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Editorial

Key elements, stages and tools for a sustainable world: an introduction to this special volume

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A B S T R A C T

This special volume of the Journal of Cleaner Production was developed primarily based on materials presented at the 2nd International Workshop Advances in Cleaner Production held in São Paulo, Brazil, in 2009. The content reflects the growing awareness of the urgent and unavoidable need for making changes to help transform unsustainable to sustainable societies.
The eleven papers provide different viewpoints to help society make progress on the journey towards sustainability. Key elements of this urgent journey are addressed in this collection of papers; some challenge society to address the problems in a systematic manner and some underscore the essentiality of proper planning by using green teams, or a Sustainable Environmental Management System. Other authors explored the role of proactive regulation and economic instruments to promote environmental performance improvements. Innovation through learning and promotion of multidisciplinary thinking as well as transference of information and knowledge between academy and industry are key aspects explored. Their inputs enabled this editorial team to propose alternatives uses for 'wastes', for substituting one raw material for another, which is environmentally and economically advantageous, for changing industrial process to decrease Greenhouse Gas emissions, or for optimizing diverse processes. The role of the Clean Development Mechanism as a promoter of implementation of innovative cleaner technologies in host countries is discussed. A systemic assessment tool, emergy synthesis, was employed to evaluate a reverse logistic enterprise from an environmental perspective.

1. Introduction

This special volume of the Journal of Cleaner Production was developed primarily upon materials presented at the 2nd International Workshop Advances in Cleaner Production held in São Paulo, Brazil, in 2009. The conviction of the authors, the Editor-in-Chief and the guest editors is that the important knowledge which was shared and developed during the conference, supported and fedback the discussion among all people involved, and permitted development of this special volume. All the papers contained in it are proof of how knowledge and sharing of information can contribute to progress for all of us on our journey towards sustainability through integration of academic results and practical applications. The content of this volume expresses the awareness of the urgent and unavoidable need for making many changes from unsustainable to sustainable societal patterns. The content reflects the belief already stated in our first special issue (Bonilla et al., 2010) that the necessary changes would only be accomplished through integration of academic results and insights with practical societal applications.

2. The necessity of a healthy environment

It is not sensible to have to justify the necessity of a healthy environment but, this editorial team considered it necessary in order to highlight the key ideas that are the starting point of this introductory article. As stated by Ehrenfeld (2007), "If the body of the world we live within and rely on for our subsistence is not healthy, then the well-being of our species becomes threatened, and the good life we seek becomes unattainable". As humans, one species among millions of species, all are totally interdependent upon the sun and the biosphere; therefore environmental sustainability is essential if we and other species are to survive on this planet. However, our intrinsic limitations, our hedonism and the jeopardizing of the ecospheric and societal health in innumerable ways have led us to forget or to postpone acting upon our responsibilities towards environmental sustainability. In addition to this, the definition and extent of the term "well-being", specifically for the human species, is complex and dynamic, thus its connotations have evolved during many centuries with widely diverse implications depending upon the cultural, climatological and geological contexts. But one thing is clear: "well-being" for us, independently of considering ourselves as individuals or members of a society, contains aspects beyond the performing of mere biological functions. In this way, and as a consequence of our multiple interactions as human beings, social and economic dimensions are included together with high quality of environmental health when the objective is assuring "well-being". In order to obtain proper solutions to ensure not only species' survival but also, their well-being, all of the diverse interlinkages must be sustained in health promoting ways.

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3. The key stages towards a sustainable human society upon planet Earth: a logical and dynamic sequence

The alleged right to exercise our well-being without realizing the real limits of the biosphere has resulted in the unsustainability of our consumption and production systems. Consumption and production systems exert numerous pressures upon the living natural resources and biodiversity, the threat of climate change, the burden of toxic substances, the exploitation of non-renewable resources and the pollution of water resources (Mickwitz et al., 2011).

It is clear that humans are facing many challenging problems since we embraced the concept of sustainability based on the three pillars (to preserve environment, social equity and conscious economy) as the goals we must achieve. As we become increasingly aware of both the intrinsic difficulties of maintaining linkages among these three dimensions and of the possibility to address the social resistance to change and the lack of consensus, to adopt a path of *Planning*, in order to attain an effective and proactive *Transformation*, it is increasingly evident that this is the only way to ensure human and other species' survival. Also, the intermediate stage of step-wise *Transition* must be properly planned because when the transition process is properly directed and controlled, that will help to ensure that the system will function on the transformational journey.

Since sustainability is a broad concept, the construction of the conception of sustainability is neither trivial nor easy, and it will only be successful if it the process is supported by informed people with general environmental awareness. Thus, the first stage, *Envisioning Sustainability* requires the effort of all humans to envision and to become engaged in accomplishing the goals we are responsible to attain. Many radical changes in paradigms, values and methods will be essential if humans are to achieve the goals pertaining to sustainable, societal well-being.

Among the changes, the simultaneous adoption of new paradigms and values (aesthetic values, holistic conception of the planet, sense of belonging to a community) is necessary in order to ensure a successful transformation to sustainable societal patterns. The establishment of more ethically sound and fair relationships between/among humans and other species will only be achieved based upon a moral reorientation. That means, that a shift of values has to occur that the new values must be sustained by the insights that nature should be valued by itself and for its life support services, not merely for how it can be converted into marketable resources. Hence, the current economic paradigm should be replaced with a new paradigm that is based upon the vision and knowledge that continued growth is undesirable and untenable (Brown and Ulgiati, 2011). That means, society must understand economics through a biophysical perspective (Brown and Ulgiati, 2011) and must adapt its economic practices and social behavior to reflect true environment costs and impacts (Price and Probert, 1997).

The sequence of *Key Stages*, proposed in the foregoing paragraphs, is dynamic since it is not introduced as something fixed and previously determined. Although we are convinced that the establishment of the goals is a necessary condition to begin the journey towards its attainment, goals will certainly change when humans be capable of considering long-term goals & purposes after learning more about linkages among systems and dimensions. *Envisioning* promotes *Planning*, which in turn enables *Transition* towards dynamic *Transformations*. By controlling and monitoring *Transitions*, on-going *Planning* must be used to adapt to new conditions. By monitoring progress on the *Transformations* the degree, intensity, and coherence with the goals will provide feedback for the dynamic evolution of the goals by, *Envisioning and* Contextualizing within the new realities as they evolve.

4. The necessity of tools to help the key changes to be implemented

Issues concerning sustainability should be explored in different ways within different contexts, as suggested by Mickwitz et al. (2011). In order to address the challenge, a *multidisciplinary approach*, although not sufficient, it is a necessary condition, to tackle the complexity of the linkages among dimensions.

As one plunges deeper into the topic of *Planning*, it is common to be confronted with different results than those that were expected especially, if the goals to be attained were not properly defined. The task is more difficult when the goal is sustainability due to the high level of complexity and long-term time horizons, which must be addressed. To properly define the goals, already seen as being the required starting point for successful *Planning*, at least the set of desirable and necessary characteristics that comprise sustainability, should be established *a priori*. For doing so, *Paradigm Changes* involving internalization of well-being and happiness concepts and of living within the boundaries of the biosphere limits, should occur. Additionally, expansion of our time-horizons and inclusion of future generations within our scope of cause–effect behavior is essential for society to begin to act in more responsible ways.

The inherent power but also the weakness of *Planning* lies on the multiple possibilities of managing that planning. *Planning* can be centralized or distributed, bottom-up or top-down, globally or locally directed. But even considering the difference in the goals, *Planning* is considered to be indispensable for *Planning* strategies towards sustainability: learning should support planning. The process of learning will be more directed and efficient if access to knowledge is facilitated through sharing of knowledge at all levels. All of these changes must be done within the context of an understanding of the *systematic character of problems*, and of the necessity to adapt the process of planning to the multiple and interrelated aspects of the problems. In this way, the problems that must be addressed have systemic influences, which affect the health of humans and nature (Ehrenfeld, 2007).

Sometimes, *transformations* towards sustainability are successful due to proper *planning* that is based upon dynamic and reflexive *learning*. At other times, the expected transformations may not be achieved; consequently, the new state should be evaluated to provide feedback to help society to learn and to continue the transformation process towards the evolving sustainable societal goals. Transformations may seem to be successful at a first evaluation but they may only result in temporary successes. Inherent limitations due to lack of complete understanding of the linkages between/among dimensions and domains of influence (local, regional or global) can be responsible for such partial successes. In this way, the *understanding of interlinkages* is neither trivial nor easy since relationships are non-linear and the effects on other dimensions are unpredictable. In spite of the difficulties, effort must be invested to make the changes. Fortunately, slow progress is being made as evidenced by papers published in numerous journals, including those in this special volume of the Journal of Cleaner Production.

Transitions on the journey towards sustainability, with the characteristics required due to the current gravity of human-induced eco-system stresses, must be purposively directed and should proceed at an unprecedented speed as stated by Mickwitz et al. (2011). In this way, tools capable of monitoring the progress of both the speed and extension are already playing, and must continue play central roles. The importance of *assessing* and *monitoring* is undoubtedly crucial as is evidenced by the increasing number of papers in the scientific and popular literature that focus upon such activities.

Both for monitoring *Transitions* and for attaining different stages of *Transformation*, assessment tools must be transparent to help decision-making and to enable societal-member's feedback. It is essential to assess the events as they occur, simultaneously, with the transition progress. In such cases, resources, time required and data intensity should must be appropriately funded in order to enable effective and efficient assessments. Additionally, there must be societal commitment to ensure quantitative and qualitative monitoring of the effects of actions or interventions, over a long-time horizon, after the *transformation* has occurred.

The obligatory presence of the three sustainability dimensions requires that specific indicators are used to monitor each dimension. Also, some indicators are needed to monitor the "overall improvement" so as to provide short and long-term support for effective decision-making based upon 'sustainability promoting' policies. Indicators may have to be aggregated in order to generate inter or intra-dimensional indices, which can be used to motivate society to continue to work toward the sustainability targets that have been established. The question concerning adoption of either aggregated indices or multimetric approaches is very important. Since no perfect approach exists the choice must be made depending on objectives, necessities, scope, available data, time horizon and target public.

The roles of Government must be clarified for creating proper legislation, of public agencies in fiscalizing, and of the population as a whole, in order to establish dynamic priorities, strategies, targets and timetables. In that way the dynamic characteristics of *Regulate and Fiscalize* underlay its potential for success because they enable feed-back among industries, agencies, government and population. Fortunately, the old punitive role of public agencies is already evolving towards a more proactive role of promoting environmental and societal sustainability through integration, learning and information sharing.

5. Overview of the sustainability aspects addressed in this special volume

The paper, "An analysis of the original driving forces behind the promotion of compulsory cleaner production assessment in key enterprises of China" (Dan et al., 2013), addressed the role of *Regulate and Fiscalize* in an holistic manner since it pointed out the importance of *understanding the linkages about* different *dimensions* as the way to make legislation and public policy efficient and broadly applicable. The authors began their paper by relating the situation in China, in terms of CP actions and CP assessment (CPA) performed by enterprises as a result of legislative demands. In this way, the government introduced the obligation of CPA, either as compulsory or as voluntary changes depending on the pollution profile of the enterprises. To obtain local governmental acceptance of the compulsory CPA, each enterprise had to follow three previous stages, according to authors' description. First of all, the enterprise had to be identified by the local government within the group obliged to elaborate a CPA according to the pollution criteria previously established (stage 1). That means, it had to be considered to be a "key" enterprise. Subsequently, the enterprise was contacted by local government by using the local major media (stage 2). Then the company had to elaborate the CPA in order to report results and to relate CP changes that they had already implemented and to provide additional proposals in order for them to continue to improve performance (stage 3), Then the CPA was evaluated and accepted when it was in compliance with the regulations (stage 4).

The authors emphasized that despite the well-demonstrated economic and environmental benefits achieved by enterprises when CP was adopted, the stages of identification of the key enterprises and the communication between the government and the company leaders was not properly performed by the local government in some regions of the country. In order to overcome this weakness, it became clear that the choice and monitoring of proper variables to check the evolution of the complex process of the CPA evaluation and acceptance, had to be improved to ensure that the system effectively supported decision-making at the company and governmental levels with the broader goal of attaining widespread CP adoption. The authors highlighted the stages in which local governmental actions should be more intensive. Internal and external driving factors were discussed based upon three quantitative indicators: a. GDP per capita, b. sulfur dioxide emissions per capita and c. staff training. The effects of the use of these quantitative indicators on the promotion of CPA were analyzed by using quadratic polynomial models. The promotion of CPA was expressed in terms of variables created from the ratios between the number of enterprises at one stage and the number of enterprises at another stage multiplied by 100%. In this way, the following variables were created: a. the published rate based upon the relation between enterprises at stages 2 and 1); b. the assessed rate based upon the relation between enterprises at stage 3 and 1); and c. the accepted rate based upon the relation between enterprises at stages 4 and 3). The findings showed that the assessed rate was the best indicator of advances of compulsory CPA in key enterprises in China. It was also concluded that the promotion of CPA was driven by economic development and pollution pressure.

The paper, "Improving environmental permitting through performance-based regulation: A case study of São Paulo State, Brazil" (Ribeiro and Kruglianskas, 2013), deals with the role of performance-based regulation as an encourager in the process of improving industrial environmental performance. Among the Actions we considered earlier as "Key Tools for a Sustainable World" to support the *transformation* processes to *Regulate and Fiscalize*, the authors of this article effectively addressed by emphasizing the relevance of positive feedback among policies, agencies and industries to attain environmental performance improvements. The authors learned that in addition to the positive effects of the new strategy of the regulatory permitting system on industrial performance, a complementary effect emerged, namely the possibility of going further on regulatory advances through learning from industrial proposals, actions and improvements. In this way, the emerging dynamic feedback system built upon the cultural and administrative changes of the environmental agencies to become a more open regulatory system.

According to the authors, the innovative permitting model was inspired by international experiences but it was also adapted to local institutional conditions. This strategy showed adherence to performance-based assumptions proposed by Zarker and Kerr (2009). Under the new legislation, the operating permit acquired a renewable character, and obliged the enterprises to update their information with the environmental agency, CETESB (Company for Environmental Sanitation and Technology). The State Decree 47.400 created the possibility of extending permit validity based on an environmental performance evaluation. As a consequence, CETESB established the principles of an essential tool, the Environmental Improvement Plan (EIP) that served as an instrument for dialogue and establishment of proposals for improving environmental performance within and among the companies.

The authors discussed that the real effects of the application of the strategy should be evaluated by checking the degree of CP adoption as a result of the EIP. Since no consolidated data were available, results from a case study corresponding to the Capuava Petrochemical Hub, performed by CETESB technicians were presented and discussed. The petrochemical hub, installed since 1972 on the border of the capital city of São Paulo, consisted of

an oil refinery, several second generation petrochemical units and other companies. It is important to note that it is located within an environmentally fragile region, this fact obligated CETESB to demand special requirements about water to the companies. In this case, the well-oriented enforcement actions of CETESB in obliging companies to prioritize improvements related to urgent and local problems reinforced the already discussed role of *feedback*. In this way, the EIP emphasized rationing water use and decreasing of wastewater generation through CP actions such as improving water use efficiency in operations and reuse of wastewater after reverse osmosis treatment. Data from wastewater reduction are presented in the paper.

One of the main conclusions from these two papers is that that public policy innovations are or can be important contributors for promoting performance improvements. It was clearly established that it is necessary to continue to improve governmental actions on performance-based adoption. The authors stated that the success of the strategy depends on the capacity of institutions, public and private, to perform their new and challenging roles, by means of *understanding the responsibilities within the system.*

In the paper titled, "Modelling a new, low CO_2 emissions, hydrogen steelmaking process" (Ranzani da Costa et al., 2013), the crucial role of transference of information and knowledge between academy and industry was underscored. The main objective of this paper was to mathematically model a steelmaking process that uses hydrogen as the reducing agent of hematite, instead of the conventional syngas, thus avoiding the release of CO_2 to the atmosphere. This paper nicely demonstrated that fundamental research resulted in practical industrial benefits because it promoted steelmaking processes that resulted in environmental and economic improvements.

The authors emphasized the responsibilities of European steelmakers to reduce their CO_2 emissions by at least 50%. The project "*Ultra-Low CO_2 Steelmakers*", (ULCOS) was created to support research to help them to achieve this goal.

The research revealed that substitution of the conventional syngas mixture, obtained through reforming of natural gas, with H_2 as a reducing agent, although encouraging, it could only be practicable with the advent of the H_2-based economy. This limitation was highlighted by the authors, even though they considered it valuable to anticipate its possible development. The model developed by the authors considered that the reducing gas flow was two-dimensional and asymmetrical, which was adjusted to real conditions since the gas was radially fed into the shaft. The kinetic model was described using three successive reduction reactions from hematite to metallic iron. The kinetic parameters of the model were supported by thermo-gravimetry, X-ray diffraction, scanning electronic microscopy and Mossbauer spectrometry.

The development of the model had the final goal of helping to optimize the operating conditions and the design of the reactor operated by pure hydrogen. The authors performed simulations, the results of which enabled them to optimize the height of the reactors, the hematite pellet size and to determine the optimal temperature of the gas injection in order to accelerate the reaction. It is significant that their simulation results projected that complete conversion to metallic iron using pure H_2 could be achieved using a more compact reactor than currently used furnaces, which use syngas.

In the paper, "Production of an axial piston: Impacts resulting from the substitution of steel with a polymer-based material" (Santos Neto et al., 2013), the authors showed the relevance of sharing knowledge between academy and industry in development, testing and application of innovations.

The work considered material substitution and documented the benefits derived from substitution. The material to be substituted was steel and the piece was the axial piston of pressure washers. The alternative material was a polyphthalamide, polyterafluoroethylene and a glass-based composite. Benefits of the new approach were due to a decrease of the steps involved in production process from thirteen to two steps. The new process also achieved and 80% reduction in water consumption, and 83% reduction in electricity consumption and a substantial reduction in manufacturing time. Additionally, benefits related to mass reduction were obtained, due to reductions of residues and better conditions for transportation. The benefits related to manufacturing and transportation, resulted in improved environmental performance. Other advantages for the manufacturer and for the end-user were due to reduced costs of the alternative material and elimination of the need for lubrication of the piston made of the new material.

Since the replacement would only be considered if the material could match the required mechanical properties, tests comprised of tensile loads and wear properties were carried out with promising results.

The paper, "A literature review on adding value to solid residues: Eggshells" (Oliveira et al., 2013), is an example of how the Industrial Ecology concepts can be used in a practical way to contribute towards sustainability. The erroneous but prevalent attitude that the biosphere is a supplier of raw materials and is a sink to dilute or mitigate all the anthropocentric wastes is countered in this paper through a study where a production residue, egg shells, can be transformed into raw materials for other production systems. The transformation of new concepts into practice and the *continuous learning* from such new approaches is clearly documented in this paper. The paper deals with the technological potential for usage of minerals and membranes (rich in proteins and glycoproteins) of eggshells and explored alternatives through an exhaustive, critical and well documented review. Usually, eggshells from industrial processes are mainly used for agriculture, but a great amount of them are discarded in municipal dumps. Mass balances and yields for each alternative were calculated for a company that produced 110 t/month of eggshells as by-product. The authors considered eight alternatives by taking into account that the last two options included the isolation of membranes and were compatible with the other six options for utilization of the mineral portion of the eggs shells.

Qualitative classification of all the alternatives according to economic benefits, environmental benefits and economic investment as well as the anticipated scale of operation were determined and discussed.

The paper "An emergy-based evaluation of a reverse logistics network for steel recycling" (Giannetti et al., 2013), is an example of the critical function that environmental *assessment* and selection of proper indicators play in evaluating, decision-making and improving the progress of an enterprise. In this case, the enterprise is a Brazilian sheet – steel distributor, who decided to overcome some problems in the steel market that would limit the supply to its clients, by implementing a reverse logistic scheme of returning scrap from clients to the steel industry plant. In order to do so, the distributor company invested in vehicles and labor and in the process, was faced with two challenges: a. clients that adhered to the proposed arrangement and b. clients who preferred to sell their scrap directly to the scrap-market. The logistical network was studied using the emergy synthesis (Odum, 1996), methodology that enabled accounting for all inputs from environmental and purchased. The emergy evaluation and comparison of the global environmental costs from both perspectives was accomplished. Environmental as well as economic benefits were documented, since the emergy methodology permits not only the transformation of all types of resources used in the enterprise into a unique unit (solar emergy joules) but it also enables one to express the global

resources invested in emergy-based monetary values (em$) to make the comparison more understandable to the public. Results showed that the quantities of recovered scrap that circulated during the time-window of the study, yielded environmental and economic benefits for distributor and industry plant. Also the minimum quantity of scrap that would guarantee environmental and economic benefits was calculated with the emergy methodology. The authors were convinced that this assessment methodology can contribute to the *Regulate* function by taking into account incentives (decreasing taxes or innovation stimulation) for users of reverse logistics.

The necessity of proper *planning* as the way to a successful *transformation* towards sustainability was well established throughout this special volume. As illustrative, the next paper titled, "Green Teams: Understanding their roles in the environmental management of companies located in Brazil" (Jabbour et al., 2013), supported reflexive learning about contributions to make *transformations* towards sustainability more secure and at the desired extent. The objective of this paper was to study the relationships between 'Green Teams' and the maturity level of environmental management in a sample of Brazilian companies. For this, an introductory conceptual background was presented that was considered useful to establish the basis for the sturdy. The authors stated that there were three evolutionary stages in Environmental Management Systems (EMS), namely reactive, preventive and proactive that were increasingly ordered according to more global environmental actions. The study was comprised of two phases: a survey of 94 companies, selected among those with ISO 14001 certification, and in-depth case studies of four industrial companies. Data collected to perform the survey were obtained through a self-administered questionnaire. Except for the five questions regarding respondent's characterization of their organization, the other eleven questions enabled the researchers to generate variables related to the evolutionary phase of EMS in the company and to gain insight into the types of action of the 'Green Teams'.

Spearman's correlations as well as factorial analyses revealed that the more advanced EMS systems that included preventive and proactive elements were related to the functioning of 'Green Teams' whereas, variables indicative of more reactive EMS achieved less positive results. The findings from the multiple case studies revealed that among the four companies the ones with the most proactive and advanced EMS achieved as well as those companies with the 'Green Teams.' Thus the company's performance correlated well with the type of EMS and the category of 'Green Team' that was functioning in the company be it reactive, or preventive and proactive.

The paper "Clean Development Mechanism in Brazil: An instrument for technology transfer and the promotion of cleaner technologies?" (Ribeiro Massote and Moura Santi, 2013), was included in the context of our presentation of *key elements* among those works that help to improve and direct the *transition* stage towards sustainability since it shows how implemented instruments and mechanisms to promote environmentally sound technologies contribute in positive ways. The paper deals with the role of the Clean Development Mechanism (CDM) as a promoter of implementation of innovative cleaner technologies in Brazil, through technology transfer. The CDM enables countries to work toward achieving their individual emissions reduction targets through projects implemented in developing countries, and in this way they obtain carbon credit certificates. In order to analyze this process, the authors worked with a database built with data collected from the Project Design Documents of 75 CDM projects in Brazil and developed a model to classify and statistically analyze the available data. It is important to note that the Kyoto Protocol established the transfer of environmentally sound technologies as part of the objectives to be attained. In this way, it is important to observe that the authors underscored that transfer of environmentally sound technologies does not necessarily imply using cleaner technologies, since end-of-pipe, pollution control technologies are also included within this group. The study revealed that 28% of the projects were classified within the group of technology transfer promoters, but when the technologies were analyzed, all the projects demonstrated transfer of "end-of-pipe" technologies. In addition, just 21% of the projects where characterized by the goal to reduce pollutants at their sources, but a more careful review showed that not all of them were related to implementation of cleaner technologies. The researchers documented that the two most important benefits reported, included professional training and incentives to improve the domestic industry. This showed that the financial resources generated by CDM projects were not directed to promote clean development.

The paper "Optimization of biodiesel production for self-consumption: Considering its environmental impacts" (Kaercher et al., 2013), is an example of the role of the *multidisciplinary approach* to propose more sustainable alternatives and to find sound solutions to problems people face during implementation and optimization procedures. The research dealt with the feasibility to develop, small-scale equipment to produce biodiesel on family farms. This possibility permits the farmers to use of local production of renewable feedstocks. Use of such small-scale biodiesel plants is expected to play important economic and social roles.

The equipment was constructed to produce from 40 to 200 L of biodiesel per day. With the objective of minimizing environmental impacts during production, an interactive matrix derived from the Leopold Matrix was built. The matrix permitted the researchers/developers to correlate activities during production with environmental impacts, which were classified according to value (positive or negative), order (direct or indirect), space (local, regional or strategic), time (short, medium or long), dynamics (temporary, cyclical or permanent) and plasticity (reversible or irreversible). The energy efficiency experiments were performed and together with the results from the impacts evaluation process, the findings helped them to optimize both the equipment design and the production processes. The main modifications that were proposed were comprised of changes in procedural routines, replacement of methanol with ethanol and thermal insulation of the system. The authors documented that adoption of distributed, self-production/consumption biodiesel equipment could make substantial, positive contributions to the local societies. However, they also highlighted the fact that to achieve the optimal improvements, the proposed process modifications to optimize production may face difficulties that should be solved, namely, the ethanol supply access to the catalyst and equipment at affordable prices must be ensured.

The authors of the paper, "Optimizing water use in the University of Sonora, Mexico" (Velazquez et al., 2013), explored different dimensions of sustainability in universities. In so doing, they illustrated convergence of social, economic and environmental aspects required to *understand linkages among dimensions*. If such interconnections are achieved, even partially, they were found to help to catalyze a successful transition towards more sustainable attitudes. Universities are expected to be, according to the public, living examples of responsible environmental behavior. Social pressures forced the University of Sonora leaders to act as a vehicle capable of searching for practical solutions in order to contribute to *transition.* This paper deals with the development and maintenance of the Sustainability Management System (SMS) at the University of Sonora, Mexico. Student involvement in philosophical support and in practical attitudes and actions was crucial to the

success of the research. The SMS covers protection of natural resources and the prevention, reduction and/or elimination of environmental and occupational risks. The Key stage related to this paper addressed interventions to prevent, eliminate and reduce water inefficiencies on the University of Sonora campus. For this purpose the research timeframe was three academic semesters, and the methodology adopted included quantitative and qualitative techniques. Data collection was comprised of: a) water consumption for watering green areas; b) the number and characteristics of water use efficiency failures in restrooms, at drinking fountains, in labs and other facilities. A survey was conducted to evaluate the internal awareness and support within the university. Since, wastewater was not large enough to represent a financial problem for the university, the option of equipment modernization was discarded as an improvement option by university administration. However, based upon this research, other solutions were proposed and new approaches to decision-making in terms of improvements in efficiency instead of solely on costs were discussed. The results of monitoring of failures revealed interesting results, which provided feedback opportunities to improve water management. The main source of the failures was due to cultural resistance to change.

Planning as the way to successful and well-supported *transformation* towards sustainable production was repeatedly established throughout the text. The necessity of *assessing* and *monitoring* the magnitude, frequency and locations of failures was found to be essential in evaluating the impacts of adopted interventions as they occurred is underscored in this editorial article.

Additionally, the paper titled, "Implementation of a Cleaner Production Program in a Brazilian wooden furniture factory", by (Ribeiro Massote and Moura Santi, 2013), provides clear evidence of the proper development of such assessing and monitoring elements. The authors reported on the adoption of the CP methodology at a Brazilian furniture industry in order to produce an eco-efficient system and to obtain environmental and economic benefits, at the same time. The paper focused upon the entire implementation procedure to identify the division with the greatest potential for environmental and economic benefits, the establishment of a mass flowchart, quantification of all inputs and outputs, the identification of sources of wastes, the selection of CP opportunities, the feasibility study of the proposed CP actions, and finally the implementation. A comparison of the before and post-implementation results was done. The economic benefits were expressed in monetary terms. Environmental benefits were expressed according to the case, in terms of amount reused, amount of wood and other raw materials saved, fuel saved for transportation (both related to purchase and disposal) and reduction of greenhouse gas emissions. Interventions resulted in reduced generation of solid wastes and liquid effluent, as well as a decrease in raw material input and water use. To attain the planned changes, actions included employee training, adoption of good operating practices, purchase of new equipment or devices, all of them with a short pay-back period, and adjustment of processes to reuse otherwise wasted materials.

6. Concluding remarks

The topics addressed in the papers selected for this special volume were addressed within the 2nd International Workshop Advances in Cleaner Production and reflect the important knowledge, which was developed and shared during the conference.

The content of this volume provides different viewpoints to help society make progress on the journey towards sustainability and expresses the awareness of the urgent and unavoidable need for making many changes from unsustainable to sustainable societal patterns.

Key elements of this urgent journey are addressed in this collection of papers; and the content was organized in such a way to evidence the systemic character of sustainability.

The necessity to see the journey towards sustainability as a sequential and multidimensional progress was well-established in this text. In this way, proper interventions at each Key Stage will help to lead to successful transformations.

All the papers contained in this volume reveal how knowledge and sharing of information can contribute to progress for all of us on our journey towards sustainability through integration of academic results and practical applications.

Acknowledgments

The editors wish to thank the authors for their work and patience. We are convinced that the time taken to finalize this special volume has contributed to a dramatic improvement and unification of its content and potential impact.

Once again, the guest editors are in debt with the Editor-in-Chief of the Journal of Cleaner Production, Prof. Donald Huisingh for the holistic and systemic way as he sees the world, being always a "sustainable" source of ideas and an inspiration to think deeper.

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