions by observing what would happen to the system as a whole when a particular strategy or combination of strategies is implemented: that is, before any time or money is invested in actual implementation. This will help eliminate or minimize waste of sacred resources and unintended consequences associated with funding R&D. ELLab offers a range of tools to improve our capacity to think systemically, including ways to distinguish problem symptoms from root causes.

In summary, a 'New Way of Thinking and Acting' can change the effectiveness of government departments, businesses, organisations and communities in many sustainable ways.

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