



Claudia DE GIORGI¹, Clara CEPPA², Beatrice LERMA³

NEW PRODUCTS AND INDUSTRIAL PROCESSES FROM WASTE

■ **ABSTRACT:**

In our era water, where earth natural resources seemed to have no value, we should do more with what the Earth produces and adopt a sustainable waste management. Therefore we must turn to Nature, where there is no waste and even surpluses are metabolized by the system itself. By adopting the methodology of the Systemic Design, according to which the output-waste of one production process become the input-resources of another, it becomes possible to propose a new production setup that can metabolize all types of waste. From waste we could obtain new products and also new industrial process, such as quail eggs from cattle breeding or plate from palm leaves.

■ **KEYWORDS:**

systemic design, sustainable production, recycled materials, eco-friendly products

INTRODUCTION

Industrial development has always been based on the accelerated exploitation of all resources, human and natural [13]. Water, air, soil, from which most of the indispensable resources for human survival derive, until not too long ago seemed to have no value and were exploited in the conviction and presumption that they would never be depleted [7].

Now we must acknowledge the scarcity of these resources and plan ways to manage them more rationally. On the one hand we are witnessing the continuous rise in the price of raw materials and a strong demand on international markets for recyclable materials, while on the other hand we are producing more waste. Along parallel lines the increase in energy consumption is skyrocketing and so is the number of consumers. Global times and spaces require a permanent availability of energy and resources, but what is available to the whole is not necessarily available to each individual to the same extent and with the same amount of freedom [8].

The raw materials that allow us to produce energy take on a crucial supranational role and create worldwide political and economic scenarios. The situation becomes worse when the resources are non-renewable sources or sources that generate high environmental risks. The greatest energy demand is actually met in two ways: by increasing exploitation of the planet's resources and by conducting a more intensive search for energy efficiency.

These solutions, however, create a vicious cycle that does not guarantee the long-term sustainable development we are hoping for.

If energy influences every aspects of our daily life, we could go so far as to consider waste an indicator of lifestyles or consumption habits of the society in which we live [9]. It tells us what we consume, how much we consume, the way in which we consume it. This statement derives from a careful observation of the power of persuasion we are all subjected to everyday, through various media that exalt the equation according to which greater consumption favors a rise in one's well-being and social prestige. Our attention to the real value of goods is clearly limited. We ignore its value when it is being used and after using it, even briefly, and we ignore its value after it is discarded. Though in daily life we make an effort to eliminate solid urban waste by differentiated collection, we are paying less attention to industrial waste.

The latter is perceived as being far from our personal sphere, though the mass media reminds us of the growing importance of its impact and the proportions of the phenomena. And this does affect our daily life. Globalized society has reached the limit of its development and is becoming aware of its dependency on energy sources and natural resources and its need to achieve sustainability [1] for its consumption requirements.

DESIGN METHODOLOGIES TO REDUCE PRESSURE OF HUMAN ACTIVITIES ON THE ENVIRONMENT

Currently when we need to design an object or service, our approach is to think about the product to be created and work on the pre-project phase. We single out the actions required to solve exclusively the expectations consumers have of that product [5].

By thinking of the product as of the main focus of the project, we immediately outline the values correlated to it, such as the raw materials, its economic value, its value as a status symbol, possession, communication: the former are essential for starting the production process and the latter influence consumer dynamics. The act of purchasing is a vital moment because it applies leverage to the psychological system of purchasers and their desire for identification through possession [10].

In this scenario there are values associated with the functionality of a product, its life cycle and relationship with the environment. But these are taken into consideration because they are imposed and not strictly necessary for the logic of consumption. Nonetheless today harming the environment, lacking resources and the myth of unlimited development have forced us to think about and reconsider the role of humans in society: a sustainable human community interacts with other living systems, human and nonhuman, in ways that allow these the systems to live and develop according to nature. In the human sphere sustainability is fully compatible with having respect for cultural integrity, cultural diversity and the fundamental rights of the various communities to self-determination and self organization.

The new paradigm considers man its design focus, humans as part of an ecological context that acknowledges the interdependence between social and natural structures. In this scenario the role of life goes back to being essential biologically, ethnically and culturally. Likewise designers are faced with a future that will allow them to design and build ecologically sustainable communities, products and services that will be in harmony with the system of the natural world: the productive process must turn to Nature, the System par excellence, to understand the complexity of a system made up of relations between different beings and the continuous evolving flow of matter; moreover in Nature there is no such thing as waste and even surpluses are metabolized by the system itself [4].

If these conditions, which are fundamental for a living system, are adopted in production, they will favor the development of a zero-emissions production precisely because the waste (output) of one process is used as a resource (input) for another production process. We are getting into an era based not on what we can take from Nature but on what we can learn from Nature [2]: in terms of sustainability, the "projects" and "technologies" of Nature are far superior to human science and technology. We must apply our ecological knowledge and know-how to the fundamental redesign

of our technologies and social institutions in order to fill the gap that today separates human design from the ecologically sustainable systems of nature.

THINKING BY CONNECTIONS: WASTE BECOME NEW RESOURCES

In a world that is ever more complex, like the world we inhabit today and will inhabit in the future, we must extend our gaze to the entire production process and see it in its entirety, i.e. not by single phases [7]. We must deal with everything produced, products and waste, to start implementing targeted actions to achieve a substantial harmonization of the relationship between the environment and local communities. Production must be seen as a support to society and not as an end in itself. Therefore we need to seek out new ways of producing that guarantee remarkable results in social, ethical and environmental terms and lead to an improvement in the quality of life.

The starting point is realizing that waste, created by manufacturing processes, or the end-of-life product, discarded and not valued, contains huge amounts of precious resources for other manufacturing processes; the goal is to build a network of know-how which, through true market mechanisms, would stimulate a reduction in all forms of waste and would help upgrade the remaining outputs. According to the first principle of Systemic Design the discards (output) of a process are used as resources (input) for another manufacturing process or products [3]: the outputs are enriched with new value and become a resource available to be in the manufacture of new products closely associated with the local skills.

Therefore it becomes possible to create new manufacturing scenarios where the output of one company, a useless material to be eliminated incurring expenses only, can be reused to ensure the survival of another company related to the business category or physical location of the first company. In this sense all in industrial production must reduce the use of non-renewable materials and evolve toward less energivorous processes, making uncontaminated outputs that can be reused for their qualities.

The methodology proposes that we add value to the discarded materials so we can eliminate waste disposal costs and create a network for marketing the outputs: this generates greater profits and creates jobs and wealth in the community by spawning new entrepreneurial initiatives, developing businesses and improving the already existing businesses [7]. By following these concepts of systemic design, the world of manufacturing, which today is truly lacking an environmentally mature culture, would succeed in achieving the goal of zero emissions.

NEW PRODUCTS FROM PRODUCTION OUTPUT

With this document we would like to illustrate a systemic production chain in which all the output are re-used and two products generated by manufacturing processes waste.

The first example regards a production chain that starts with a cow farm and ends with the retail sale of final products, passing from the milking phase to

slaughter. Till now there have been various critical points within the entire process due mainly to the insufficient valorisation and improper use of outputs which are thrown away carelessly. Among them I would like to point out the water which contains certain percentages of urine or milk or blood, in addition to the organs and blood of the animals. By applying the systemic methodology, and using Systemic Software, it was possible to establish new ways to use these resources and create local flows of material. The outputs from the cow farm were sent to other production enterprises: the water with urine content was sent to water treatment facilities to be treated. The manure, sawdust and urine were used in biogas production plants which produce methane and sludge that are excellent ingredients for high-quality compost for farming purposes.

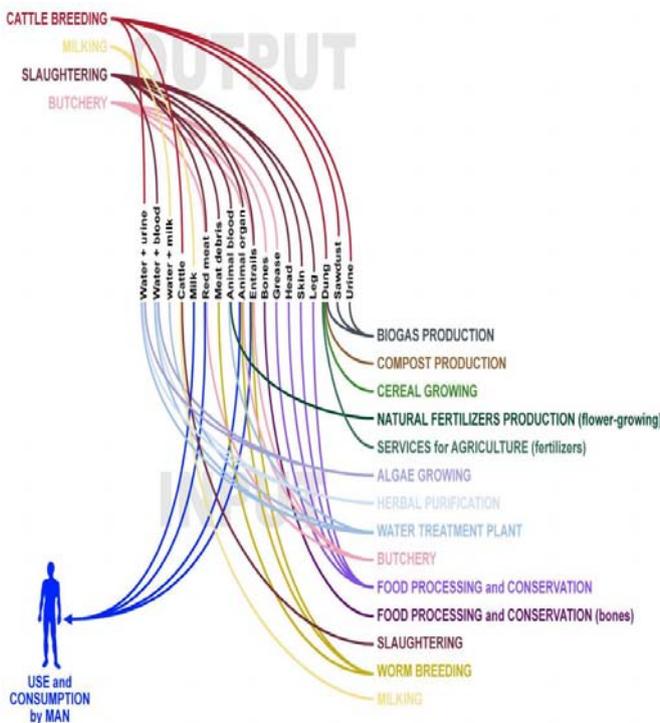


Figure 1 - New flows of material generated by systemic methodology

The outgoing material of the milking phase is currently thrown away but the water contains a certain percentage of milk. This resource is rich in nutritional value if managed systemically and can be used to feed freshwater fish. Numerous critical points were also found in the slaughtering process. Particularly noticeable was the problem of the squandering of certain fundamental by products with a high biological value, e.g. the blood [9]. In the new web of connections blood is used for the production of soil and natural flower fertilizer. Blood traces were also contained in the water sent to treatment plants and plant-filtering processes. The remains of the meat and some of the animals' organs and entrails give a major contribution to raising worms, an essential food for raising quail. Quail eggs are high-quality food products.

The greatest innovation consists of raising the awareness of producers that the problem of waste can be solved by activating complex relations in which the outputs of one productive process connect the nodes, which are local companies, of a network in which know-how, well-being, material and energy transit. The advantages of such approach are environmental and economic; among these the most important goal is to reduce the cost of waste treatment and therefore increase the profits from selling the company's outputs, reducing environmental costs, such as the consumption of energy, pollution and traffic caused by the transportation of materials; the use of already existing materials in loco removes the need to exploit virgin raw materials.

The second example is about the Areca palm leaves, which are transformed into plates (Eco vision_Eco friend, Balipaguli, Post Kodapadavu - 574 269 Bantwal Taluk, Karnataka, India). The leaf sheath of Area (Areca Catechu Linn) palm, extensively cultivated in South India as a cash crop, supplies a strong pliable material that is amenable to shaping. The bio plates are obtained directly from nature and it is not chemically modified neither coated during the manufacturing process. Moreover the plates are obtained from the dead leaves (come off), which could be otherwise rot: this product is obtained from the plant leaf part, which in the course of its biological life cycle, dries, falls and regenerates. The processing waste is reusable as food for the animals present in the farm or as fuel for the ovens needed for plate dehydration.

BioPlates are biodegradable and compostable, and can be used as animal feed and it is combustible too. Palm shed leaf sheaths are first carefully sorted and then thoroughly washed and mechanically pressed in a pre-heated form. A final trimming process gives finish to the products. The entire manufacturing process uses no chemicals, resins, and dyes, strengthening agents or synthetic materials whatsoever. A specialized baking & sterilisation process ensures that the plates are totally germ free, hygienic, and suitable for using for food. Moreover its biodegradable nature means that BioPlate can be easily disposed off after use, and over a period of time decays with the soil like any other naturally shed leaf.



Figure 2 and 3 - BioPlates

The third example is a textile obtained from salmon leather. This material is produced from salmon skin, fish canning waste: a byproduct of the fish processing industry that usually gets tossed into the landfill.

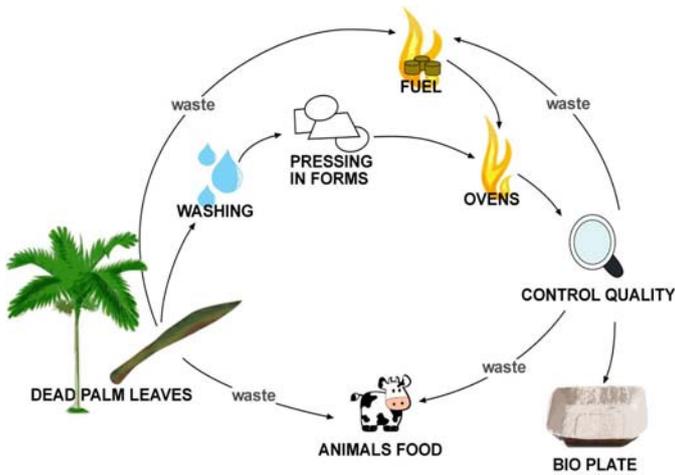


Figure 4 - Simplified systemic BioPlate production process

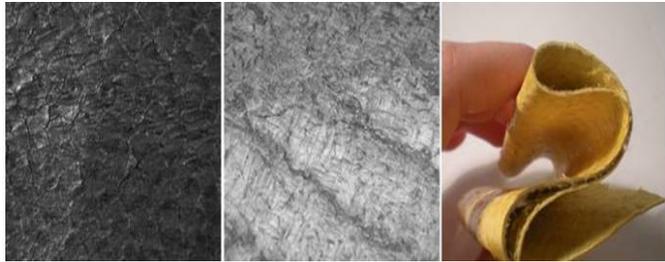


Figure 5 and 6 - Salmon leather

This leather has a vegetal base colour from salmon skins and is 100% chrome-free tanned. Salmon leather was recently used by a fashion designer [12] and in a Museum exhibition.

From recycled glass and medical waste, it's possible to produce a range of products ranging from furniture complements: tiles fully realized only using this recycled materials.

The pharmaceutical field conservation requires the use of materials whose properties (chemical resistance, stability) will not adversely affect the medicine characteristics with which is directly in contact, not only under conditions of normal use of the drug, but also if the product is subjected to a process particularly stressful, such as sterilization or freezing. The glass for pharmaceutical use must have a quality certificate to guarantee the neutrality of the container, under the rules of the European Pharmacopoeia: the characteristics are classified into three categories according to the chemical formulation of the mixtures and surface treatments. These glass, obtained from medical waste, such as beakers and vials, defined neither hazardous nor radioactive medical waste, are recycled and allow to obtain coatings of high aesthetic quality and extremely versatile for use indoors or outdoors.

Among the Italian companies of the art of re-use of recyclable materials, there is Cermway (Ceramiche MyWay, Via L. Pirandello 7/9, 41042 Fiorano, MO, Italy) which produced Hailstone and Glass, composed of 98% recycled glass from medical waste.



Figure 7 and 8 - Hailstone and Glass, produced by Cermway

The growing awareness of waste management has produced many innovative ways of recycling waste into new products and materials. Much of our waste is packaging related. After use it is thrown into our trashcans and transported to expensive landfill sites or incinerators [11].

Smile Plastics (Smile Plastics Ltd, 244 Grays Inn Road, WC1X 8JR London, United Kingdom) is one of many companies across the world committed to sourcing and developing innovative ideas and markets for recycled materials, concentrating on transforming plastics into multicoloured sheets.

The original wastes are discarded shampoo bottle, rain boots, yogurt pots, mobile phone case, which can be seen in the surface. For example each phone case can be seen in distorted, tortuous detail, compressed into two dimensions but still clearly identifiable as someone's personalized mobile, saved from the landfill and preserved for ever as a table top or even as the latest style in coasters. The sheets obtained are not all identical: each product has a unique aspect.



Figure 9, 10 and 11 - Bottle produced by Smile Plastics and Origins by Yemm & Hart

Origins is the name of decorative material, produced by Yemm & Hart (Yemm & Hart Green Materials, RR1 Box 173, 63655 9610 MO Marquand, MO, United States), made from recycled polyethylene consumer detergent bottles. This material is comprised of one-gallon milk jugs, which are collected locally and processed by grinding, washing and forming the plastic into pellets [6].



The bottle recycling designation is HDPE. The decor is not printed, but is all the way through the material. Origins panel possess virtually identical properties compared with virgin panels. It's a non-toxic material that causes no harm to the environment during its manufacture or use and it helps to minimize waste.

CONCLUSION

In conclusion designers have to see the industrial world as a system, freeing us from focusing solely on the product and its life cycle, extending our attention to the entire commodity chain, and considering the problems of waste on the same level as that of raw materials [10]. In the future, designers will have this new responsibility: designing an object with all its functional, symbolic, cultural and technical factors fully coordinated and integrated, is now a well-established method, and yet today's world increasingly demands, and in future will continue to demand that projects to be seen as part of a system: different production situations need to be related to each other.

REFERENCES

- [1] Barbero S., Fassio F., Campagnaro C., Ceppa C.: *Energy produced by its own territory: How outputs generate widespread business*, Proceedings of Changing the change, Allemandi, Turin, 2008.
- [2] Benyus, J.: *Biomimicry: Innovation inspired by nature*, New York, Morrow, 1997.
- [3] Bistagnino L.: *Design sistemico. Progettare la sostenibilità produttiva e ambientale*, Slow Food Editore, Bra (CN), 2009.
- [4] Bistagnino L.: *Ispirati alla natura*, Journal Slowfood n. 34 Slow Food Editore, Bra (CN), June 2008., pp.104-105.
- [5] Bistagnino L.: *Il guscio esterno visto dall'interno*, Casa Editrice Ambrosiana, Milan, 2008.
- [6] Brownell B.: *Transmaterial*, Princeton Architectural Press, New York, 2006.
- [7] Ceppa, C., Campagnaro, C., Barbero, S., Fassio, F.: *New Outputs policies and New connection: Reducing waste and adding value to outputs*. Proceedings of Changing the change, Allemandi, Turin, 2008.
- [8] Cottrell A. H.: *Environmental economics*, Wiley, New York, 1978.
- [9] Ganapini W.: *La risorsa rifiuti*, ETAS Libri, Milan, 1985.
- [10] Germak C.: *L'uomo al centro del progetto*, Allemandi, Turin, 2008.
- [11] Lefteri C.: *Materials for inspiration design*, Rotovision, Hove, 2006.
- [12] Chua, J., M.: *Salmon Leather: A Fishy Fabric, But Will Designers Take the Bait*. www.ecouterre.com, 2009/09/09
- [13] Zorzoli G.B.: *Preface*, in: Ganapini W., *La risorsa rifiuti*. ETAS Libri, Milan, 1985.

AUTHORS & AFFILIATION

Claudia DE GIORGI¹,
Clara CEPPA²,
Beatrice LERMA³

¹⁻³POLITECNICO DI TORINO, DEPARTMENT OF ARCHITECTURAL AND INDUSTRIAL DESIGN, Viale Mattioli 39, TORINO, ITALY



ACTA TECHNICA CORVINIENSIS
- BULLETIN of ENGINEERING
ISSN: 2067-3809 [CD-Rom, online]
copyright © University Politehnica Timisoara,
Faculty of Engineering Hunedoara,
5, Revolutiei,
331128, Hunedoara,
ROMANIA
<http://acta.fih.upt.ro>