What is this Integrated Vegetation Management, this IVM – Now, Today, and into the Future?

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ABSTRACT

Integrated Vegetation Management, or IVM, has been touted over the past few decades as the approach for rights-of-way vegetation management. It is an approach based on Integrated Pest Management systems at its core, but also includes the necessary administrative and institutional structures and components to create a full management system. IVM was central to the development of the existing American National Standards Institute (ANSI) A300 Part 7-2006 Vegetation Management standards and the International Society of Arboriculture best management practices. IVM has continued to evolve over the last decade, with examples of expanded emphasis of work on: 1) broad assessment of environmental impact, 2) building social awareness and responsibility; and 3) elevated focus on safety and reliability of service. The time is right to redefine IVM and bring it in its new form to the public, regulators, and practitioners so it can be fully engaged and applied on rights-of-way (ROW) across the world. This paper presents a history of IVM, its current state and use by ROW industries, and possible future change. A bibliography of key references is provided that every ROW vegetation manager should read, along with this paper.

Keywords: Integrated Pest Management, IPM, IVM history, management system

INTRODUCTION

"Integrated Vegetation Management" is the phrase that has been used by the electric utility industry and other allied rights-of-way industries and institutions (such as roadside, railroad and pipeline) to describe the processes and procedures to manage right-of-way (ROW) vegetation. The phrase reflects a systems approach to vegetation management, where a variety of management components – those processes and procedures needed to perform vegetation management – are integrated together to produce desired, sustainable changes in the managed right-of-way.

Integrated Vegetation Management (IVM) is defined as (ANSI 2006; ISA, via Gardener 2007):

> a system of managing plant communities in which compatible and incompatible vegetation is identified, action thresholds are considered, control methods are evaluated, and selected control(s) are implemented to achieve a specific objective. Choice of control methods is based on

> effectiveness, environmental impact, site characteristics, safety, security and economics.

This definition seems short in terms of capturing fully the breadth and depth of IVM. In the ANSI standard (ANSI 2006), some added dimension to IVM is presented as "The reason for Integrated Vegetation Management":

> to promote sustainable plant communities that are compatible with the intended use of the site, and discourage incompatible plants that may pose concerns, including safety, security, access, fire hazard, utility service reliability, emergency restoration, visibility, line-of-sight requirements, regulatory compliance, environmental, or other specific concerns.

Yet, even with this addition, the ANSI definition still shorts the full portrayal of IVM. Consider the following new, extended definition (new text in italics; text from ANSI or ISA in normal font):

> *IVM is a system for making decisions and applying vegetation management treatments based on a series of components and steps consistent with principles and practices of Integrated Pest Management (IPM). It is used to systematically, yet with an artistry that best comes with experience, understand, justify, choose amongst, selectively apply, and monitoring different types of treatments, with an overall goal of eliciting site-specific, ecosystem-sensitive, economically-sensible and socially-responsible treatment effects that lead to refined achievement of management objectives and continuous improvement in practice.* Choice of *vegetation management action* is based on effectiveness, environmental impact, site characteristics, safety, security and *socio*economics. IVM is meant to promote sustainable plant communities that are compatible with the intended use of the site, and *uses combinations of treatments (usually chemical and biological) to control, prevent and otherwise* discourage incompatible plants that may pose concerns, including safety, security, access, fire hazard, utility service reliability, emergency restoration, visibility, line-of-sight requirements, regulatory compliance, environmental, or other specific concerns. *The key steps of IVM consistent with IPM are: 1) gaining science-based understanding of pest and ecosystem dynamics; 2) setting management objectives and tolerance levels based on institutional requirements and broad stakeholder input; 3) compiling a broad array of treatment options that are combined in various ways to produce desired plant communities, including biological, chemical, manual, mechanical, cultural and physical methods, and applying them in concert on a site-specific basis to foster prevention if possible, and control of the pest problem with an emphasis on biological control; and 4) monitoring the system to determine when treatments are both necessary and how effective they were in achieving desired plant communities and meeting objectives. IVM is considered a sustainable endeavor for management of a specific ROW site because of its balanced considerations and actions upon both socioeconomics and environment.*

A long, complex definition – but this is needed to fully portray IVM today. Key elements and aspects added to the ANSI and ISA definitions were: clearly connecting IVM to IPM; presenting sustainability as a guiding principle; and referencing the complexity, fullness and artistry that requires a professional in its application.

This new definition is a bit cumbersome. Consider the following hyper-short definition:

> *Integrated Vegetation Management is tantamount to Integrated Pest Management with plants as the pests, and application considerate of sustainability principles and practices.*

How did all this develop, this IVM as portrayed by these definitions, the long and the short of it? How did we get here? And, what possibly can be next?

IVM reflects the current state of the evolution of professional ROW vegetation management. As a profession, it is important to regularly reflect on where we have been, where we are going, and what is next for work endeavors. Such reflection leads to elevated practice of vegetation to the betterment of the company or the institution that is responsible for the right-of-way and for society as a whole for they are affected by ROW vegetation management in many direct and indirect ways. It is the purpose of this paper to provide some information and thoughts on IVM, specifically providing some thought-provoking ideas and references to address: How did we get here? Where are we now? What next? The paper is meant to be a primer for the novice vegetation manager on a history of IVM, a treatise for the non-utility stakeholder so they can appreciate the richness and depth of development of vegetation management practice, and a synthesis for the experienced vegetation manager so they can continue to grow and add to the evolution of IVM with their work and thought energies.

"Where Have We Been?" to "Where Are We Now?" – A General History of IVM

After reading literature and having many discussions with various thought leaders in ROW vegetation management, the following history of IVM was developed that is a perspective, my perspective. This history is framed by four different eras, each defined as periods with consistent management focus, specifically on the objectives of managing power line right-of-way vegetation. There are many other ways to organize the history of IVM, but this approach has worked (e.g., as a presented paper at the ROW10 conference) to share ideas and stimulate discussion. The era framework reflects and celebrates what we – the right-of-way industry and particularly the electric utility industry – have accomplished over the past 100 years.

NOTE: I count myself as one of the "we", as many of you readers should. I have not managed a power line right-of-way, but I have worked on them as a scientist, enjoyed them as a citizen, and been otherwise affected by them in many positive and productive ways.

Era #1: 1890s through the 1950s

Electricity was first transmitted in the late 1800s, and with it came the need to manage vegetation. From the 1890s through the 1930s, vegetation was maintained by the hand cutting of undesirable plants, mostly trees. In the 1940s, after the machinations of war were shifted to a focus of producing societal goods and services, herbicides were synthesized and mass manufactured for utility use to kill undesirable plants. Immediately, the question arose: "Should herbicides be used to broadcast-treat power line rights-of-way with the use of phenoxy herbicides to shift plant communities to grasses and other monocots?", or "Should herbicides be targeted at individual, undesirable plants and the desirable, low-stature plants left untreated?". These questions have only recently been resolved as not being one or the other, but some possible combinations of both depending on the right-of-way condition and situation. Science-based answers to these questions began in the northeastern United States with the work of Frank Egler and William Niering, and soon after them William Bramble and W. Richard Byrnes. Their "Gamelands 33" study, which began in 1953, was the first, long-term, rigorous, replicated, manipulative field experiment on ROW. It has run since and produced a large portion of today's understanding of the cost and effectiveness of vegetation management. Research from Gamelands 33 provided a first inkling that ROW could produce a diverse suite of values and services. The focus of the work was on testing the effects of various mechanical and chemical treatments on ROW plant communities and game animals.

In Era #1, for the period 1890 through the 1950s, maintenance of vegetation on power line corridor rights-of-way was all about safety and reliability (with a small inkling about animals and the environment from Gamelands 33), and the managers of those days did it.

Era #2: 1960s through the 1970s

High efficacy and low cost of herbicides lead to their broad scale and often indiscriminate use. In the 1960s and 1970s, it was common for herbicides to be applied across long expanses of ROW, edge-to-edge using helicopters. This meant problems with drift and a variety of overspray on sensitive ecological features that we recognize today, such as riparian areas. Yet, despite the possible high degree of control of problem plants with such broad use of herbicides, severe electric transmission outages and blackouts occurred in the mid-1960s that raised concern for mismanagement of vegetation on ROW. The 1960s was also the time when publics shifted their societal focus from economy to environment – it was the decade of the environmental movement. This trigger point in time was punctuated with Rachel Carson's book on the misuse of pesticides … *Silent Spring* (1962).

In the 1970s, societal concerns about human health and safety, and the environment, resulted in increased regulations on the ROW vegetation management industry. Federal and state agencies instituted legal strictures that forced expanded use and considerations for management planning, best management practices to protect water quality, and required training and education on herbicide use and associated certifications for applicators.

In Era #2, for the period 1960 through the 1970s, maintenance of vegetation on power line corridor rights-of-way was all about safety and reliability, but was expanded to include regulations and considerations for the environment driven by societal concerns … and the managers of those days did it.

Era #3: 1980s through the 1990s

In the 1980s, vegetation management on power line corridors was unknowingly being developed and applied in ways consistent with classic Integrated Pest Management principles and precepts. Since 1959, the core principles of IPM have included: 1) basic, science-based understanding of the biology and ecology of the pest organism and the ecosystem within which it occurs; 2) development of tolerance levels based on stakeholder desires that aid in deciding when, or when not to treat the pest; 3) pest management aimed at preventing the presence and development of the pest; 4) pest management aimed at controlling, and not extirpating, the pest; 5) integrated use of biological control as a way to reduce and balance use of chemical methods; and 6) monitoring the pest to provide information to aid in management decisions. ROW vegetation management is in many respects "pest" management, where the pest for ROW vegetation management has been tall-growing trees and other plants (we have seen a recent expansion of the types of pests on ROW to commonly include noxious and invasive, exotic plants, too). New herbicides were being introduced – the biosynthesis inhibitors (e.g., glyphosate, and a variety of imidazoline and sulfonylurea herbicides) – that broadened and deepened the manager's toolbox, and provided chemicals for use that had near 100% efficacy with a wide variety of plants. These new herbicides elevated the opportunity to selectively remove undesirable plants while causing only minimal disturbance to the desirable plant community.

In the 1990s, the core components of IPM were expanded and ordered to better capture the breadth and complexity of ROW vegetation management, and to make IVM a full management system. The new IVM management system encompassed the professional discipline, and included commitments to continuous improvement through expansion of monitoring to include not just the pest, but the whole functioning of the management system. IVM was being recognized as a complex of management considerations, decisions and activity with a commitment to improvement and elevated practice over time.

In the 1990s, forestry and other allied disciplines and professionals embraced new concepts of ecosystem management and sustainability. Ecosystem health and integrity, biodiversity conservation, and elevated stakeholder involvement in management defined the change. Forest certification – formal accounting, branding and marketing systems for defining sustainable forest management practices – became a force for professional accountability. Utility vegetation management – IVM – was soon to be caught up in these changes.

In Era #3, for the period 1980 through the 1990s, management of vegetation on power line corridor rights-of-way was all about safety, reliability, regulations, environment, and socioeconomics, but was expanded to include considerations for integration and management systems and inklings of sustainability … and we did it!

Era #4: 2000s through the 2010s (Present, and a Bit into the Future, too)

In the opening decade of the new millennium, IVM emerged as a fully developing system that was codified into standards (ANSI A300) and best management practice guidelines (International Society of Arboriculture). Understanding and commitment to IVM rose to a high level. But, that was set back some with a series of blackouts, especially the eastern North America blackout. This event – which was traced to mismanaged vegetation and grid system failures – resulted in new, severe federal regulations meant to guarantee that safety and reliability were assured, always and everywhere. In many sectors of the industry, these new regulations caused a drop back to earlier eras of vegetation management (referred to as "backsliding" in professional vegetation management by many in the industry). It is only now that companies are embracing once again the full meaning and application of IVM.

Presently, IVM is expanding to be set in a program of larger more encompassing systems, stakeholder considerations, and documented planning so as to be more readily sustained in its application, in both time and space. Accreditation programs are expanding or being developed to recognize full, proper and sustainable performance of IVM (e.g., see paper by J. Goodfellow, this conference). Accreditation and other means of formal review and accounting is part of what is being referred to in management principles as "social licensing" – society scrutinizes and holds to accounts those that affect their lives.

In contemporary Era #4, for the period 2000 through the present, management of vegetation on power line corridor rights-of-way was all about safety, reliability, environment, socioeconomics, integration, management systems, but was expanded to fully include considerations for sustainability and accountability … and we are doing it!

Summary

Upon reflection, over the course of the last 100 years of vegetation management on power line ROW, it can be concluded that ROW vegetation management has been and is: 1) complex, with increasing complexity over time; 2) broad in terms of the types of issues, concerns and other information needed to make sustained management decisions, with breadth also increasing over time; 3) long standing – ROW vegetation management has unfolded now for over 100 years; and 4) responsive, in that the profession has indeed changed over time as knowledge and society have changed.

Where Are We Going? A Pendulum Assessment of ROW10 and the Future of IVM

Before continuing on with reflection and thinking about what is next for power line corridor vegetation management, and IVM in specific, a review of those agents of change associated with the passage of one era to the next, is presented as follows, with specific attention to those factors and forces of change that might have bearing on the future. Agents of change for this paper were grouped into six categories: 1) administrative; 2) environmental; 3) regulatory; 4) socioeconomic; 5) systems; and 6) science / technology. While all six operate during an era, it appears that only some factors and forces of change operate to really drive an era and cause a change to a new era (Figure 1). Clearly, the ROW industry has been responsive. IVM as a professional endeavor is the result of growth and development of vegetation management over a long period. Changes in vegetation management have been both episodic and continuous. Episodically, there have been events such as blackouts that have triggered an expansion of regulations. Expansion of knowledge through work experience and long-term research is a more continuous agent of change. What we have today, after the various episodes and progressive developments. is a complex management approach that has shifted from a single focus on safety and reliability to a broader, systems approach. This does not mean that safety and reliability are minimized or marginalized. Not at all as these foci will always be first. But, how they are provided for has become more complex.

It is broadly recognized that management and other human affairs are regularly shifted and pushed by forces and factors that, over short periods of time, come from one dominant agent of change, and then later often shift to being pushed by another, often opposite, force or factor – like a pendulum (Figure 2). Science and technology associated with socio-economics can push on management for decades, and then be pushed back by science and technology associated with the environment. The pivot-point, or hinge, for the pendulum is the constant presence and force of people through administrations and institutions. They form the necessities of management, such as "staying solvent and in business" and "following the law". While some of these necessities may change over time, they are omnipresent.

For ROW vegetation management, the pendulum has been pushed back and forth over the course of the last 100 years. In Era #1, the pendulum was pushed to the right as through forces and factors associated with economics nearly alone. In Era #2, the pendulum was swung back with society's interest in the environment, and today it seems the pendulum may be coming back again.

A snap-shot of where the profession is at in terms of forces and factors was studied by evaluating all of the papers presented at the 10^{th} International Symposium on Environmental Concerns in Rights-of-Way Management. All 78 originally submitted papers were categorized as to type by title. Six types of papers were used: administrative, environmental, regulatory, socioeconomic, systems and science / technology – these are those main groupings of factors and forces that act as agents of change for IVM. Each category was defined as follows, with the key words and phrases coming from the different paper titles.

> Administrative: easement acquisition, inventory work, risk evaluation, and licensing process analysis, access road inventory

Environmental: invasives, vernal pools, biodiversity, habitat, predator use, conservation, mitigation, restoration

Regulatory: Best Management Practices, biological compliance, permits, recommended setback distance, spill response, environmental permitting process, environmental inspectors, regulatory compliance

Socioeconomic: Social – social media strategies, public participation, stakeholder engagement, visual resources, cooperative approaches, public perception, outreach, consultation and collaboration; Economic – cost-benefit analysis, least cost analysis

Systems: IVM, performance, Environmental Management System, strategic approach, planning tool, accreditation, integration, Integrated Pest Management, incident command approach, vegetation management protocols, decision making

Science and Technology: field computers, GIS/GPS, LiDAR, herbicide effectiveness, photogrammetry, aerial laser survey, geospatial technologies, remote sensing and analysis

The Right-of-Way symposium was first held in 1976 with the following meeting purpose: "to achieve a better understanding of the current and emerging environmental issues related to right-of-way management by sharing research and practical experience throughout the world." (from the preface statements at the beginning of the symposium proceedings). For the last five or so symposia, and in some respects right back to 1976, the symposia topics have been much more than just "environmental". And with that the symposium proceedings can be viewed as an important collection of industry actions during a certain period, as the papers in the symposium reflect where the research and development efforts have occurred in the ROW industries over short-periods of time (average period duration between conferences and published proceedings of 4 years), and therefore offer some objective perspective on contemporary issues and concerns.

Results for ROW10 were generally, equally balanced among type categories:

Agent of change	# of papers
Administrative	5
Environmental	18
Regulatory	12
Socioeconomic	14
Systems	14
Technology	15
TOTAL =	78

It seems, at least by the balance of papers presented at the ROW10 conference, that the factors and forces are in somewhat of a balance, or at least we are at some point where the pendulum has swung and is now hanging straight down. It is not clear if this means that IVM has developed to the point of being the right path of professional work, and now we see that it is changing only by increasing the depth and fullness of understanding.

Future of IVM ?

Two assured things I know. First, the next decade for IVM will be much the same as today. This is in line with the adage about the weather forecaster – if all he or she says is that tomorrow will be the same as today, she or he will be right more than half the time. It is a safe prediction to say IVM will be the same for a while. And, after that, who knows, except that it will likely be different. It is amazing in retrospect to consider how vegetation management has changed over time. Consider that just 30 to 40 years ago, there were: 1) no computers; 2) little concern for biodiversity, ecosystem health and integrity, and sustainability; 3) little to no regulations; and 4) few professionally educated and trained vegetation managers. Yet, today, all of these are present in force in ROW vegetation management.

It is hard to fathom how different vegetation management and IVM will be in the future. But it will be different. Things will change. And, we know from the experience of over a century of electricity transmission and vegetation management that: 1) the ROW industry will be responsive; 2) change will occur episodically and continuously as driven by the forces and factors from economics, environment, regulations, society, systems and technology; 3) complexity (and maybe even "chaos" – as that is what follows complexity) will reign; and 4) society will become more and more interested in what is being done to their ROWs.

So, IVM today is well developed and complex. IVM in the future will be … different, likely even more complex, maybe even chaotic, and certainly embraced and refined in its development and application by the ROW industry. It has been our history.

ACKNOWLEDGEMENTS

A thought paper is a difficult one to really bring out who should be acknowledged – it becomes a list of "who has affected my professional life", and with that listing comes a risk of forgetting someone important. I take that risk, and acknowledge the following people who have affected my learnings and experience with ROW vegetation management over the past 20 years: Larry Abrahamson, Ben Ballard, Ken Finch, John Goodrich-Mahoney, Kevin McLoughlin, Ed Neuhauser, Lew Payne, and Tom Sullivan. And while I acknowledge these folks for their positive influences on me, know that I take full ownership and responsibility for the ideas put forth, especially any errors in fact or thought. The paper reflects some of my current understanding. My goal with this paper was to foster thinking and discussion. As with all ideas, those found in this paper are subject to comments and criticisms. I invite you to send such to me so that I can adjust my thinking, writing, and teaching. Thoughts and understanding grow and change over

time with new learning that comes from experience and discussion. I hope for more of both. Thanks in advance.

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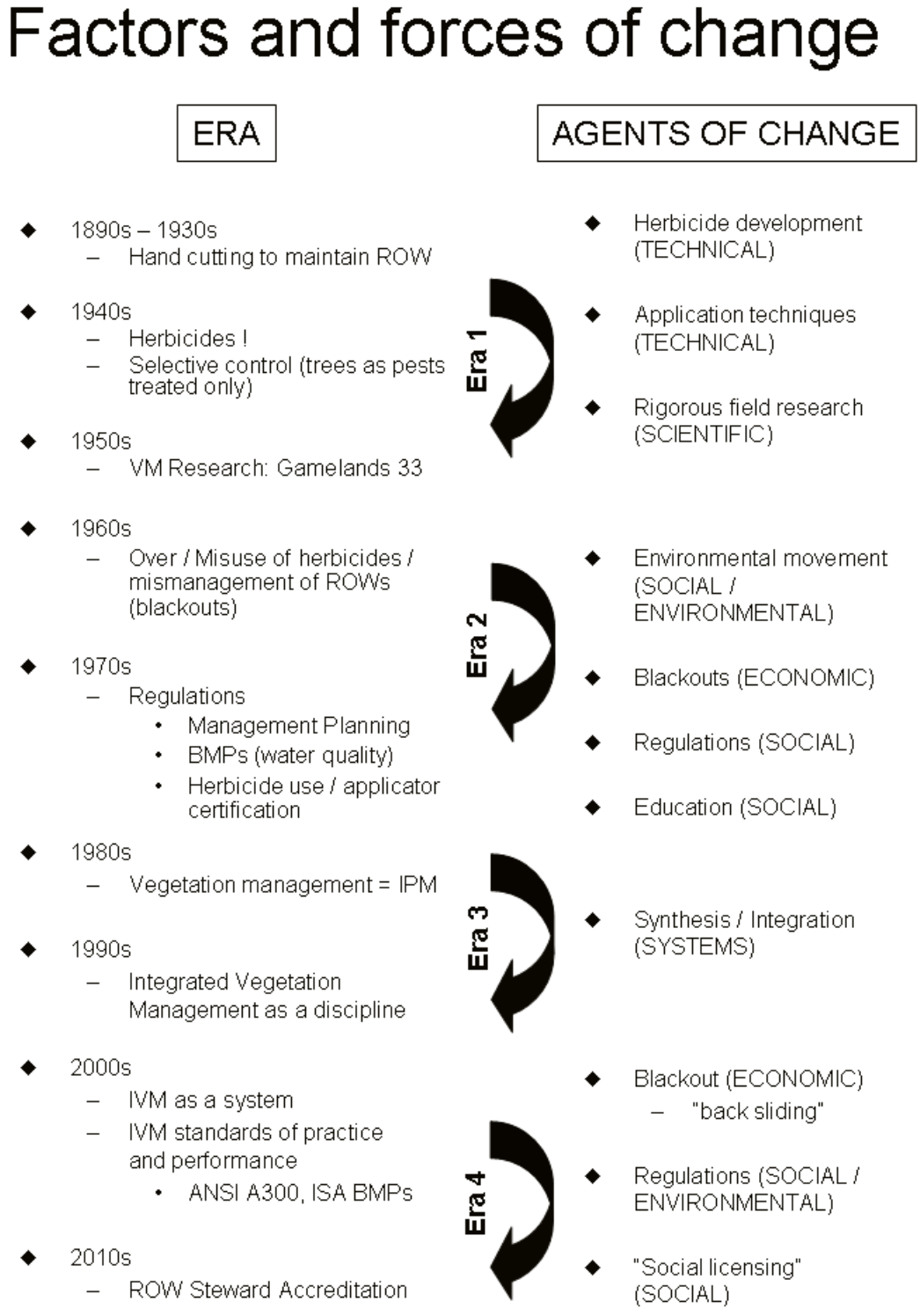

Figure 1. Factors and forces that have caused changes in vegetation management on power line rights-of-way over four eras and a century of change.

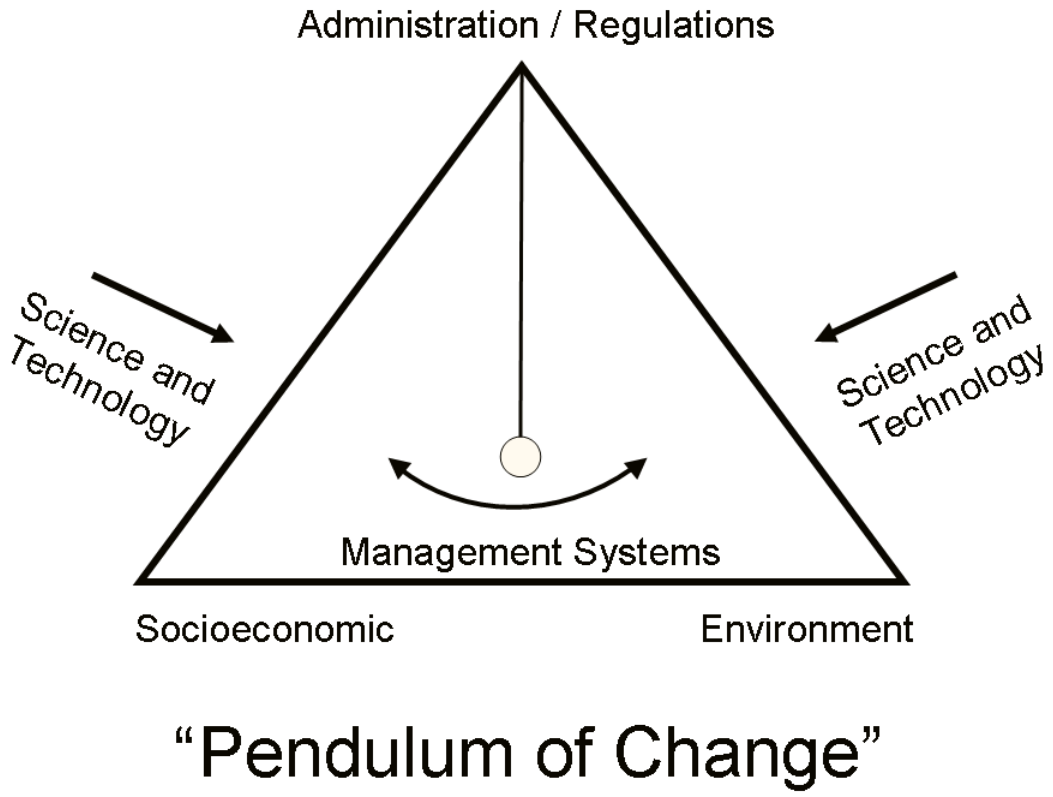

Figure 2. Shifting systems of management from emphases on socioeconomics to the environment depending on knowledge and opinion as meted through science and technology, and swung by administration and regulations.