*Annual Thematic Workshop 2014*

*Nantes - March 27th 2014*

# Notion of functionality in eco-design

## *Organization*

**Date**: **March 27th 2014**

**Location**: **Nantes 44000 (France), Institut de Recherche en Santé de l'Université de Nantes (IRSUN), 8 quai Moncousu (15 min. walk from railway station), amphitheater Denis Escande.**

**Itinerary from station**: http://googl/maps/QUZtV

**Participation fees :** free and reserved to EcoSD members and for presenters

**Mandatory registration for participants** through EcoSD website : http://www.ecosd.fr/fr/inscription_ata.php

**Lunch offered**

**Language of the seminar**: English

***Stakes****: the notion of function in eco-design: can have different meanings, according to the discipline (engineering, economy, sociology), and according to the life cycle step. When a product is conceived, eco-designing imposes to foresee the use phase and end-of-life phase. However, there are differences between the "expected functions", and the actual "usage" of products (can we make an analogy between "supply" and "demand" in economy?). This gap between function and usage could be explored to improve environmental performances of products (adjusting the function is a performance axis by itself), as well as to better define comparison basis between similar (but different because multi-functional) products? This problematic is transversal to eco-design: eco-usage, functional economy, Life Cycle Assessment (functional unit and consequential LCA)… This problematic can be resumed by the following key questions: How to define functions? How to predict and quantify functions, utilities and usages? How to compare complex objects?*

**Objectives**: to cross different visions from different disciplines and reach a common frame to face the problematic

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# Program

**8:30 - Welcome coffee to participants**

## 9:00 to 9:15 – Opening of the seminar

Anne Ventura and Stéphane Lepochat

- **9:15 Stéphane Lepochat** (Evéa)
  *"Examples of multi-functional products."*
- **9:40 Nicolas Antheaume** (Institut d'Administration des Entreprises, Université de Nantes)
  *"Unexpected functions: case of short distribution channels in agriculture."*
- **10:05 Hayo van der Werf** (INRA Rennes)
  *"Economic value as a functional unit for environmental labelling."*

**10:30-11:00 – Coffee break**

- **11:00 Christophe Gobin** (Vinci construction)
  *"Functionalities of buildings, the notion of signature."*
- **11:25 Stéphane Morel** (Renault)
  *(to be confirmed)*
- **11:50 Thierry Gidel** (Université Technologique de Compiègne)
  *"From function to functionality, from engineering to economy."*
- **12:15 Jean-Claude Boldrini** (Université de Nantes)
  *"Functions, value criteria and usage : methods in value management, innovation marketing, strategy and innovative design."*

**12:50-14:00 – Lunch break**

**15:20 – 15:45 – Coffee break**

## 14:00- 15:45 - Various frames for characterization of functions

- **14:00** **Daniel Collado-Ruiz and Hesamedin Ostad-Ahmad-Ghorabi** ()
  *"Fuon theory: beyond comparing oranges with oranges"*
- **14:25** **Anne Ventura** (chaire génie civil écoconstruction, laboratoire GeM, Université de Nantes)
  *" Function, economical actors and life cycle."*
- **14:50** **Bernard Yannou** (Ecole Centrale Paris)
  **"***Quantification of utilities of products in usage situations."*

## 15:45–17:00 - Some propositions for new approaches

- **15:45** **Faustine Laurent** (Akajoule – IRSTEA)
  *"Systemic approach of territorial biogas plants to define relevant functions for their environmental assessment."*
- **16:20** **N. Tcherchian, D. Millet and P.Alain Yvars** (SUPMECA Toulon, SUPMECA Paris)
  *"The influence of the level of definition of functional specifications on the environmental performances of the complex system – The Eco CSP approach."*

**17:00 -17:30 – Collective discussion**

**17:30 -18:00 – Closing of workshop**

# Abstracts

**J.-C. Boldrini**

*IEMN-IAE - Université de Nantes*

## *Functions, value criteria and usage : methods in value management, innovation marketing, strategic management and innovative design*

Environmental criteria are expressed in the job instructions, the user requirements or the functional performance specifications of (new) products. Our assumption is that environmental criteria are parts of the value of these products. A difficulty is that "value" is this polysemous word which is used in a wide range of subjects (design, management...) but with various meanings. More, and surprisingly, some authors use it abundantly but without giving any definition. We will first present the definition of value in "value management" (VM) and especially its extension in the European standard EN 12973 (2000). We will show that this definition, linked with other important VM concepts such as functions, life cycle, environments and stakeholders, can provide a very good guidance in Ecodesign. In order to better take into account the users' point of view, this definition may be extended by studies in marketing. This enriched definition of value is fruitful in strategic management, for example for drawing business models up. In conclusion, an extensive identification of value attributes, including environmental criteria but not only, helps :

- marketers, to capture what is necessary for or desired by users,

- designers, 1) to identify user related functions, in all the phases of the life cycle and for all the interested parties and 2) to adjust the design with the expected functions in order to minimize the possible discrepancy between expected results and real results,

- managers, to devise business models to ensure both customers satisfaction and firms incomes,

- users, to compare the functions implemented with the effective satisfaction of the need when using the product.

**D. Collado-Ruiz[(1)] and H. Ostad-Ahmad-Ghorabi[(2)]**

*(1); (2)*

## *Fuon theory: beyond comparing oranges with oranges*

The carbon footprint of our computer screen is 865.32 than our computer mouse… so what? A prerequisite to compare environmental assessments of products is for them to be functionally equivalent, that is, to have a similar functional unit. Nevertheless, even for the same product, the functional unit can be phrased and defined in different ways. And all these formulations might be legitimate. But it makes it no more useful for comparison.

To standardize the phrasing of functional units, the authors have developed the concept of functional icons, in short fuons. Fuons are defined as an abstraction of a product, based on its essential function flows and additional functions or features. A fuon consists of a set of quantifiable parameters which represent the functions and features of a product. Thus, the use of a fuon will help to include all the necessary parameters for phrasing the functional unit of a certain product. Furthermore, all products that share the same fuon, and within the fuon the same parameters, will be included in the same product family which can be used for life cycle comparison. While the development of fuons is an information intensive and time consuming task, its application is quite simple and requires the knowledge of information that is usually known in the early stages of the product development process.

This paper discusses the state of the art of fuon theory, presents the fuons that have already been developed, how fuons can be used in the product development process and where the theory has to lead to in future.

**F. Laurent[(1), (2)], T. Bioteau [(1)], L. Aissani[(1)], G. Accarion [(2)], F. Béline [(1)]**

*(1) IRSTEA, UR GERE; (2) AKAJOULE SAS*

## *Systemic approach of territorial biogas plants to define relevant functions for their environmental assessment.*

Anaerobic digestion of organic residues has been developing in France those past few years. As the main arguments for the deployment of biogas units are connected to environmental concerns, there is a need to quantitatively asses the actual effects to the environment of implementing such AD plants. Among the environmental assessment tools, Life Cycle Assessment (LCA) is the most widely used methodology.

LCA is based upon the function fulfilled by the system studied. Two major elements of the LCA come out of this function: the functional unit and the alternatives to be compared with. When the process studied fulfills several functions that cannot be studied apart, the LCA practitioner choses a function to be the main one and the co-functions are then taken into account thanks to an allocation procedure.

When it comes to biogas systems, defining the major function can be difficult, since AD process is multifunctional. Such a unit can meet the need to handle organic waste, which origins are varied: manure, residues from food production, organic fraction of municipal waste etc., and often require being co-digested in order to increase the cost-effectiveness of the project. The biogas produced by degradation of these waste constitutes a source of renewable energy with several options for recovering this energy, since it can be converted into electricity and/or heat, used as fuel in adapted vehicles, or injected into the natural gas grid. For the digestate – remaining residue outcoming the process – direct landspreading can be practised, but it can also be post-treated in order to concentrate the nutrients (N and P mainly). This second option offers the possibility to increase locally the efficiency of nutrients or to export such a fertilizer out of the territory.

Because of those multiple functions fulfilled by a biogas system, the opportunity to implement a collective AD unit within a territory depends on the stakeholders needs, and the AD scenarios must match the local constraints. The aim of this study is to develop a systemic approach of AD implementation schemes thanks to GIS. This conceptual framework will help define the matching AD schemes by taking local features into account and consequently the proper function of the system, prior to an environmental assessment through LCA.

**N. Tchertchian[(1)], D. Millet[(1)], P.-A. Yvars[(2)]**

*(1) SUPMECA Toulon; (2) SUPMECA Paris*

## *The influence of the level of definition of functional specifications on the environmental performances of a complex system - The EcoCSP approach*

The tendency towards a homogenous mode of development modeled on that of Western countries means that sustainable development has become increasingly urgent. In order to implement such development, it is not enough to make superficial reductions of environmental impacts; it is necessary to thoroughly redefine products and their expected performances in such a way that the consequences are compatible with sustainable development. In the domain of product design, this means that it is no longer sufficient to use assessment tools « after the fact » to check the impact of products whose functional unit was defined prior to production; it is now necessary to rethink the definition of the functional unit itself.

This article aims to present an approach based on a combination of life cycle analysis methods (LCA) and problem solving by constraint satisfaction (CSP). This original approach makes it possible to vary the design of the different dimensions of the functional units of a complex system and thus to make it easier to identify the best architecture along with the best functional definition of the system. Indeed currently, LCA demands that the functional unit be fixed; this means waiting until

the design process is completed before undertaking any assessment of the system. The EcoCSP approach that we present here makes it possible to specify Negotiable Functional Requirements in order to move towards an environmental optimum that corresponds to an acceptable specification.

Applying the EcoCSP approach to the design of a passenger ferry enabled us to identify significant negotiable functions such as the ship's speed, the number of passengers transported and the level of comfort…

The EcoCSP method apprehends the problem of configuring the product architecture while at the same time dealing with the problem of defining functional requirements. However, any modification of the system's functional requirements may result in new social, economic and environmental constraints. It is thus necessary to pay attention to these outcomes in order to avoid any imbalance among the three mainstays of sustainable development.

**H. van der Werf, T. Salou**

*INRA, UMR1069 SAS*

## *Economic value as a functional unit for environmental labelling*

*The views expressed here are those of the authors and should not be attributed to INRA.*

In 2009 the French government passed a law on environmental labelling of products, to be based on a product's life cycle. To implement this law a one-year trial has been conducted.

The French parliament produced a report, based on this trial, on the interest of environmental labelling. Regarding food, the report criticizes the functional units (FU) chosen: 100 g, 100 ml, as they do not reflect the functions of food. These FU will favour high-input intensive systems and result in higher impacts for products from low-input and organic systems aiming to produce quality products. We explored the effect of the choice of FU on the ranking of agricultural products from production systems of contrasting intensification level. We used LCI data for organic and conventional pig and broiler to calculate impacts for three FU.

When using the FU live weight, organic animals had larger impact values than conventional animals, illustrating that a mass-based FU favours intensive conventional systems over less intensive organic systems that produce less product of higher value. Per ha of land, organic animals have smaller impacts than conventional animals, but production is lower. Organic agriculture thus constitutes a less impacting mode of land use for a given territory. When the FU economic value is used, organic animals have similar or lower values for eutrophication, lower values for climate change and higher or similar values for land occupation.

The FU economic value is attractive, as it considers product quality through the product's price. The price difference between organic and conventional animals reflects a willingness of consumers to pay more for a product that is perceived to be of better quality. There often is a tradeoff between quantity and quality. A mass-based FU tends to favour products from systems that focus on quantity rather than quality, yielding products of basic quality. An economic-value-based FU will be more favourable to systems producing products of superior quality.

More generally, an economic-value-based FU is very well suited for environmental labelling of any type of consumer product. Basically a consumer has a certain budget to spend; an economic-value-based FU may guide the consumer towards reduced impacts per Euro spent.