Exploring Environmental Management Evolution through Maturity States and Behavior Over Time Graphs

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Abstract

This paper hypothesizes that successful corporate environmental management proceeds through a series of characteristic stages independent of industrial context. Our classification proposes six different maturity states: Environmental Compliance, Training, Systematization, ECO², Eco-Innovation and Leading Green Company. Through collaborative modeling and surveys we develop a causal structure and behavior mode of an evolutionary process.

KEYWORDS: Environmental Management, Causal Loop Diagrams, Behavior Over Time, Maturity States.

1 Introduction

One element of socially responsible business is awareness of environmental effects of their activities, in part because of the deterioration provoked by past enterprises and activities (Angell and Klassen 1999, 575-598; Ludevid 2004; Claver and others 2007). This awareness has spawned a new future as well, with increase demand for products and services that minimize environmental impact (Park and Seo 2006, 147-154) as well as new visibility and corporate accountability (D'Anselmi 2011). Some authors rank environmental management as a "new industrial revolution" (Berry and Rondinelli 1998, 38-50).

The emergence of this awareness is likely to have started with increased environmental regulation in response to untoward events (Claver and others 2007; Sarkis 2001, 666-686). Regulation alone does not provide incentives to innovate and to go beyond regulatory compliance (Brunnermeier and Cohen 2003, 278-293). Those firms that invest more effort into their environmental management must have some belief in economic or social returns for their reward (Bansal and Roth 2000, 717-736; Siegel 2009, 5-16). Moreover, stakeholder pressures have also effect on corporate ecological responsiveness (Bansal and Roth 2000, 717-736).

Comparison of environmental management efforts across firms and industries requires some consistent benchmark for processes and outcomes, and multiple classifications have been proposed (Jabbour 2010, 1222-1225). Previous research classifies the evolution of corporate environmental management in three stages: reactive or passive, preventive or active, and proactive (Berry and Rondinelli 1998, 38-50; Jabbour 2010, 1222-1225; Borri and Boccaletti 1995, 38-42; Venselaar 1995, 9-12; Jabbour and Jabbour 2009, 477-495). However, the work to date is very general and does not deepen in each of the states.

The aim of this research is to create a detailed qualitative model of the evolution of environmental management. Our preliminary fieldwork indicates that companies working towards improving their environmental management go through similar patterns of behavior that appear to evolve from within the firm. We discuss these patterns in the context of stages of maturity (Fraser, Moultrie, and Gregory 2002) and develop causal loop diagrams (CLD) to describe possible cause-effect relationships. Support for systemic influences would help identify leverage points for organizations looking to advance their environmental practices towards excellence.

2 Methodology

Our research looks to models of process maturity as an organizing principle. Maturity approaches have their roots in the field of quality management. One of the earliest approaches is Crosby's Quality Management Maturity Grid which describes five phases of quality management that companies evolve through (Crosby 1979; Crosby 1996). A widely known derivative of the quality management maturity concept is the Capability Maturity Model (CMM) for software, with five identified stages: 'Initial', 'Repeatable', 'Defined', 'Managed' and 'Optimizing' (Paulk and others 1993, 18-27; Hefley and others 1995, 559-566). While staging is a useful construct, the true value of a maturity model comes when it is tied to processes and causal analyses that help organizations move forward.

Our study includes three steps to date, discussed below (Table 1). The starting point of each of these steps is the result of the previous step.

METHODOLOGY STEPS	**Information Gathering through Interviews**	**Information Processing through GMB Workshops**	**Information Validation through Surveys**
RESULTS	•Factors •Baby CLD Model	•Factors •Stakeholders •Policies •Indicators •BOT •Maturity States •Preliminary CLD Model	•Factors •Stakeholders •Policies •Indicators •BOT •Revised timeline •Updated CLD Model

Table 1. Methodology

2.1 Information gathering through interviews

In the Information Gathering step we conducted interviews with environmental managers from nineteen enterprises among different industrial sectors in the Basque Country of Northern Spain. These firms were selected as a convenience sample, taking into account their self-assessed level of environmental management. Some of the companies were in their first maturity states and others were quite advanced. The study includes firms from different sectors such as chemical, automotive, railway, elevators, and electrical equipment. The average face-to-face interview lasted on average around 75 minutes. We wanted to understand how environmental management has been deployed in each enterprise and the consequent factors that affect environmental management.

2.2 Information processing through GMB workshops

To assist in the synthesis of the interview results, we conducted two Group Model Building (Vennix 1996) workshops with a panel of environmental experts. The participants included environmental managers of different enterprises, environmental consultants and academics with experience in environmental projects. In the first workshop, exercises included activities for stakeholder identification, policies options, and proposals for maturity states and indicators. In the second workshop, the experts discussed the dynamic behavior of the most significant indicators, providing a reference mode for a complete evolution of the maturation process. Finally, the workshop participants reviewed a preliminary Causal Loop Diagram (CLD) model that captured elements of the transition among stages.

2.3 Information validation through surveys

Using the results of the workshops, our team developed a survey instrument to elicit comments about the evolutionary model from a wider audience to examine its generality (Forza 2009, 84-161). The sampling frame was based on an on-line list of Italian and Spanish companies. The on-line survey was opened by 215 firms and completed by 92. As 37 questionnaires were incomplete they have been deleted, obtaining a final sample of 55 firms, 29 Italian and 26 Spanish.

The questionnaire had four parts. In the first part the proposed maturity states were defined and respondents were asked to order the different maturity states in ascending evolutionary stages. The stages were ordered alphabetically to avoid influencing respondents, and there was the option of marking some states as parallels, deleting others, or adding additional ones for ranking.

The second part of the questionnaire focused on activities and actions that take part in each maturity state and the apparent intensity of their importance. The respondents were asked to consider the importance of ten factors for each maturity state, ordered by a four-point scale. New factors could have been added as well.

The third part was an open ended question about the incentives and obstacles towards attaining an environmental certification. The last part consisted of general information about the companies.

Using the results of the surveys the ordering of the maturity states and the associated causal influences we gained additional confidence in the activities within each state.

3 Results

It appears that many companies perceive their movement towards constructive environmental management as unique, focusing on the particulars of their firm and its context. We conclude, however, that our sample of companies have more in common with each other than they may realize. We base our conclusion on our review of three data sources.

3.1 Factor classification

After completing the first round of interviews, notes from all the discussions were reviewed for factors and metrics that came up in multiple firms. Some factors were identified by the informants as direct influences, others were considered to be indirect influences. In addition, the importance of factors changed based on the relative maturity of the firm's efforts. Our initial grouping of the main factors include:

- **Society's Environmental Awareness:** As social pressure to avoid environmental degradation increases, firms appear to become more aware of their own responsibilities.
- **Environmental Legislation:** In concert with social concerns about degradation, there are changing legal and professional norms. Companies make great efforts to influence the regulatory environment, conform to standards, or risk being penalized.
- **Environmental Impact:** This factor measures the real environmental impact of the company. As a company increases its environmental improvements and innovations, its residual environmental impact decreases.
- **Company's Green Image:** Several enterprises have seen environmental management as an opportunity to surpass their competitors so they can increase their market share.
- **Formalization:** This factor measures how the firm's internal environmental management becomes more systematic over time. Companies start with a low or localized approach to environmental activities, and formalization may be an indicator of increasing maturity towards environmental excellence.
- **Market Demand:** This factor assesses the market demand for environmental products and services. The market includes customers, suppliers, competitors and other stakeholders that affect the activity of the company.
- **Operational Savings:** This variable measures the true savings produced by improvements and innovations that companies carry out, such as realized reduction in the consumption of resources.
- **Top Management Commitment:** All our informants agree on the importance of Top Management involvement in their activities. While many firms start their environmental management programs without strong leadership commitments, advancing beyond rudimentary compliance requires a much clearer strategic statement and investment. Interestingly, the visibility of the environmental management program appears to be a precursor to managerial support.
- **Training:** This factor captures the training and instruction given to workers when employing new environmental equipment and procedures. Well-trained workers in

turn become more committed themselves to environmental issues, resulting in additional support or opportunities for improvement.

- **External Communication:** This variable measures the evolution of external communication of environmental issues. When the Top Management is highly committed to environmental improvements in the company, the external communication increases to inform stakeholders about the improvements and innovations that the company has carried out.

From this stage of our research, we were able to capture almost all of the concepts proposed by the subjects of our initial round of interviews. We used this information to help identify and organize an initial theoretical model for the next stage of analysis.

3.2 Stakeholder identification

During our first GMB session we conducted an exercise to elicit and cluster the interest and influence of stakeholders on the environmental management of a single firm (Andersen, Richardson, and Vennix 1997, 187-201).

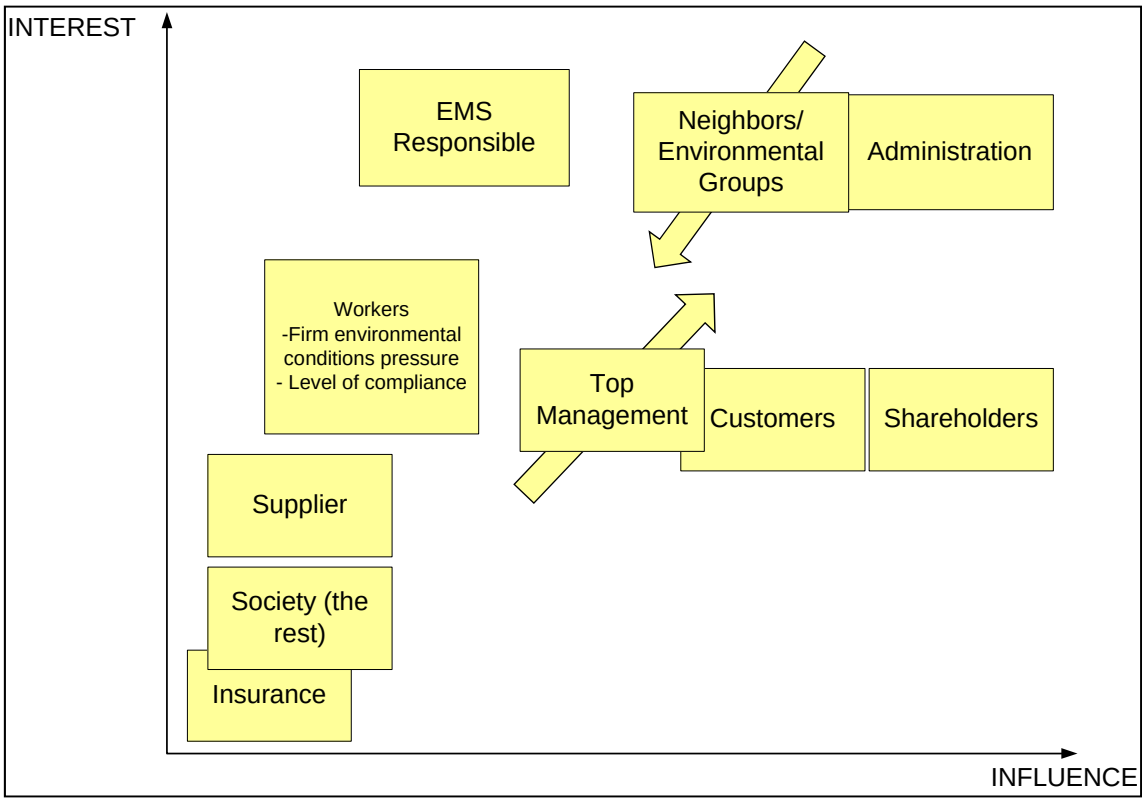

Figure 1. Stakeholder identification

Stakeholders with the highest interest and influence in the problem of environmental management are in the upper right quadrant of Figure 1. Administration has both high interest and high influence in environmental management, as the company needs to respect law and regulation or face penalties. Neighbors near the firm's facilities have great interest in the firm's immediate environmental impact, and they have great influence if they press significantly to obtain certain environmental achievements. Environmental Groups have a high interest and influence in achieving that each company lowers its environmental impact. The influence and interest of Neighbors and

Environmental Groups may drift lower as a company environmental management improves.

A second cluster of stakeholders is considered to have medium-high influence and medium-high interest. Customers have medium interest and significant influence on the company's incentives, possibly increasing over time. Shareholders have medium interest but their influence is very high as they are the ones that provide companies' capital. Top Management may have no more than moderate interest or influence at first. As environmental management maturity increases, however, their influence and interest may grow.

A group of less influential and interest stakeholders include the firm's Workers and Environmental Management System (EMS) staff. The workers may have medium interest in the company environmental management, but their influence is quite low as they do not participate in the management decisions. The environmental management system managers have high interest in developing and maintaining excellent environmental management, but without much independent influence.

Our experts identified a final group of stakeholders with relatively low influence and interest in the environmental management of the firm: Insurance, Society and Suppliers. Insurance companies can force enterprises to comply with some environmental requirements. Nevertheless, their interest and influence over the problem is considered small. The diffuse concerns of Society stimulate little interest and influence in the absence of other factors. Finally, the company's suppliers may have low-medium interest and quite limited influence as they do not wish to disrupt their relationships with the firm.

3.3 Policy identification

The experts at our GMB identified policies that could be implemented to improve the environmental management. We then asked the experts to cluster similar policies and then order the clusters according to the temporal line in which they are likely to be implemented. These six groups are: Legislation Fulfillment, Training, Systematization, Cost Savings, Eco-Innovation and Green Company (Figure 2). With minor modifications, these policies were used as the basis for the different maturity states and sequence presented in the survey instrument (Section 3.5).

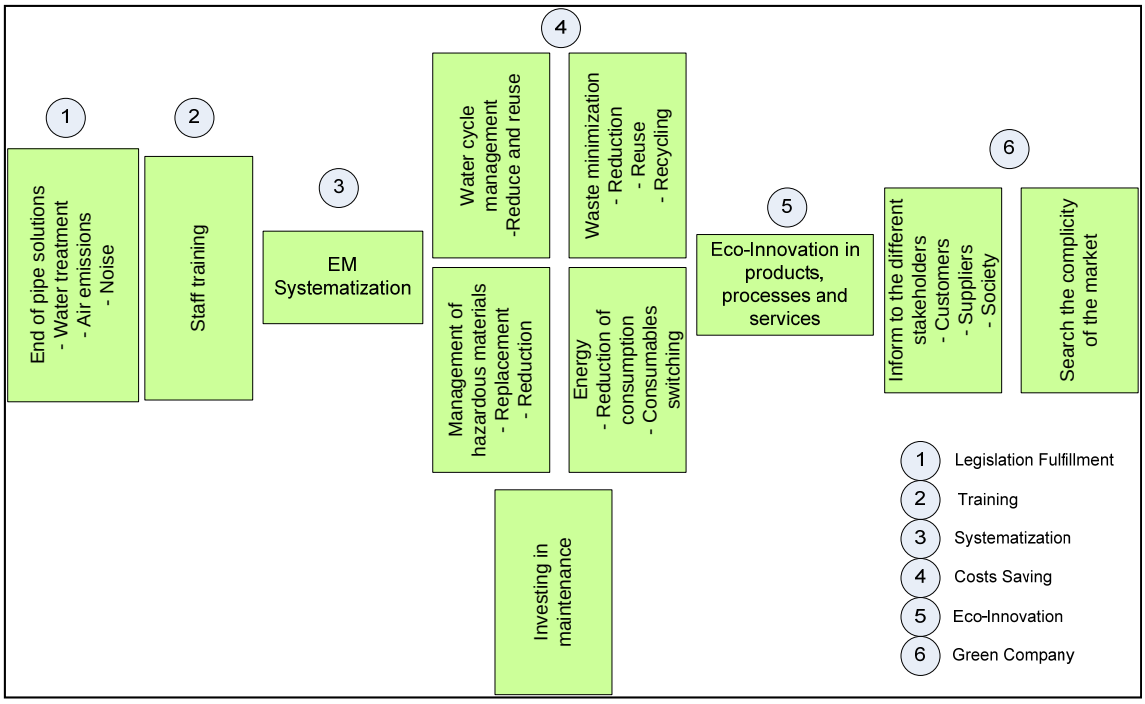

Figure 2. Policy identification

1. Legislation Fulfillment. According to our experts, the first stage in environmental management is fulfilling the requirements of law. In this state the policies that are being implemented are often termed “end of pipe” solutions, technical activities that mitigate the effects of dirty production, e.g., water treatment, reduction of air emissions, or noise reduction.
2. Training. Training in the efficient and effective use of equipment and procedures that advance environmental management and measures of the firm beyond compliance.
3. Systemization. Once successful measures are identified, they may be formalized and, in some cases, certified by external agencies. The special characteristic of this state is the identification of all environmental aspects of the firm.
4. Cost Savings. Firms have numerous opportunities to seek out operational cost-savings, including water cycle management, hazardous materials management, waste minimization, energy management and investing in maintenance to achieve maximum equipment performance.
5. Eco-innovation. In this state environmental management generates innovation in products, processes and/or services. Among these tools are eco-design, Life Cycle Assessment (LCA), carbon footprint and eco-labeling.
6. Green Company. During this state, stakeholders are informed about the company’s environmental management, and the measures and progress that permit the company to develop and sustain a green image.

3.4 Indicator identification

Our experts next identified indicators of a firm's actions and results within each policy (Table 2). Actions reflect the effort needed to carry out activities, while results measure the consequences.

Policies	1	2	3	4	5	6
ACTIONS	-Investment in end of pipe solutions -Environmental demands	-Training provided (hours)	-Work hours dedicated to environmental management (formalization hours)	-BAT investment	-Environmental tools (labels, LCA, CO2)	-External communication
RESULTS	-Environmental impact -Compliance requirements	-Compliance requirements	-Certifications state	-Consumption -Environmental impact	-New green products, processes and services	-Press impact -External recognition

Table 2. Indicators identification

Within Legislation Fulfillment possible actions include the investment in end of pipe solutions and environmental demands required by legislation. The results would include the degree to which environmental impacts are mitigated and compliance requirements fulfilled. Training efforts and compliance could be suitable metrics for the second state. Systematization efforts could also be captured by the effort dedicated to environmental management formalization and attainment of a suitable set of certifications.

In more advanced programs, Cost Savings investments in the development of Best Available Techniques (BAT) would result in changes in resource consumption and lessening direct and indirect environmental impact. Eco-innovation is characterized by the use of advanced activities and environmental tools used such as eco-labeling, eco-design and life cycle analysis. As a result, new green products, processes and services are measured for their contribution to the firm. In the final state, Green Company, external communications to the different stakeholders about the environmental measures carried out by the company is considered. As a consequence, the press impact and the external recognition for movement towards environmental excellence are measured.

At this point in the analysis we need to recognize that these metrics do not fit neatly into a timeline. Companies move quickly to advertise their adoption of green innovations, even if the end result may be unproven. Cost savings are likely an integral part of any change that moves beyond compliance. Our experts identified these as likely indicators of more general evolution of advanced environmental management.

3.5 Maturity CLD Model and Behavior Over Time (BOT)

As a final workshop exercise our experts constructed behavior over time graphs of important indicators they considered important. –This data provided insight into the sequence and relative import of the causal variables identified in earlier discussions, from which causal models are derived.- These are idealized states that move towards the

achievement of highly responsible environmental management. They do not depict influences that work to undermine the goal. The behavior of these data is captured from the discussion of the experts, and therefore may be more complex than needed to capture the key dynamics.

After the survey, the names of the maturity states were slightly changed and the final CLD model was developed. The six maturity states that have been classified are Environmental Compliance, Training, Systematization, ECO^2, Eco-Innovation and Leading Green Company (Figure 3). The time that a company might spent in the six states until it reaches environmental excellence might vary between eight and fifteen years depending on the sector and resources among other reasons.

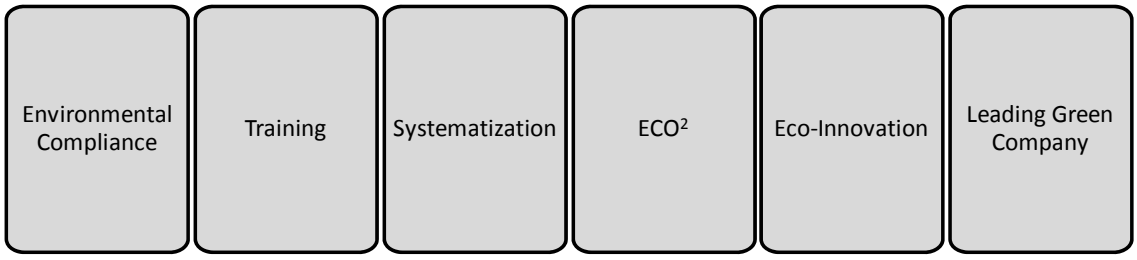

Figure 3. Maturity States (Post-survey)

3.5.1 State 1. Environmental Compliance

Environmental Compliance is depicted as the result of two structures (Figure 4). The first, *Evolution of Environmental Requirements,* proposes that increasing *Total Impact* of environmental effects will increase *Societal Demand* for mitigation. In turn, this drives *External Environmental Demands,* such as regulation and review, which lead to identification of standards that decrease the *Specific Acceptable Impact* of a firm on the environment. Lower acceptable impacts also decrease the firm's relative *Compliance with Requirements,* increasing pressure for *Process Improvements,* and decreasing the growth of *Specific Real Impact* and *Total Impact.* A second balancing loop active at this early state is *Environmental Compliance, as* compliance with requirements increases when the firm's specific environmental impact is reduced, decreasing pressure to enact additional improvements and subsequent impacts.

The expert's BOT for this state starts with the presence on unmet external environmental demands, followed by the definition of specific impacts, and compliance requirements. New end-of-pipe solutions, considered the fastest way to reach compliance in the short-term, are introduced, though the number of new introductions declines over time (Figure 5). Sometimes, however, external requirements continue to grow even after the acceptable impacts are defined.

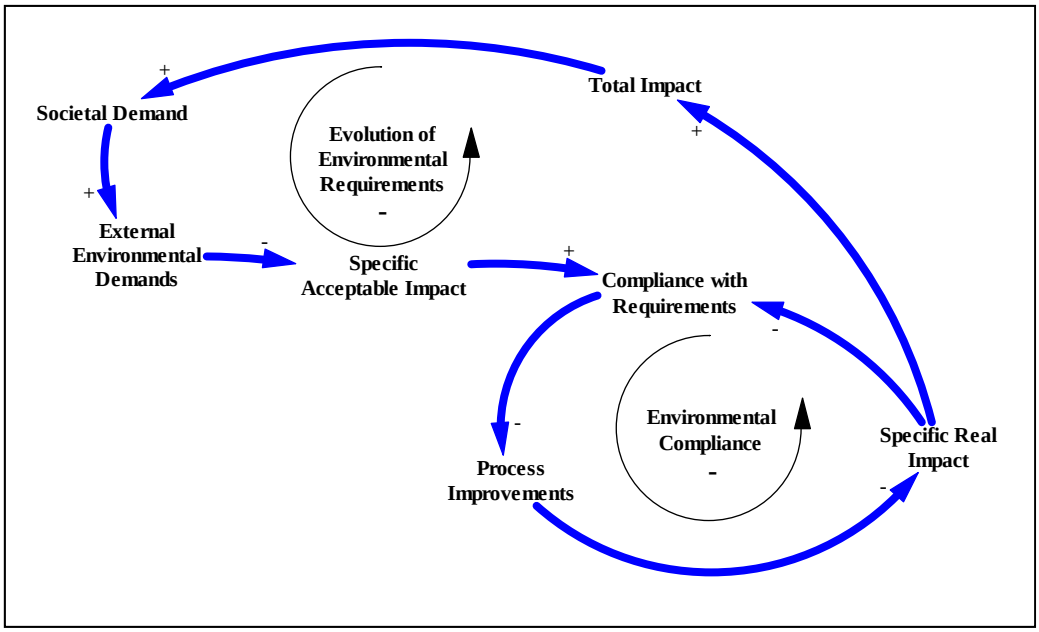

Figure 4. Environmental Compliance State

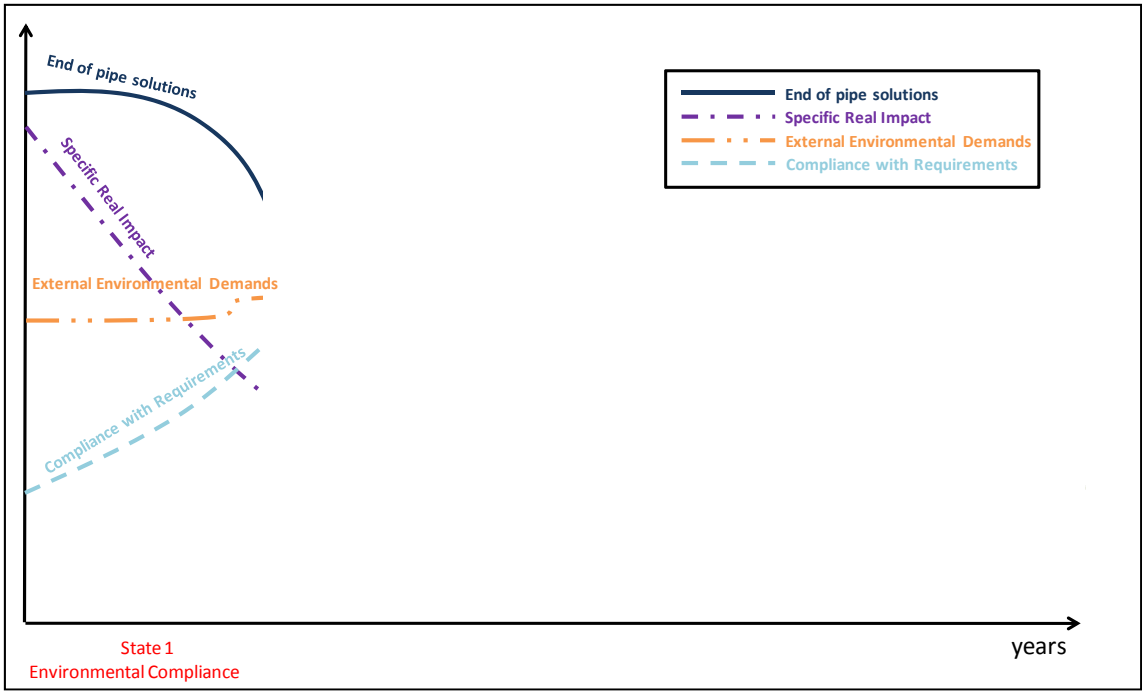

Figure 5. Environmental Compliance BOT

3.5.2 State 2. Training

As part of the advancement to a more mature state of environmental management workers may be trained beyond the needs of simple compliance and increase the effectiveness of earlier process improvements. There are two new variables influencing the behavior in this state: *Training Required* and *Training Provided* (Figure 6).

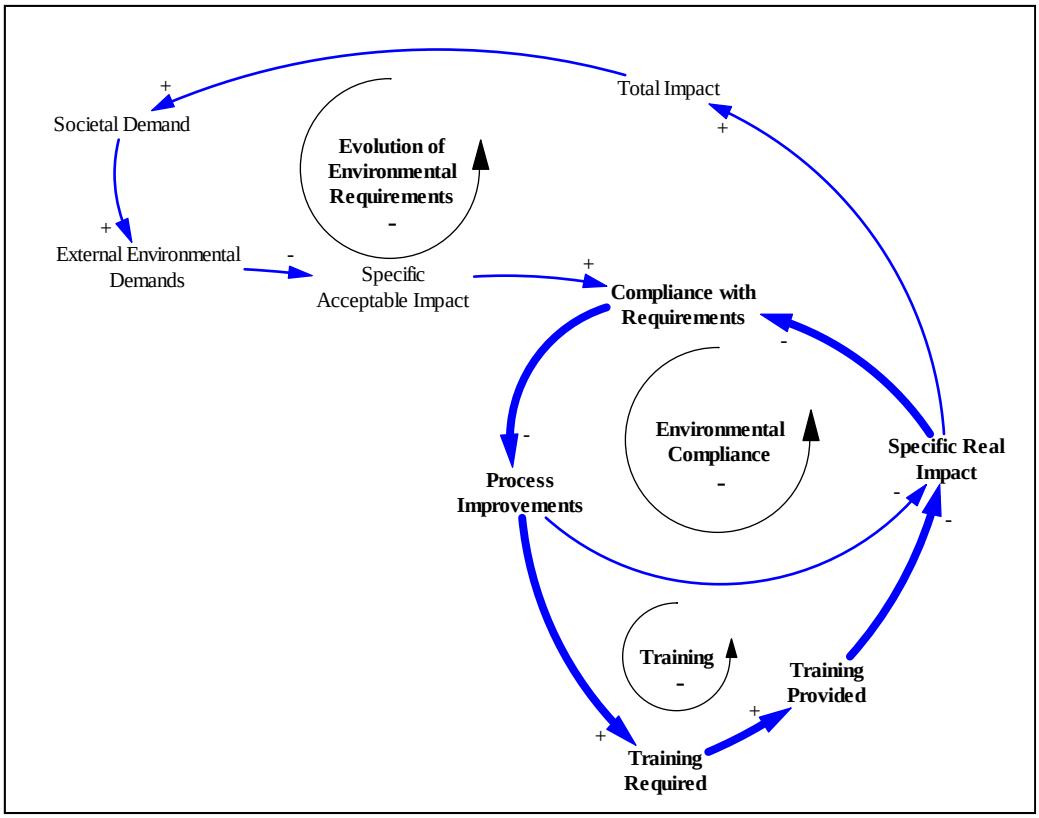

Figure 6. Training State

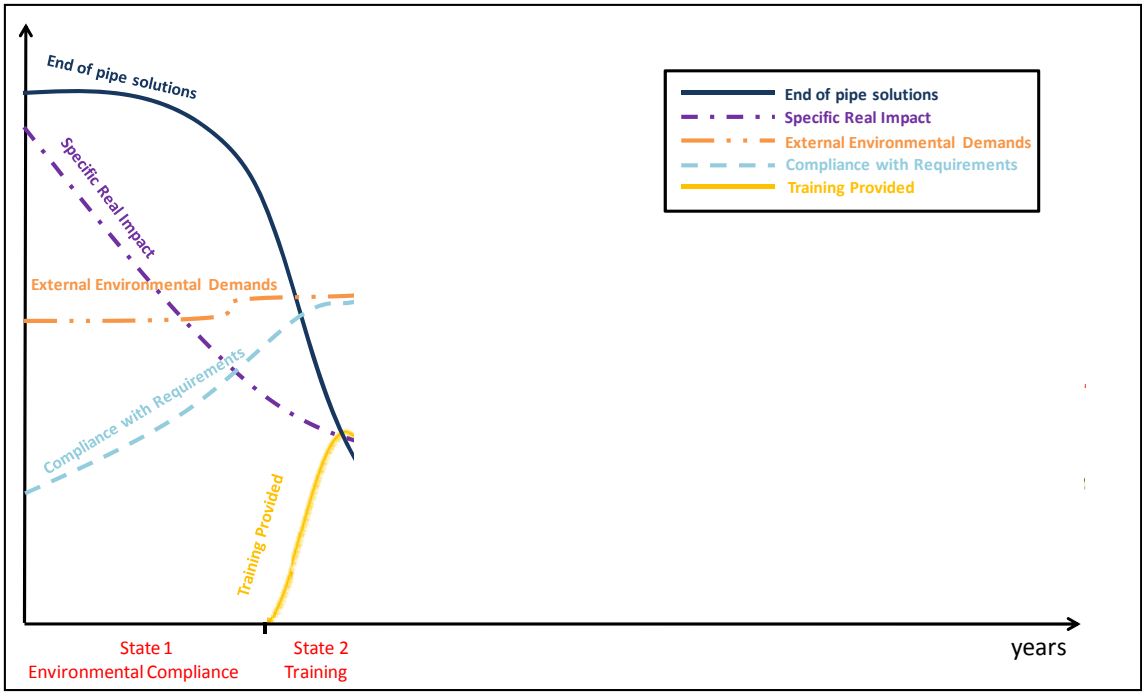

Figure 7. Training BOT

As process improvements increase, training required and training provided follow, reducing the firm's specific environmental impact, and increasing compliance with requirements (Figure 7). The rate of end of pipe solutions continues declining, as it is

more and more difficult to find improvements to carry out, reducing the rate of decline in current impact.

3.5.3 State 3. Systematization

There is a point in the companies' environmental evolution in which companies start to systematize good environmental practices. The trigger at this stage is *Market Demand* that requires green measures to companies, so the *Top Management Commitment* to environmental management starts to grow (Figure 8).

As *Societal Demand* increases, *Market Demand* for improved environmental responsibility grows, leading to an increase in *Top Management Commitment*. If management is committed to environmental practices, it will formalize the measures that have been implemented in the company previously. Sometimes this *Formalization* can be seen in the form of certification, such as ISO 14001, EMAS or local recognition. As *Formalization* increases, the *Process Improvements* in the company grow and the *Specific Real Impact* of the firm on the environment decreases. *Total Impact* decreases, the *Societal Demand* for change decreases. This balancing loop is labeled *Meeting Societal Demands*, as the company tries to fulfill what the society requires.

In addition, when *Market Demand* increases, *Top Management Commitment* grows, resulting in an increase in the *Formalization*. Consequently, there are more *Process Improvements* what leads to a decrease in the *Specific Real Impact* of the firm. If the impact is smaller, the *Market Demand* for additional indications of environmental management decreases. This second balancing loop is called *Meeting Market Requirement*.

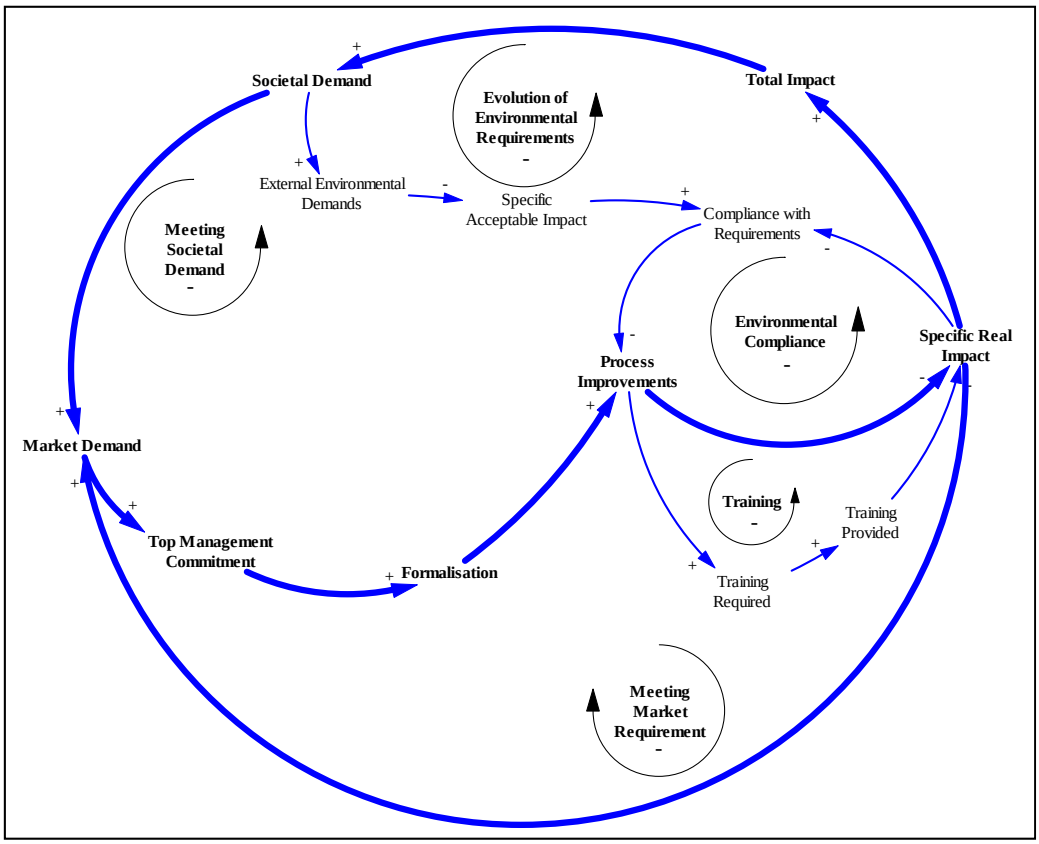

Figure 8. Systematization State

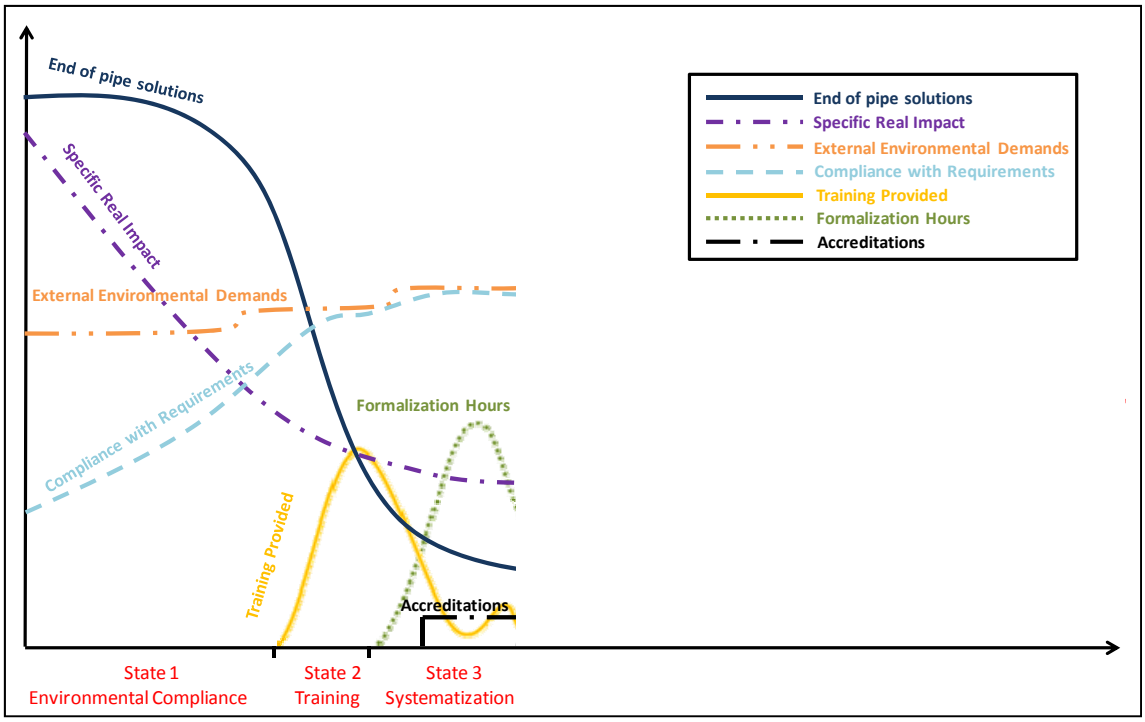

Figure 9. Systematization BOT

Figure 9 shows the introduction of two new variables: the *Formalization Hours* and the *Accreditations*. Both variables are indicators of *Formalization*. The *Formalization Hours* measures the number of hours devoted specifically to the environmental systematization. On the other hand, the *Accreditations* is a way of measuring the results obtained due to these *Formalization*. In this state companies start to obtain some environmental certifications.

Furthermore, the *End of pipe solutions* and the *Specific Real Impact* decrease in a slower way, as it is more and more difficult to improve performance. Still, *Compliance with Requirements* is affected by the changes in *External Environmental Demands* that grow over time. Our experts posited that *Training Provided* will fall once processes are formalized, changing again when as new improvements are introduced. It might be argued that training should follow formalization, but this was not a rationale presented by the expert panel.

3.5.4 State 4. ECO^2

This fourth state is called ECO^2 because at this point companies obtain ecological and economic benefits (Suzuki and others 2010). As there are more and more improvements, companies will start to obtain operational savings (Figure 10). In this state, as the *Top Management Commitment* increases, *Formalization* increases and hence, the range of *Process Improvements* increases. Once the company has made improvements beyond those needed for compliance, they achieve economic benefits from better operations and increase *Savings*. This stimulates increased *Top Management Commitment*, leading to a reinforcing loop called *Economic Benefits*.

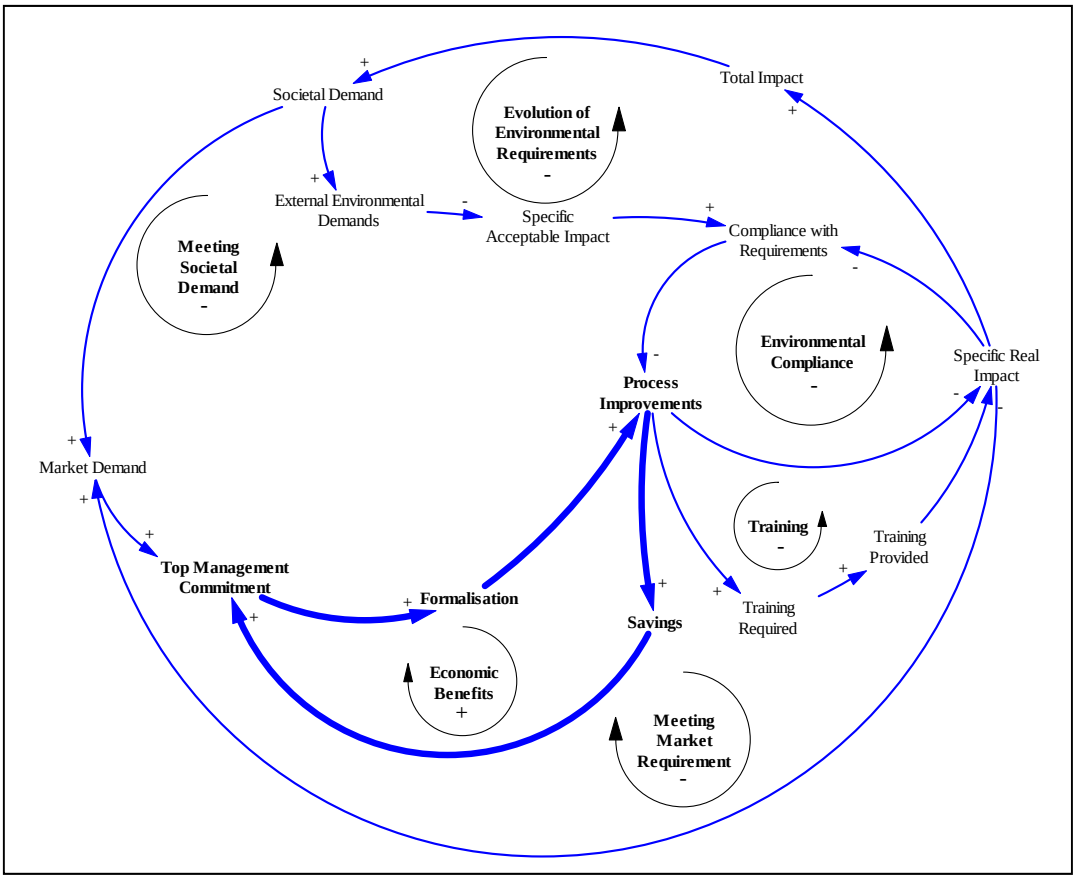

Figure 10. ECO^2 State

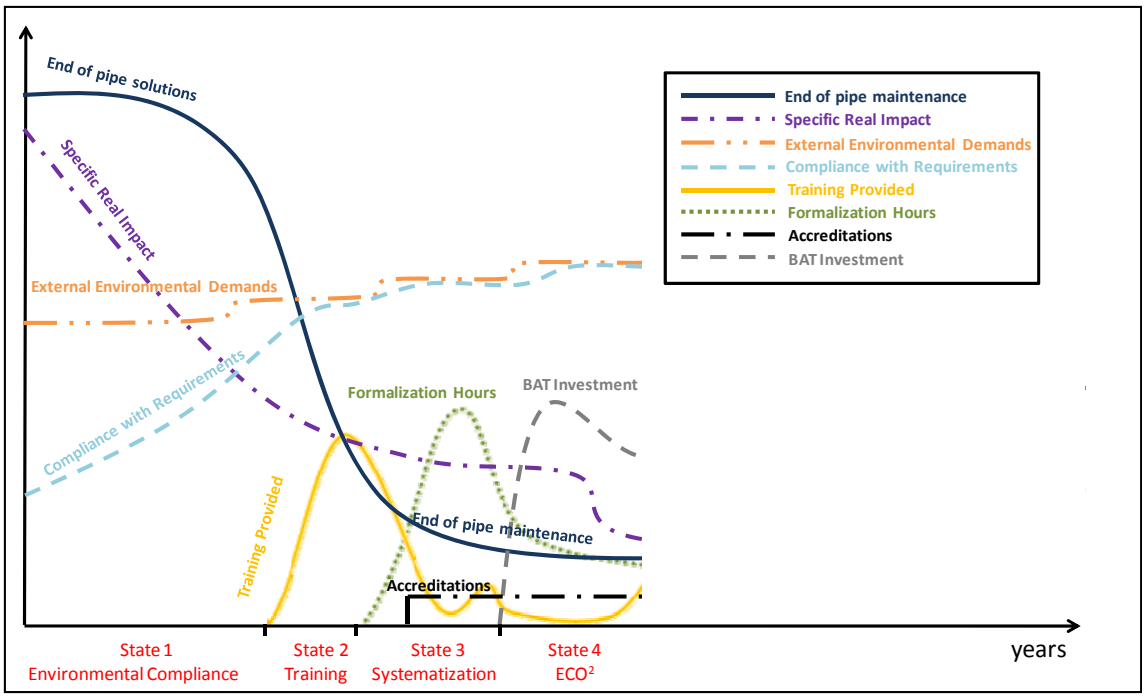

Figure 11. ECO^2 BOT

Figure 11 shows the evolution of environmental management, from the Environmental Compliance state to the ECO^2 state. On one hand, there are few new *End of Pipe solutions*, but *End of Pipe maintenance* grows. The process and product improvements, which appear in the model, are also reflected by *Best Available Techniques (BAT) Investment.* The firm's *Specific Real Impact* goes down as a consequence of the *Formalization* in the previous state. Some of the measures taken in the Systematization state are likely to have a lagged effect.

3.5.5 State 5. Eco-Innovation

Once companies have achieved the systematization stage and begun realizing operational savings, the firm may begin to recognize the value of new green products, processes and/or services to the activities of the company. We propose that the introduction of these innovations, companies may obtain additional more benefits; the *Specific Real Impact* might decrease, and *Market Share* may increase (Figure 12).

The variable *Process and Product Improvements* has been renamed *Process and Products Improvements/Innovations* as innovations influence the same variables as improvements did in the previous states. The new loop that appears in this maturity state is a reinforcing loop labeled *Eco-Innovation* that increases *Market Share*.

As *Top Management Commitment* increases, *Formalization* grows and the workers will introduce new green products, processes and services. As a result of the increase of *Process and Products Improvements/Innovations*, the *Market Share* grows and hence *Top Management Commitment* continues growing.

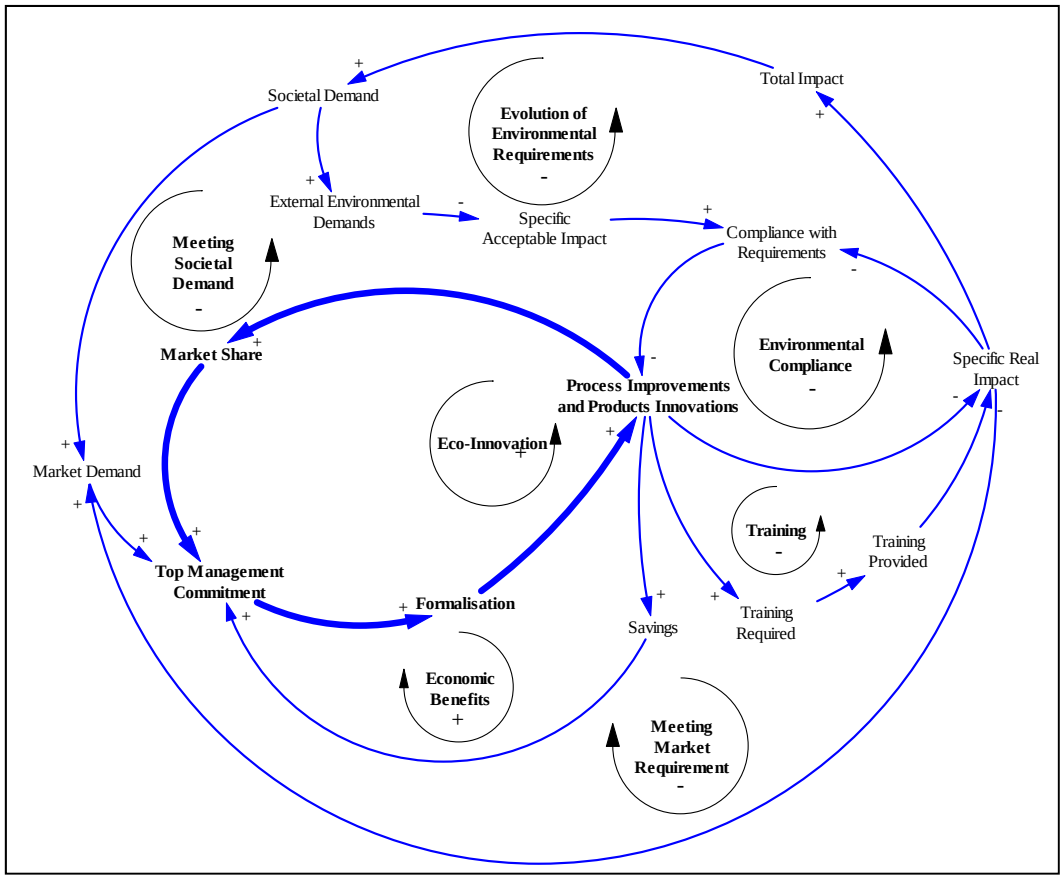

Figure 12. Eco-Innovation State

Figure 13 shows the evolution of the indicators through state 5. In the Eco-Innovation State, there are more Accreditations as companies try to implement innovations in their processes and products. These innovations may result in accreditations such as eco-labeling and eco-design.

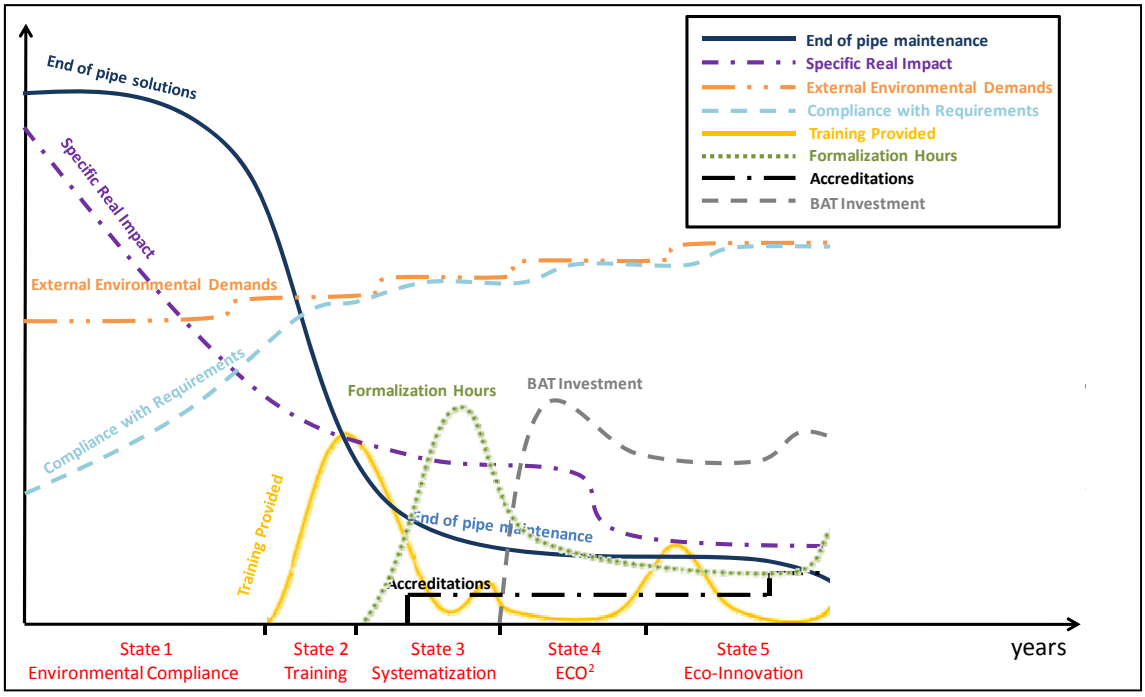

Figure 13. Eco-Innovation BOT

3.5.6 State 6. Leading Green Company

Once the state of eco-innovation has been reached, the company is poised to become a green company. Companies begin to make public their environmental practices and they compete on environmental issues (Figure 14).

As the *Top Management Commitment* increases, *Communication* grows and this contributes to the company's *Green Image*. As the image of the company improves, *Market Share* follows, and *Top Management Commitment* will continue growing, obtaining a reinforcing loop called *Green Company*.

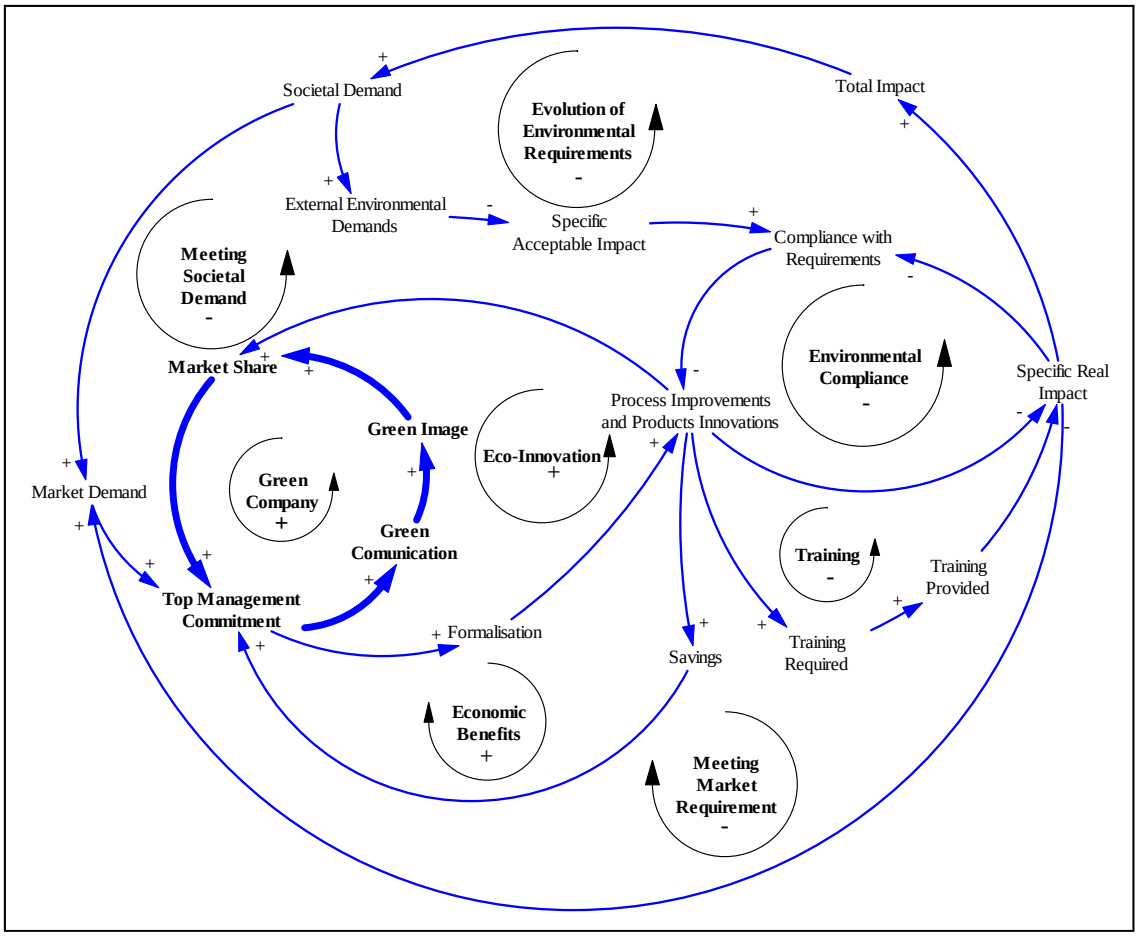

Figure 14. Leading Green Company State

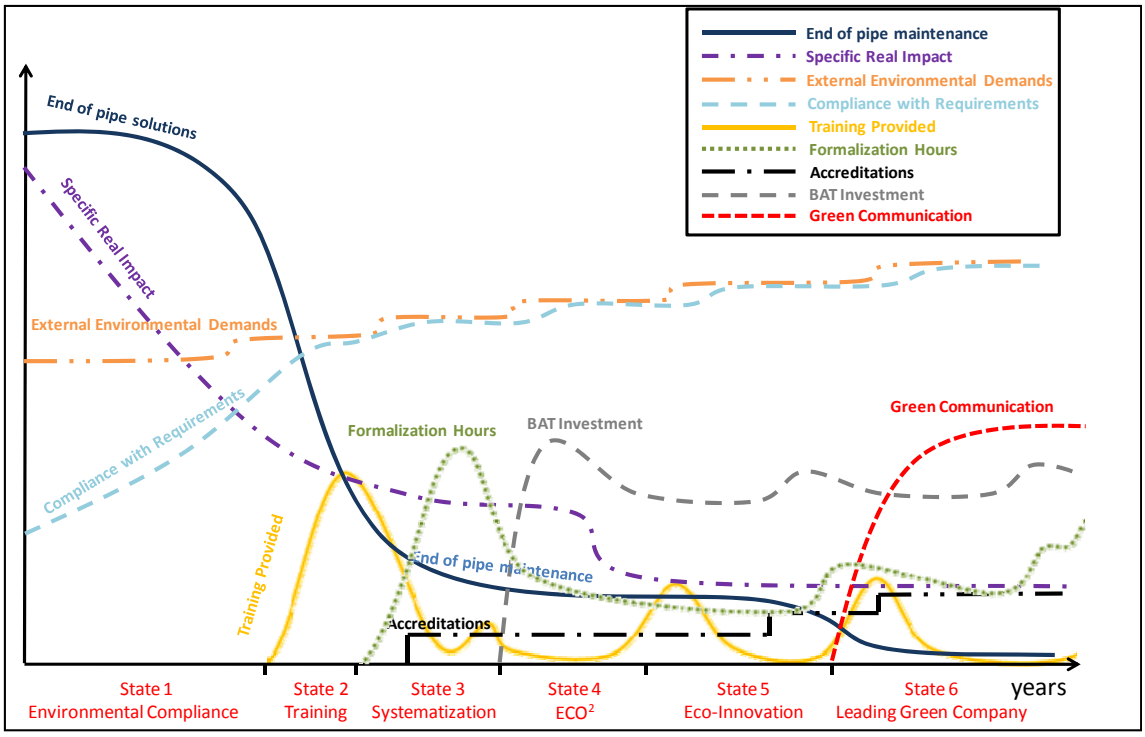

Figure 15. Leading Green Company BOT

Figure 15 shows the completion of the behavioral evolution. A driving factor towards being a Leading Green Company is *Green Communication*. Innovative companies support their focused commitment to the environment with sustainable results. While communications and claims of environmental responsibility may occur earlier, they may be less believable to the marketplace without evidence of the transitions though the earlier stages.

4 Conclusion

This research proposes a maturity causal model that represents the evolution of environmental management. It extends and improves on previous research by adding explicit causal forces behind the evolution. This provides a technique for assessing maturity states as well as steps that can assist or negate their ecological advancement. Moreover, this classification helps companies to understand the need for non-technical elements in the process, such as Top Management commitment.

Our proposal is supported through the use of complementary techniques of grounded theory model-building combined with data review and corroboration through survey. The next step of this research is to make a formal environmental maturity model with field-based data collection.

Future research will also try to identify some tools and best practices that take companies to the higher states of the process. Our initial panel of firms identified themselves between states 3 and 4, Systemization and ECO^2. Moreover, an analysis of the interrelationships among companies and external companies, such as suppliers, would extend the boundary of the model to include the effects of strategic partnership and on environmental management.

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