

GREEN CLEANING SERVICE: A MANAGEMENT APPROACH BY INDUSTRIAL ECOLOGY

O. Cintas, J. Hernandez, X. Jim nez, A. Meluni

oliviacintas@hotmail.com, junakao@hotmail.com, xiomareja@hotmail.com,
alemeluni@hotmail.com

Technical University of Catalonia. Master in Sustainability

Abstract

Based on the "UPC Sustainable Plan 2015" the Technical University of Catalonia (UPC) is developing different actions related to the improvement of the university community from a sustainability perspective. One of these activities is the introduction of the Industrial Ecology (IE) discipline into its educational program.

Taking advantage of that, the purpose of this paper is to check whether IE framework is applicable and viable to improve sustainability at UPC. IE concept is focused on an integrated and systemic view by taking into account the interactions between the different involved stakeholders; as well as the way they manage the whole process from "cradle to cradle"¹. That means an analysis which goes from the extraction of the raw materials till the reintegration of the final wastes, closing the loop.

In order to reach the goal of this research, the principles of IE will be applied to one of the services offered by the university, such as the cleaning service. This one is a good exemplary case of study due to different stakeholders involved and to environmental impact produced in each step of this process.

This study is focused on the analysis of the management process by using some of IE tools. Furthermore, the study will be taking into consideration IE's strategy which is to substitute toxic substances by others less hazardous while dematerialize and decrease waste, by reducing the usage of resources such as water, energy and cleaning products.

Once the process has been analyzed, it will be verified whether IE has been applying the proper frameworks which reduce the environmental impacts and, at the same time, produce a positive impact on daily good practices to the university, community and society.

Key words: Industrial Ecology, Cleaning Service, University Technical Catalonia, Management Process, Clean Products.

¹ "Cradle to cradle: remaking the way we make things". McDonough, W; Braungart, M. Ed. North Point Press, 2002, New York.

1. Introduction

The general objective is to check whether IE's framework is applicable and viable to improve sustainability at UPC.

And the specific objective is to look for the application of some IE concepts to UPC's Cleaning Service system.

Based on the "UPC Sustainable Plan 2015" the Technical University of Catalonia (UPC) is developing different actions related to the improvement of the university community from a sustainability perspective. It basically works in four different but correlated fields: Management, Education, Research and Compromise & Social Interaction. One of the aims of the Educational field is the introduction of the Industrial Ecology (IE) discipline in its educational plan. This is a goal that it was just reached by the implantation of a specialization into the Master on Sustainability.

Following the aims of the UPC Sustainable Plan, and taking it as the politic and action sustainable framework reference at the University, it should be important to implant some of the IE principles in others fields too. The University management is one of the most relevant in order to improve a sustainable system guided by Industrial Ecology principles.

Different ways exist to manage the existing services and processes within the University, but at the moment and in its great majority they aim mainly at the improvement of its efficiency in terms of reduction of the consumptions, thus to obtain a reduction of the consequent economic expenses. Often initiatives of management efficiency are undertaken that, inasmuch as they are useful to a better operation and management of the resources, does not take into account other elements that can influence these measures. To solve a problem and to improve a sector of management of the university in a systemic optics, mean to understand all the process and the metabolism in this way related and the possibility of managing it in collaboration with other existing services, taking advantage of each one of the resources that correspond to the energy not re used and therefore dissipated outside the system. Synthesizing we can say that many of the measures that take, have a "reductionist" approach, it means focused boarding to the limitation of some damages or the improvement of others, but leaving on the one hand the complex interactions of an live system such as the university is with all its services. The function that has the boarding of these thematic from the point of view of the EI however, is to include the processes in its complex and multiple relations, being looked for the most opportune form to loop the cycles of production through three basic principles: to reduce, to reuse, to recycle, to improve therefore the management of the metabolism of the whole system.

Like in an "eco park" properly of an industrial context, the University should be able to work as a whole system that uses its resources minimizing the environmental impact and promoting the interaction between the different stakeholders including in its management services.

Following the objectives of this study, it is important to show the benefits that the Industrial Ecology should give to the university management system.

Industrial Ecology is a discipline of study and analysis that has as primary intention to compare living systems of nature to those of an industrial or rather productive. It is what is meant by biomimicry. The University is a community and as a place that provides for the operation of productive processes which, although not at the industry

level, it takes into account an approximation of a company, level of organization and management of services to the community. Especially at the management level is the important contribution that could be the subject of Industrial Ecology improved levels of sustainability, understood as the holistic functioning of the processes. In the specific case under consideration in this article (The Cleaning Service), there are many contributions that it can give in reducing the environmental and social impacts in the immediate surroundings, but also in society as a whole. The University is a living system too that should work in a correlated and more efficient way.

The first step to get to this long term vision, is searching all the information related to the service system management, and specifically the ones that can help to understand its metabolism, such as material and energy flows.

This information is very useful for a primary IE diagnosis, but it is not available at the moment. Starting by this background, the present work tries to analyze if some of the IE principles such as dematerialization, detoxification and decarbonization, can give an effort as a first contribution for the improvement of the sustainability in the University System and in particular on the specific analyzed case of study: the cleaning service.

2. Justification of the chosen service.

The Cleaning service is a very complex service that uses products that are very harmful to the environment and to people's health. For example, they might pose risks if purposefully or accidentally mixed with other cleaning chemicals. Some chemicals in cleaning products can also have adverse effects on the environment. In high enough doses, some chemicals could increase the biological oxygen demand in surface water or harm sewage treatment plant bacteria. Some chemicals may be toxic to aquatic life in low concentrations [1].

The cleaning service has been chosen because it has been the service less studied in order to improve the sustainability in universities. Besides, the field of incidence of cleaning services is very wide because involves a lot of aspects in quotidian life in different spheres like industries, houses, colleges and inside the University.

3. Examples of similar or related experiences in other universities

As it has been mentioned, there wasn't founded any specific scientific study about Cleaner service at universities.

However it is known that a method to introduce or improve the awareness about sustainability related to green cleaning between different stakeholders at Universities, schools and colleges had been created in United States of America the "Green Clean Schools" and the "Healthy Schools Campaign's national partnership", in their initiative also participates cleaning industry, educational leaders, parents and advocates in the direction to adopt environmentally friendly policies, practices and products, then this Green Team to act in all levels, national, state and local distributed "*The Quick and Easy Guide to Green Cleaning in Schools*", as a result of a pilot program carried out in Chicago, which consist on distribute the guide to every school, to implement a district-wide green cleaning policy and plans [2].

Other interesting option also sponsored by the Healthy Schools Campaign between others is the "Green Cleaning Award for Schools and Universities", where they chose a Grand Award winner and honorable mention for: school districts, colleges and universities, the criteria followed by the jury are in the framework of

comprehensiveness of the Easy Guide, quality of green cleaning products, equipment and procedures, and level of support or the actual commitment of institutions [2].

In other way, the field of suppliers, there is an experience from UAB, Universitat Autònoma de Barcelona, with the chain of green suppliers and their introduction of practices in the procurement of green purchasing and the analysis that they made in order to identify barriers for implementation and supervision, and the way in they deal with those. The UAB's green supply management was divided into five case studies: office material, recycled toner cartridges, fair trade coffee, reusable glass bottles and catering services. In all of them are studied the acquisition model, and the perspective of the supply chain if it is, loop or linear [4].

4. Methodology

Following the objective of the research has proceeded with a diagnosis of the current situation, looking at the Contract for the Cleaning Service in the UPC [4], analyzing three main areas of interest related to it: the used products, the equipment and its present use and management in their organization, relationships and the roles of actors involved in the process.

The methodology followed in this study should have the possibility to be applying at whatever service of the University, to analyze the applicability of IE principles. The analysis started with the search of all the dates reachable in the University management service. The Cleaning Service in the UPC is managed by a transnational company specialized in this work (ISS). The UPC contracted it and had established a protocol of use and manages of products and equipments. The first step has been the analysis of them, looking at each technical schedule of products and equipments and making a table of evaluation of them that shows the different products and machines utilized, looking at the presence of toxic elements, the environmental impact and finally the impact on the human health. At the other hand it has been created a diagram of the cleaner management system that follows others criteria, due to the different aims that can have the organization management based on: communication flow between the UPC, the ISS and the users of the service.

The result is a complete table of characterization of the Cleaning Service, which can give the information needed for the following step of the methodology.

Once analyzed the state of the art based on the requirements of the study, it has been implemented some of the principles that characterize industrial ecology as a way to analyze and manage systemic process [5]:

- Design a quasi-cyclical economy. This means increase resource utilization by working in network. For example by improving management of waste generated and check whether this waste can be used as an input in another process to achieve the closing loop of the system at each step.
- Substitution. Avoidance of upsets to the metabolism of the natural system. For example toxic material substitution by less hazardous product in order to pollution prevention.
- Dematerialization. Minimize the use of product or equipment for the same service.
- Thermodynamically efficient energy utilization. Decrease of energy intensity by encouraging efficiency energy utilization and emphasizing the use of renewal energy.

It is analyzed whether these principles have the potential of moving university society towards sustainable development patterns.

5. Diagnosis of cleaning service at UPC

Based on the cleaning service contract, it is analyzed the following fields.

5.1 Products

It has been made a classification of products with information about the toxicity, the environmental impact, and the possible impact on the human health. The research is based exclusively on the information take out from the cleaning service Contract.

The main products utilized in the UPC Cleaning System are basically described in it and shows which are the mainly chemicals used for the products.

Table 1. Types of chemicals used in the products of the UPC Cleaning Service

TYPES OF CHEMICALS		
DETERGENTS	DISINFECTANTS	VARIOUS
QUATERNARY AMMONIUM DESINFECTANT	AMONICALS	STAINLESS STEEL CLEANER
CHLORATE DESINFECTANT	FLOOR POLISH	FLOOR ACIDS DECAPANTS
ALDEHYDES ASSOCIATION DESINFECTANT		OXILIC ACID
		FLUOSILCATE

Source: own elaboration based on the Contract of Cleaning service in the UPC

These chemicals are basically disinfectants and detergents components that might have an impact on the human health, mainly for the employers that used them; anyway they are permitted by the ISO 14001:2000 certification. This information is useful for this research only with the intention of showing the presence of them and for taking in account the possibility to change them for others "green" products.

It has been found in the Contract some schedule of the more used products, and all them have a correct level of impact on the environment and on the human health, based on the ISO 14001. The only product that has a negative impact on the human health is a disinfectant for WC (Forte Gel). It contains a 10-20% of hydrochloric acid and should cause risks for the respiration and can be irritant for the eyes.

The paper used is made from trimmed paper and so it is a recycled and recyclable material. The waste bags too are made of a minimum of 80% of recyclable material.

5.2 Equipments

It has been made a classification of utilized equipments and their environmental impact, energy and waste consumption based on the Contract information. There is an important information related to the quantity used, important for understand if is it possible applied dematerialization policies.

Table 3. Characterization of equipments

Equipments	Quantity	Toxicity	Environmental Impacts	Human Health Impacts
Mops 60 cm Mesdi	98	No		no
TTS Modular cars	97	No	Those incurred in their manufacture, and perhaps to reject, at the end of its shelf life, but not in use	no
Ladder 5 slangs				
Kettal	8	No		no
Ladder 9 slangs				
Kettal	8	No		no
Dust vacuum cleaners			Level of noise: 58 dB, acceptable during a short period	Influence in hearing acuity if used frequently
Taski	7	No		
Aguamat moquets-washer				
Taski	1	No	If exceeds quantity of water	
Vacuum cleaner (dust-water) Vacumat			Level of noise: 64 dB, acceptable during a short period,	Overstraining access to difficult places, Exposure to damage by short circuit of wires
Taski	1	No		
Hydro-cleaner (Water pressure) 240			Water consumption at maximum pressure: 240 L/h	
Nilfisk	1	No	Electric consumption: 1.9 kW	Dispersion of fragments or particles by the water jet pressure
Poolisher (high and low speeds)			Level of noise: 64 dB, 57 dB acceptable during a short period,	
Ergo 165				
Taski	1	No		no
TTE Broom				Overstraining by bad posture
Diversey	1	No		Projection of particles by splashing liquid cleaning fluid or battery
Mop with batteries	1	No		Overstraining by bad posture Projection of particles by splashing liquid cleaning fluid or battery

Basically there is a problem related to the impact that the equipments may have on the employees, mainly for the exceeded level of noise of some of them. In the Bibliotheca of the Campus Nord of the UPC all the floors are coating of moquette and it needs a very relevant quantity of water to wash it and for its maintenance. The modular cars should

have an environment impact mainly for their manufacture, but not for its use. It mean that it should be possible to think on a different way to make this equipments taking in account the reutilization of the water and using recycled materials, but actually there's no producer in the market that can offer modular cars of this type.

The right chosen of tools improves the quality of system, for that the equipments and materials are selected taking into account the techniques and procedures more adequate per each zone.

Also the equipments of quotidian or periodic usage considered in the Campus Nord, centres and dependencies of UPC, are the following:

- Set of cleaner utensils
- Truck of lift
- Van for the team of specialists and the supervisor

5.3 Organization: Service organization

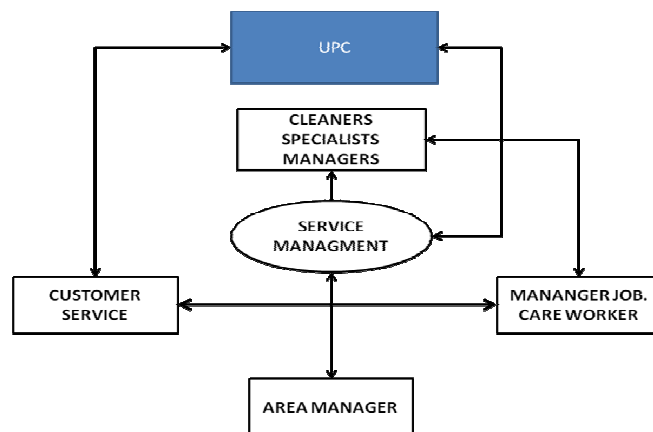


Illustration 1. Cleaner service Organization at UPC

Source: Contract of Cleaning service in the UPC

The UPC contracted the ISS Company which provides the logistics necessary to carry out the cleaning of university.

For each campus of the UPC, ISS provides cleaners / as ordinary cleaners / specialists and responsible people. The manager is the link between the client (UPC) and employees. In turn, the service manager is who oversees the manager work at each center and the area manager supervises this one.

Based on this information it has done a communication analysis and as shown in the diagram below:

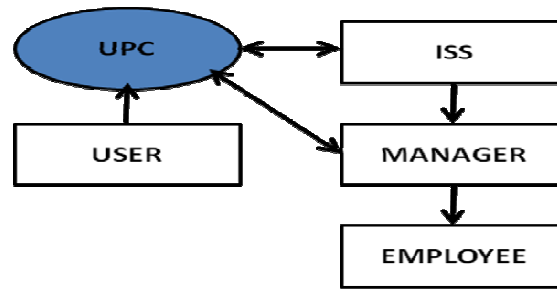


Illustration 2. Information Flow

Own Elaboration. Source: Contract of Cleaning service in the UPC

The most relevant result is that the users do not have any communication with the employees and with the manager. There is no information flows between those parts.

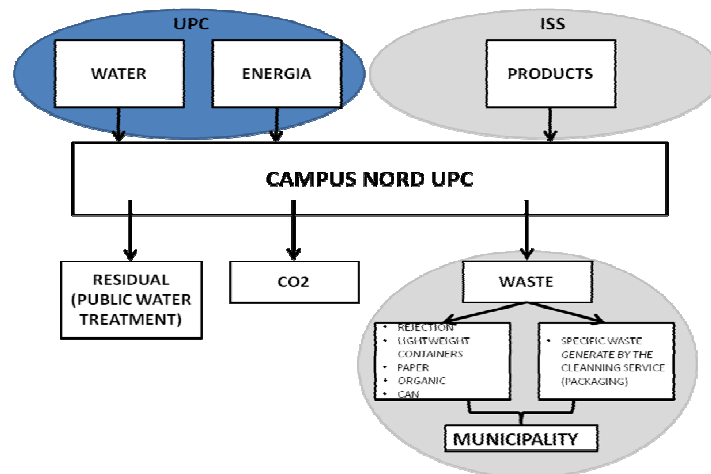


Illustration 3. Flow analysis of energy and matter in Cleaning Service

Own Elaboration. Source: Contract of Cleaning service in the UPC

Taking cleaning service as a system and analyzing all the flows that go through it, it is observed an input of energy, water and cleaning products. These flows will be respectively leave the system on one hand as CO₂, wastewater and in the other hand products leave the system as part of wastewater, environmental air and waste in the form of light packaging.

Also cleaning service is in charge of separate collection of waste paper, organic rejection, packaging, batteries, toner, etc. These wastes are managed by the cleaning service and afterward they will be given to municipality. It is important to mention that waste generated by cleaning service will be managed separately from the rest.

6. Discussion

In order to check whether Industrial Ecology principles are applicable to the cleaning service, it has made the following comparative table, identifying where is possible to apply them for products, dividing the impact of the packaging and of the liquid product

too. At the same time it has been verified if these principles should be applicable to the equipments. It has been used as IE principles:

Recycling, reuse, substitution, dematerialization and efficiency energy utilization.

Table 4. Applicability of the IE principles to the Cleaning Service in the UPC

Classification		Product		Equipments
		Packaging	Liquid product	
IE principles	Recycling	The Cleaner Service has got a policy of waste management for the packaging of the products, but at the moment there's no information about its effectiveness.	The waste liquid product is mixed with water and actually this water is not recycled.	There is not policy concern about this
	Reuse	Actually some of the packaging are rechargeable	The waste liquid product is mixed with water and actually this water is not reused.	There is not policy concern about this
	Substitution	There is not policy concern about this	The toxic products have been changed with others less dangerous.	The equipments have been changed by others with less environmental impact.
	Dematerialization	At the same time packaging reuse means dematerialization, because less material is required	There is not policy concern about this	There is not policy concern about this.
	Efficiency energy utilization	There is not policy concern about this	There is not policy concern about this	According with the ISO 14001:2000 the equipments used are energetically efficient.

The more important results are about the lack of policies concerning the applicability of IE principles for the liquid products and for the packaging of the products. There is no policy of reutilization of the water used by the Cleaning Service and for the dematerialization of packages.

All the information reached in the Cleaner Service contract are about the type of products and equipments used, about the use of them in each campus and in each building, but there's no information about the quantity of products use, neither the costs of the use of energy and water resources, in term of economy and environmental costs. Furthermore the environmental and human health impact is evaluate following the criteria of the ISO 14001:2000 and they respect the legal levels, but what the IE would express is that it is not sufficient for the improvement of Sustainability in this Service and then in the University System. The Cleaner Service just recycle some of the

materials used and respect all it needs a particular and more depth research that can aim to search all the lack dates. Starting from the analysis of them it should be possible to see how re use some of the products, how improve the recycling of some products and finally how to generate a systemic system based on the exchange of energy between the different products used.

These are important barriers for the continuation of the present study, so the following step of the research should be the analysis of the lacking information, trying to involving the management service into this process.

7. Conclusions

Starting from the analysis of the Cleaning Service in the UPC based on the Service Contract, it was possible to see that UPC doesn't apply IE principles, but they should be applicable.

It was confirmed, through a bibliography web search, that there is a lack of examples in the scientific literature about case of IE principles applied to the Cleaning Service.

There is another important problem related to the lack of communication between the different Stakeholders involved in the process. It means that the Cleaning System works as an isolated system; in fact it doesn't work in coordination with other services of the university that should be good partners for a better efficiency of the system, to reach the cycle loop of energy and materials.

Some recommendations:

To reach a more sustainable system the cleaning service should take into account the participation and the feedback of its users, understanding that they are the more important stakeholder capable to make the difference on the effectiveness of the service system.

On the other hand there is a problem of lack of information, before mentioned, related to energy and water consumption, that should be taken into account by UPC researchers for improving the generation of these dates and to make possible a more sustainable service.

Definitively achieving the sustainability of the whole system, using the IE principles, it is a question that depends by innovative policies. So the cleaning service should work in a double way, improving itself by policies and from the information that could receive from the users too.

8. Bibliography

[1]. Weenen, H. Towards a vision of a sustainable university. International Journal of Sustainability in Higher Education 1, 20-34 (2000).

[2]. Green Clean Schools "A national partnership to green America's schools published: [Consulting online: 22/04/2009]. Available at: <http://www.healthyschoolscampaign.org/programs/gcs/guide2/2-1-choose-products.htm>

[3]. Bala, A., Muñoz, P., Rieradevall, J. & Ysern, P. Experiences with greening suppliers. The Universitat Autònoma de Barcelona. J. Clean. Prod. 16, 1610-1619 (2008).

[4]. Technical references of cleaning service's contract of UPC (2009)

[5]. Erkman, S. in Perspectives on industrial ecology (eds BOURG, D. & ERKMAN, S.), Greenleaf, 2003

9. Acknowledgements

The authors thank to Pep Barroso Calico, from "Servei de Patrimoni" of the UPC for helping with all the information about cleaning service management; to Marta Garcia Sanchez and Marta Hernández Bastida, of the Library "Gabriel Ferraté" of the UPC, whose help was invaluable. Special thanks to Didac Ferrer, professors of Industrial Ecology at the UPC Master of Sustainability, for giving us all the knowledge required to develop this paper.