DEVELOPMENT AND APPLICATION OF GREEN MANAGEMENT IN A PUBLIC AUTHORITY

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Abstract

The objective of this work is to present the criteria of "Green Management" applicable to service companies and public authorities, in order to help them take the path of sustainability, highlighting the new types of waste on which they should focus in order to be considered by the whole community, "green activities".
In this article are presented the criteria applicable to each green waste applying to a case study in a Municipality of Veneto.

Keywords:
Green management, Sustainability, Public Authority

1. CRITERIA OF GREEN MANAGEMENT

To achieve sustainability, the tool of greater importance to create a useful model is the Green Value Stream Mapping, which has the goal of eliminating the seven green wastes (energy, water, materials, garbage, transports, emissions and biodiversity) and is accomplished through [1]:

- the broad definition of the study area;
- the preparation of a work team;
- the segmentation and clustering of the output's characteristics;
- the identification of the impact associated with the activities concerned;
- the collection of critical information;
- the representation of the current state;
- the proposal of improvement opportunities, both for physical activities of transformation and administrative ones, systematically eliminating the negative impacts;
- the representation of the future state;
- the preparation of the implementation plan;
- the review and update.

The criteria for each of the green wastes are [2] [3]:

a) energy

From the perspective of environmental waste it refers to the consumption of electricity and gaseous and liquid fuels used to power the different present utilities (facilities, machines, etc.), and which is one of the factors that contribute to the negative impact on the environment. Therefore, the objective will be to use only clean energy, but also provide to self-produce it. The steps for the elimination of energy waste are:

- identify the use and the sources of energy in every activity of Value Stream Map;
- measure or capture the data consumption of the energy used in each activity;
- minimize the use of energy for each activity;
- offset the remaining energy use;
- transition to the use of renewable self-produced energy;
- identification of cost savings and/or environmental ones achieved with the adoption of the proposed solutions bringing them back in the Green Value Stream Map;

b) water

The waste of water lies not only in its use, but also in the fact that companies are paying ever increasing costs to use it and to offload the contaminated or non-reusable water resulting from the activities. The ultimate goal, that should be achieved, is to minimize and eliminate the costs of the provision of water and those arising from the collection to purify it, trying to aim, if possible, to take advantage of direct rainwater harvesting and the reuse of water multiple times. This aim cannot be achieved immediately, but it is possible to get there by:

- identifying the activities in which the water is used;
- measuring or detecting the amount of the consumed water;
- measuring the toxicity of the wasted water;
- minimizing the amount of the used water;
- minimizing the toxicity of the wasted water;
- self-implementing rainwater harvesting;
- aiming at the continuous water reuse;

c) materials

Eliminating the waste of materials within the activity reduces and eliminates the need to use new raw materials to realize the services and reduces the negative impact on both the environment and the economic aspect. The goal is to get all the outputs back into circulation in the activities to create other services or put them back in nature as nutrients and create a continuous cycle, obtained by:

- identifying the inputs and outputs of materials for each activity;
- measuring the amount of the recyclable and compostable materials;
- classifying each input and output as a biological nutrient, technical nutrient or otherwise;

- evaluating materials according to their impact on the environment and society;
- phasing out materials with a negative impact on the environment;
- minimizing the used materials;
- moving toward the use of 100% recyclable, reusable or compostable materials;

d) garbage

People thinks of this waste when it has already been created. An enterprise must therefore try to reuse the wastes created in the activity. The goal is to use all the waste products such as biological or technical or energy nutrients or completely eliminate them. In this way a company would be able to avoid depositing them all in landfills and thereby protect the environment.

This can be achieved by:

- identifying the creation of waste in the various activities;
- analyzing the composition of such waste;
- measuring the amount of harmful substances;
- minimizing the creation of waste;
- moving towards the creation of a 100% reusable or biodegradable waste, and the total elimination of waste;

e) transports

The transport of people and material is one of the major negative impacts on the environment. It is more complicated to see the economic benefits produced by the elimination of wastes in transports, but there are both incentives that can be used for vehicles that are environmental-friendly and benefits due to lower costs for route optimization. The goal will be to eliminate the negative environmental impact caused by transports which can be achieved by:

- identifying activities that require transportation;
- identifying the mode of travel and the distances traveled;
- minimizing the traveled distance;
- moving towards the use of completely ecological means of transport;

f) emissions

To find this type of issue it will be necessary to look for the direct sources. The emissions contribute to air pollution and their reduction will give a positive contribution to environmental protection. The goal is to eliminate completely the harmful emissions, and it can be achieved by:

- identifying the sources of emissions;
- measuring the type and amount of such emissions;
- minimizing emissions using devices that prevent pollution;
- moving towards the total elimination of harmful emissions;

g) biodiversity

Biodiversity (variety of living beings that inhabit the planet) comes from the fact that businesses pays a certain price when they takes away a part of the biodiversity of a particular area and when creates serious and

immediate environmental impacts. The fact of trying to minimize previously analyzed wastes contributes to help reducing the damages to biodiversity. The objective is to eliminate the destruction of biodiversity and to promote the regeneration of what has already been taken from it, which can be achieved by:

- identifying the existence of damages to biodiversity;
- by measuring the amount of damages;
- minimizing the loss of the biodiversity;
- moving towards the regeneration of the biodiversity.

2. CASE STUDY

Considering the guidelines given by the model presented above, it has been possible to analyse the buildings under the control of the Municipality of Meduna di Livenza by applying the criteria of Green Management in order to verify the presence of the seven green wastes, even if not all the types of wastes and analysis could be taken into consideration, due to the particular reality that was examined.

2.1. Energy

Regarding the electric energy, all the data considered were taken from the bills that the Municipality receives every month from the energy distributor.
Thanks to this analysis was possible to detect the presence of some issues, like the anomalous consumption of reactive energy in some facilities, fact that caused the payment of surcharges added to the monthly bill.
The principal issues were found in the gym, that presented in 2013 a consumption of reactive energy above the limits nearly every month (except in October), with values that vary according to the monthly consumption of electric energy as shown in Table 1.
The amount was higher in autumn/winter (the maximum consumption was detected in December and in January) than in summer. This is due to the fact that in summer most of the activities done in the gym are suspended, then the amount of energy consumed decrease and with it also the reactive energy consumption.
Anyway, the amount of surcharges paid (48,10 € in 2013, Table 1) was not sufficient to justify power factor correction actions, like the installation of batteries of capacitors to remove this problem, because the payback times would have been too long, making this actions impractical and uneconomic.
The actions suggested for these situations are: the continuous control of the amount of reactive energy consumed per month, the detection of the source/sources of the reactive energy consumption and the analysis and evaluation of possible interventions in order to reduce or remove this problem.

Gym 2013			
	Cos φ (-)	**Surcharges (€)**	**Reactive energy (kVARh)**
January	0,805	14,79	458
February	0,835	5,78	179
March	0,893	0,13	4
April	0,836	2,45	76
May	0,821	2,75	85
June	0,786	0,81	24
July	0,822	0,10	3
August	0,832	0,10	3
September	0,859	1,26	39
October	0,896	0,00	0
November	0,862	3,33	103
December	0,786	16,60	499
Total	-	48,10	1473

Table 1 (data from the bills of Enel Energia)

Regarding the minimization, the only suggestion is to inform people about a rational use of energy, because the consumption is related to the amount necessary to run the different activities that are already trying to avoid every waste.
The energy consumed is offset by the presence of 3 photovoltaic systems mounted in 2011 with a power installed of 86 kWp that partially covers the energy consumption. Moreover the Municipality is trying to achieve the goal of offsetting the 20% of the energy consumed by self-producing it using renewable sources as prescribed by the European Union in the 20 20 20 strategy.
As regards the thermal energy consumption related to fuels, the heating system is alimented with methane, but the management of this facility was outsourced to an external company that administrates also the maintenance of the system; for this reason there are no data available about fuel consumption.

2.2. Water

For what concern water, the consumption is related to the utilization of sinks, toilets and fire systems for every building taken into consideration and for the fountains present in the area. An analysis according to the data reported in bills has been performed and the results does not present any issue that need to be taken into consideration.
Every leak is reported to the responsible employee who immediately calls the plumber to promptly solve the issue, avoiding the presence of wastes. Then, also for this green waste, the only suggestion is to inform people about a rational use of water, a resource that must be managed correctly,

because, according to scientific studies and previsions, it will be interested by a worldwide crisis in a near future this is why it is already called “the blue gold”.

2.3. Materials

Concerning materials, the reality presents only goods necessary for office management, this include paper for printers and copiers and stationery. The procurement of office supplies is managed according to requirements. Furthermore the paper used in the Municipality is 100% recycled paper, this practice was introduced six/seven years ago, this stress again the attention that is given to environmental respect.

2.4. Garbage

As regards garbage, in this reality there is a boosted waste collection, every family has its own bins for wastes and the collection is administrated door-to-door, allowing a value of 75,1% in 2013 (data from ARPAV [4]) for the differentiated waste collection, much higher than national average 42,3 % in 2013 [5].

In fact, Meduna di Livenza receives every year since 2010 a recognition for being a high recycling Municipality and it is in position 147 over 929 in the ranking for town in north Italy with less than 10.000 inhabitants having an index of 70,13, the 81,6% of differentiated waste collection and a total pro capite production of municipal waste of 0,57 [6].

In Table 2 is presented the position in the raking of Meduna di Livenza from 2010 to 2014 with the respective parameters included in the analysis.

Every family has a bin for organic waste, a bin for dry waste, a bin for glass, a plastic bag for plastics and aluminium and a recycled paper bag for paper and cardboard; all the bins can contain 120 dm^3 of waste, except for the bin for organic waste that allow a collection of 21 dm^3 of materials, the plastic bag can contain 100 dm^3, while the recycled paper bag can contain 25 dm^3 (data from Savno).

Non-domestic users, instead, can choose between bins with a capacity of 120/240/1100 dm^3, according to their needs (data from Savno).

In 2013 the amount of garbage produced was 6.926,468 kN subdivided in:

- 1.727,541 kN of organic waste;
- 965,991 kN of dry waste;
- 865,143 kN of paper;
- 253,883 kN of cardboard;
- 117,916 kN of plastics;
- 740,557 kN of glass/aluminium;
- 965,108 kN of glass
- 1.290,329 kN of other types of wastes.

Year	Category	Position	Inhabitants	Index	% RD	PC RU
2014	Absolute	98	2.926	72.20	80.92	0.67
	Municipalities under 10.000 inhabitant VENETO	45				
2013	Absolute	179	2.952	70.13	81.61	0.57
	Municipalities under 10.000 inhabitant VENETO	146				
2012	Absolute	313	2.972	64.09	72.71	0.69
	Municipalities under 10.000 inhabitant VENETO	246				
2011	Absolute	1143	2.968	52.71	66.00	0.59
	Municipalities under 10.000 inhabitant VENETO	827				
2010	Absolute	167	2.957	77.27	71.63	0.69
	Municipalities under 10.000 inhabitant VENETO	130				

Table 2 [7]

Aiming to discourage the production of dry waste that is not recyclable every family has a certain number of collections of the dry waste bin included in the fee paid each year (the number is calculated according to the number of members of the family); each additional collection is paid over the annual fee.

Moreover every years are organized some meetings in primary and secondary school with the goal of educate and inform children about ecological life style and eco-behaviour and also informative campaigns to update every citizen about the actions promoted by the Municipality to reduce the ecological footprint and to give advices regarding eco-friendly actions that can be applied to everyday life.

Furthermore the Municipality encourage the use of reusable diapers, initiative that permits to reduce the amount of garbage produced by family with children, each family that presents the receipts that certify the purchase of reusable diapers receives from the Municipality a certain amount of money.

2.5. Transports

Regarding transports, the public transports that serve the town are managed by external service companies, no data is thus available. The Municipality, instead, administrate the transports of kids to kindergarten, primary and secondary school. This service is accomplished by the owned minibus and partially outsourced to a private renting company; this is due to the fact that the timetables of schools are different, making impossible to dispatch the service only by using the owned minibus.

A different analysis has been executed about transports related to waste collection, with the aim of identifying the best path to collect the garbage, allowing time and cost savings and the reduction of emissions related to transports.

The transport of waste has a significant impact on urban transports. The aim here is not to consider the transport from the town to the treatment centre, but to consider the collection within the urban area.

The collection of various wastes produced is carried out in specific days [8]:

- twice a week for organic waste, every Tuesday and Friday;
- every two weeks for dry waste, on Wednesday;
- every two weeks for paper and cardboard, on Tuesday (alternate to plastic and aluminium collection);
- every two weeks for plastics and aluminium, on Tuesday (alternate to paper and cardboard collection)
- once per month for glass on the third Wednesday of every month.

There is no production of harmful or toxic substances and thus there is no generation of hazardous waste.

Knowing the urban area, it is important to determine the best path for the collection and transport of the various types of waste, which satisfies the condition of optimality of cost, time, length and service provided to users [9]. The first three conditions have to be imposed in the calculation code, while the last condition is difficult to express in numerical values.

The problem has been addressed through the simulation of the route itself. It requires a detailed analysis of all the components of the service and it is complex to implement and treat, but provides much information.

It allows to simulate the collection service for the various configurations without making any direct and practical experimentation.

The method used is the complete random one, which simulates the path by choosing the route randomly. The road urban network is outlined by a graph (Figure 1) [10]. The route is regarded as a set of nodes forming a connected set of branches. As shown in Figure 1 it has been decided to apply the model to a hamlet of Meduna di Livenza called Mure.

Set the starting node, the next node is chosen randomly, based on the adjacency matrix, thereby selecting one of the possible nodes reachable from the starting node connected to it with a branch (the first branch of the path). For the second and subsequent branches the same procedure will be used.

Figure 1

Set the starting node, the next node is chosen randomly, based on the adjacency matrix, thereby selecting one of the possible nodes reachable from the starting node connected to it with a branch (the first branch of the path). For the second and subsequent branches the same procedure will be used.

The program ends when it reaches one of the following conditions:

- the maximum allowable volume transportable by the vehicle has been exceeded;
- it has completed the removal of all wastes in the district;
- it has reached the maximum total number of branches forming the path exceeding a predetermined number.

A mathematical model was created to solve the problem, powered by data characterizing the streets present in the area (width, direction of travel, slope, traffic level), the nodes that make up the intersections and the branches that make the road network and the containers assigned to the individual branches.

The road network of the portion of the town examined has been outlined according to the graph of Figure 2.

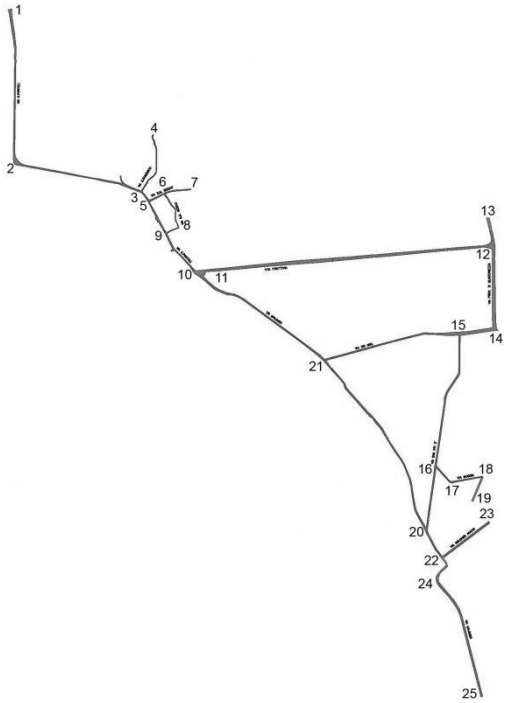

Figure 2

As the costs of collection are also variable depending on the type of waste in question (from a minimum of 110 €/t for glass up to 375 €/t for the plastic to which must be subtracted the contribution CONAI (National Packaging) of 229 €/t, data from [11] and updated with [12]), the times and lengths were determined for each of the twelve different paths obtainable by processing the problem (Table 3).

Therefore, the calculation processing has allowed to detect two optimal solutions between the different paths obtainable, which are those relating to the distance of the following branches:

1-2-3-3-4-9-8-7-6-6-5-9-10-22-23-20-17-18-19-19-18-17-16-

and alternatively:

-15-14-13-13-12-11-22-21-16-20-24-25-25-26-27

-21-22-11-12-13-13-14-15-16-20-24-25-25-26-27

For the choice regarding which of the two paths will be implemented, the route must be examined and the verification about the correctness of the values of the average speed of the vehicle used for the collection, the time to perform there the inversion in dead-end streets, etc. should be performed.

PATH	LENGTH (m)	ACTIVITY TIME (s)	OPTIMAL PATH
1	11.818,63	13.659	
2	12.906,81	13.659	
3	12.468,73	13.659	
4	13.622,28	14.013	
5	11.818,63	13.659	
6	11.818,63	13.659	
7	12.452,28	14.013	
8	11.818,63	13.659	
9	11.818,63	13.659	
10	11.818,63	13.659	
11	**11.778,63**	**13.659**	**X**
12	**11.778,63**	**13.659**	**X**

Table 3

2.6. Emissions

For what concern the emissions, the only emitting facility is the heating system that is fed by methane, so the emissions are limited to this facility.
As explained above the management of this facility is outsourced to an external company, thus there are no data available.
Regarding the emissions of the vehicles used for transports it has been decided to start a test period to collect the data necessary to identify, analyse, minimize and possibly eliminate their emissions.

2.7. Biodiversity

Finally, regarding the biodiversity, any analysis was possible because the reality examined is a Municipality that does not discharge toxic substances that can threaten the flora and fauna present in the area; on the contrary, a big attention is dedicated to environmental respect and the conservation of the ecosystem.

3. CONCLUSIONS

The aim of this work was to propose the criteria of Green manufacturing that could be used both by service companies and by public authorities in order to identify the presence of the seven green wastes and to try to minimize, or better, to remove them, allowing to avoid environmental impacts and making the reality studied a “green activity”. The criteria of Green Management has been successfully applied to a Municipality allowing to exemplify how to use these guidelines and what are the results of this analysis.
Obviously this work will be subjected to continuous improvements according to technological enhancements that will allow to further reduce the impact of every activity on the environment.

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