

# Clean Technology Requires a Systems Approach

D. Kralj<sup>\*, \*\*</sup>

<sup>\*</sup> ART-K, BusinessConsulting, Na gricu 47, 2000 Maribor, SLOVENIA, davorin.kralj@amis.net

<sup>\*\*</sup> Institut for Business Excellence, Faculty of Organisation Studies, Novo mesto, SLOVENIA, davorin.kralj@fos.unm.si

## ABSTRACT

The challenge of addressing climate change in the context of moving society towards the environmental, economic and social goals of sustainability requires radical innovation of cleaner technologies and processes which meet individual and social needs at acceptable costs with significantly reduced environmental impacts. This paper describes by the author examining business processes for promoting innovation for sustainability, and develops the argument that systems thinking and practice are needed to transform these processes. Most of the environmental challenges we face could be resolved if each individual and organization slightly changed their habits and practices. The key to achieving this is education – providing the knowledge and desire for change to happen. A truly sustainable society will only be created when caring for the environment becomes second nature to us all. We as individuals, and indeed society as a whole, change our habits all the time. Ten years ago very few people recycled their waste yet today the majority have learnt the habit. For many it is no longer a conscious effort, recycling has simply become the way things are done. Small changes such as this accumulate to change the paradigm of our society. A sustainable society will only be reached when caring for the environment becomes second nature to us all.

**Keywords:** clean technology, innovation, systems approach, lightweight concrete, recycling

## 1 INTRODUCTION

The systems approach sees innovation as an iterative matching of technical possibilities to market opportunities, through both market and non-market interactions, feedbacks and learning processes, rather than as a one-way, linear flow from R&D to new products. It also emphasises the importance of the institutional framework of social rules, conventions and organisations in determining the rate and direction of technological innovation. Policy measures form a key part of this framework. Thus, innovation is seen as a dynamic, cumulative, systemic and uncertain process, giving rise to path dependency and the potential for lock-in of technological and institutional systems. Similarly, policy making is seen not as a top-down, linear process but as an interactive process of governance involving various forms of partnerships, collaboration, competition and negotiation,

shaped by the institutional settings in which they occur. Individual policy domains, such as economic policy, innovation policy and environmental policy, are seen as having their own communities with specific preferences, ideologies and backgrounds, leading to distinct imperatives and rationales for action. In this view, in order to understand how substantive policy outcomes arise, and to enhance them, it is necessary to examine the policy processes from which they arise.[1]

## 2 APPROACH TO ENVIRONMENT MANAGEMENT

Holistic Management offers a new decision-making framework that managers in a variety of enterprises, cultures, and countries are using to help ensure that the decisions they take are economically, socially, and environmentally sound, simultaneously—both short and long term. When implementing changes, employees should be motivated adequately. The inclusion of enterprises in the international market, the care for reputation, that the enterprise profit with the environment protection and permanent development, places the politics of environment protection to the base of the professional politics.

An organization should implement an effective environmental management system in order to help protect human health and the environment from the potential impacts of its activities, product or services; and to assist in maintaining and improving the quality of the environment. Having an EMS can help an organization provide confidence to its interested parties that:

- a management commitment exists to meet the provisions of its policy, objectives and targets;
- emphasis is placed on prevention rather than corrective action;
- evidence of reasonable care and regulatory compliance can be provided ; and
- the systems design incorporates the process of continual improvement.

An organization whose management system incorporates an EMS has a framework to balance and integrate economic and environmental interests. An organization that has implemented an EMS can achieve significant competitive advantages [8]. Economic benefits can be gained from implementing an environmental management system. These should be identified in order to demonstrate to interested parties, especially shareholders, the value to the

organization of good environmental management- It also provides the organization with the opportunity to link environmental objectives and targets with specific financial outcomes and thus to ensure that resources are made available where they provide the most benefit in both financial and environmental terms. The innovative operation helps us in this direction. The innovative operation is operation that, according to the production and all other its components is found on innovations. That's why the following characteristics indicate it:

- Each cost is basically unnecessary. It gets really unnecessary when we know and want to work in more intelligent way.
  - Each product or procedure falls sooner or later out of use. So we must incessantly doubt about all given habits, although we count them (still) for perfect and correct. Otherwise we cannot achieve the contemporary quality of life.
  - Everyone is concerned about the quality of life and for this reason (as possible as perfect!) Everyone is also concerned for quality of the whole operation and its all components. That's why we have to develop our brains and activate the creativeness of everyone.
  - We should search constantly and everywhere the possible novelties! Only rare of them will become innovations, but without intended search, there will be even less of them, probably not enough.
  - For this reason we should work as clever people [2].
- This recognition lead us to sustainable responsibility.

### 3 SUSTAINABLE RESPONSIBILITY

Humankind has been developing for several thousand years. Life has been more and more complex rather than simple, be it in terms of biology, in terms of economy, in terms of sociology, in terms of technology, in terms of communication and languages, what so ever. All these »terms« became parts of knowledge, which humankind has developed over all those millennia, and especially in the last decades. This development is a response to the fact that life has been increasingly difficult to understand and master. New and new information has been added, this at least has been the intention. What actually has happened and still is, is production of data rather than messages and information. [2]. The consequence of the lack of co-operation, especially of an interdisciplinary one, is oversights, several kinds of blindness: we do not see the real reality. Specialization without co-operation beyond the borders of that specialization locks us in its own arena. If we are economists, we are – for obvious natural reasons, limits of time and capability –not able to think and act in the role of mechanical engineers, medical doctors, cooks, cleaners, unless we learn another skill. We do not have much of a chance to learn all the skills, which are around these days. So, we tend to go on specializing and getting more and more locked in our own cage in our thinking and

acting. In this we achieve, that the reality around us is simple enough to be manageable with our own skill [2].

The idea that business has a responsibility other than producing goods and services is not new. In 1919, Henry L.Gantt stated his belief that the community would attempt to take over business if the business system neglected its social responsibilities. Looking back, the attitudes of managers toward social responsibility seem to have gone through three historical phases:

- Phase 1; which dominated until the 1930s, emphasized the belief that that business manager had but one objective . to maximize profits,
- Phase 2; from the 1930s to the early 60s, stressed that managers were responsible not only for maximizing profits but also for maintaining an equitable balance among the competing claims of customers, employees, suppliers, creditors and community,
- Phase 3; still dominant today, contends that managers and organizations should involve themselves in the solution of society's major problems.

Most of the environmental challenges we face could be resolved if each individual and organisation slightly changed their habits and practices. The key to achieving this is education – providing the knowledge and desire for change to happen. A truly sustainable society will only be created when caring for the environment becomes second nature to us all Ultimately, most of the environmental challenges we face could be resolved if each individual and organisation slightly changed their habits and practices. The key to achieving this is education – providing the knowledge and desire for change to happen. We as individuals, and indeed society as a whole, change our habits all the time. Ten years ago very few people recycled their waste yet today the majority have learnt the habit. For many it is no longer a conscious effort, recycling has simply become the way things are done. Small changes such as this accumulate to change the paradigm of our society. A sustainable society will only be reached when caring for the environment becomes second nature to us all [4]. Caring for nature means implement innovation of processes in green direction.

### 4 INNOVATION OF PROCESSES

Innovation has received serious attention from social scientists, managers and public policy makers, however, this attention is still insufficient. This indicates that innovation is still a novelty (a science); it can be regarded as an engine for novel changes in social, economic and political arrangements in companies and other organizations as well as for society as a whole. To innovate is to create new ideas and to implement them in a useful way. New ideas can pertain to a technological innovation (new technical inventions, new machinery or products), a process

innovation (new services, programmes, or production procedures), or an administrative innovation (new institutional policies, structures or systems) [5].

The environment protection and permanent development with processes innovation is a complex process, where the earlier events have more influence than the later one. From here it originates the sense of activity planning of these, who administrate, who define the aims, who organize and so on. The inadvertence of independence between the parts of totality, that's why also synergic characteristics of the totality, which parts do not have as an individual part, it leads to simplification, that has in case of environment protection the catastrophic experience. Experience show that the environment protection and permanent development as a part of entrepreneur's philosophy is not carried into effect enough. The business system is not isolated from the environment, but it is co indedently interweaved with other business systems, that's why the environment protection and permanent development with processes innovation are also results of social environment. The systemic reflex ion with the administration is necessary [2]. Innovation is necessary on all domains and everybody is included in innovation. The role of management is shown in creativeness for the support of collaborators' creativeness. The administrative innovation is so a segment in the innovative business system. In the example of environment protection it is necessary that we are as much collaborative, creative and target directed as possible [6]. To the purpose of environment preserving development, the aims of environment protection are also:

- Changes in production and samples of use, that contribute to the minimisation of natural sources use and creativeness of waste,
- Development and use of such technologies, that decrease and suppress environment charges,
- Use of harmless and decomposed chemicals and substances that have not been accumulated in alive organisms [2].

Experience show that the environment protection and permanent development as a part of entrepreneur's philosophy is not carried into effect enough; this is so because of administrative workers, who were used to make decisions independently without collaboration of other experts. Without participation of everybody in the chain sequence and from here resulting co dependence it is not possible to expect the good results. The partial solution gives the partial results. The law about the hierarchy sequence and co dependence brings the cognition that it happens more or less all in life in nature and in creating in processes, in which the earlier events have more influence than later one. Consecutive (direct and indirect) influences of parallel events, but they interweave because they more or less depend on one from another (= coindependent) [3].

## 5 CLEAN TECHNOLOGY AS A RESULT OF SYSTEMS APPROACH

The model of recycling construction waste of concrete from lightweight aggregates containing expanded glass was developed in order to include environmental performance in the design of building operations and minimizing construction waste. The quantities of waste LWC made of expanded glass currently are not so large, because of this fact the question of whether it is possible and economical to collect such waste separately arises. However, from an environmental point of view, the recycling or re-use of a building is generally better than demolition, because the environmental costs of energy, water and materials for refurbishment and re-use are less. Creative collaboration and new waste management philosophy has led to a new perspective: rest (or remnant), and waste (construction) material is a raw (construction) material. Table 1 presents contrasts between "Old" and "New" Rest and Waste Approach based on DST (Dialectical Systems Theory) [4].



WAS	IS (DST)
Rest And Waste Material	Rest And Waste = RAW Material
	
Disposal	New product

Table 1: Contrasts between "Old" and "New" Rest and Waste Approach

We used LCA (life cycle assessment). LCA is a technique for assessing the environmental aspects and potential impacts associated with the product (ISO 14031:1999(E) 1999) and can assist in identifying opportunities to improve the environmental aspects of products at various points in their life cycle (ISO 14040:1997(E) 1997). The accent was made on identifying opportunities for improving the environmental aspects of LWC and the next step as a recycling crushed construction waste from concrete from lightweight aggregates and fresh concrete from lightweight aggregates as a binding. Recycling followed as the the next activity under normal room conditions:

- a) assembling rest construction waste from LWC with aggregates containing expanded glass and hard polyurethane (PU),
- b) crumbling into small pieces,  
after that we took crumbled construction waste of concrete from LWC with aggregates containing expanded glass and hard PU (mechanical reprocessing), as a raw input material in the processing line to the standard mould,
- c) charging volume of standard mould used for preparation of concrete specimens for compression test with "new" raw material,
- d) binding reaction occurred between new raw materials of

- fresh LWC with aggregates containing expanded glass and rest (waste) material of LWC with aggregates containing expanded glass and hard PU,
- e) binding process or the binding reaction refer to hydration of cement and
- f) quality control.



Figure 1: Cleab Technology Requires a Systems Approach

Promoting such causes and activities as recycling should redound to business's benefit [7]. Construction wastes of concrete from lightweight aggregates provide us an opportunity to think about this. The whole process of creative problem solving is a complex system in itself, dynamically changing over time, with permanently interacting system elements, it requires a systems thinking perspective in order to be understood and applied [2]. On this basis we thought about recycling of construction waste from concrete from lightweight aggregates and hard PU. In our research we proposed a model of recycling construction materials, made from lightweight concrete, with aggregates containing expanded glass and hard PU. It can be seen from the results that recycling of concrete from lightweight aggregates Poraver® and hard PU improves the life cycle of the material, and there is no more remaining of waste concrete from LWC with aggregates containing expanded glass and hard PU. With this solution the material is brought to the life cycle of a product. To include, it is possible to innovate production processes. Our results show that concrete waste material of concrete from lightweight aggregates and LWC with aggregates containing expanded glass and hard PU can be incorporated in to the recycling process. We showed that specific selection of technological procedure and the quantity of remaining waste concrete from lightweight aggregates and LWC with aggregates containing expanded glass and hard PU, can play a crucial role for the characteristics of the recycled material. Thus, a new recycled material has been created with new characteristics of density, compressive strength and thermal conductivity, which conforms with the Rules on heat protection and efficient use of energy in

buildings (SI OJ RS No.42/2002) and can be used for heat protection and efficient use of energy in buildings.

## 6 CONCLUSION

The content and methods of administration and leading have an essential meaning for dynamic adaptation of business systems in relation to marketing economy. From the cognition, that the innovation brings better exploitation of all potentials, also on the domain of environment protection, it results the measurement of responsible people with the administration of business systems. The whole treat of environment in the administration and leading of professional processes is inevitable condition for the preservation of natural balance in the environment. Punctual creativeness and direction are results of relationship managers have to the environment. One point of view of administrative measurement is substituted with many points of view, inter structural creative collaboration. Without participation of everybody in the chain sequence and from here resulting co dependence it is not possible to expect the good results [2].

## REFERENCES

- [1] Foxon, T.J.(2006) "Applying systems thinking and practice for promoting sustainable innovation for climate change mitigation" Paper for Heinrich Boell Foundation Montreal Follow-up Meeting, Berlin, 27 September 2006
- [2] Mulej M., "System Thinking", UM-EPF, Maribor. 1992.
- [3] Mulej M.: "Towards an Environment- Friendly Entrepreneurship", In: Mulje. M., Dyck, G., eds., Self\_Transformation of the Forgotten Four-Fifths, Kendall/Hunt, Dubuque, Iowa, 281-288, 1998.
- [4] Kralj D, "Dialectal system approach supporting environmental innovation fro sustainable development", Kybernetes, October 2008, Vol 37, Issue 9/10 1542-1560, 2008 .
- [5] Markič, M: *Processes Innovation – A Precondition for Business Excellence*, UM –FOV, Organizacija, Maribor. 2003.
- [6] Nonaka I., Toyama R., Konno N.: "SECI, Ba and Leadership: A Unified Model of Dynamic Knowledge Creation", Long Range Planning, 33, -34, 2000.
- [7] Reinhardt, F.L., "Bringing the Environment Down to Earth", Harvard Business Review on Green Business Strategy, HBS Press, Boston, MA Roca, V.Alejo (2005) Draft report EU Energy efficiency, 2210(INI) 16 p. EU 2007.
- [8] ISO 14004:1996(E) Environmental management systems -- General guidelines on principles, systems and supporting techniques