Innovation and Design Processes: Towards a Model of Social Responsibility

Giuseppe Longhi and Linda Comerlati*
longhi@iuav.it, linda.comerlati@gmail.com
IUAV University of Venice, Italy

Abstract: The design practice today is rapidly evolving due to complex and integrated driving forces that lead to a new holistic design method based on a collaborative and socially responsible approach. Due to the depletion of physical resources, we have to replace the current processes based on material consumption with new processes supplied by goods that are limitless and can be used by a large number of people without causing exhaustion. The main value of today design is then human capability to produce ideas since they are non rival and non expensive goods. The main factor of economic growth is technological progress that works at the rhythm of decoupling to increase productivity by reducing raw materials consumption. The paper proposes an organic method for urban and architectural design based on the limitlessness of human creativity and on the intangibility of scarce natural resources, implemented in a local design experience.

Keywords: Metabolic Design, Human Development, Social Responsibility, Decoupling, Disruptive Innovation.

An Organic Model of Social Responsibility

The conference topic “Design theory and methods to cross the disciplinary boundaries thank to creative and innovative solutions able to radically alter our infrastructure and built environment idea” reminds me of an important paper by Donella Meadows, “Dancing with systems” (Meadows 2008).

The question is: what are the driving forces of today’s dance design? I think they are:

- change in human resources role,
- resources depletion,
- technological innovations,
- resilience.

This system of elements suggests an interdisciplinary holistic design model, basically inspired by the theories of Robert Solow, Jane Jacobs, and Nicholas Georgescu Roengen that could be defined 'an organic model of social responsibility'.

Change in Human Resources Role

Due to the depletion of physical resources, to which the construction sector activities contribute significantly, we have to replace the current processes with new processes supplied by goods that are limitless and non rival, that can be used by a large number of people without causing exhaustion.

This principle marks the transition from a design model dominated by the supremacy of physical capital (products and goods), to a holistic model in which five driving forces interact: ideas, institutions, population, human capital (measured by education, research and development) and physical resources (measured by financial resources, artifacts, equipment and infrastructure).

The development of human resources becomes the qualifying purpose of the project, in symmetry with the model proposed by neoclassical economists since the late ‘60s, first with Robert Solow (Solow 1957) and later with Robert Lucas (Lucas 1988), in synergy with Jane Jacobs (Nowlan 1977), until Paul Romer (Romer 1986; 2014).

In fact, according to Solow, the main factor of economic growth is technological progress. This is mainly powered by enterprise externalities, an intuition that is completed by Lucas and Jacobs, who emphasize the role of the city (and, in particular, of its size and dynamism), because from its size depends the intensity of the externalities, in terms of human relation concentration, able to generate technological progress.

On this topic Paul Romer argues that development is a function of one unlimited available good, the ideas, which are powered by knowledge. This model introduces important changes in design thinking, because the ideas:

- are substantially different from the physical capital (land, infrastructure, capital and objects); they are non rival goods, as can be used simultaneously by a large number of people without creating congestion or depletion. So in the city it is important to encourage the growth of creative people, facilitating their importation and cultural development, stimulating the creation of new infrastructures to host new social classes, and renewing the infrastructures for the knowledge growth;
- develop new technologies, such as biotechnology, which help to demolish the specter of diminishing returns, that haunts the economic thought from
Ricardo to Keynes to the present day. On the contrary, new technologies are generative since they create increasing returns through research, to kick-start new machinery and products available at decreasing prices. In addition, in the design and construction sectors, the new frontiers of technology, based on dematerialization and biotechnology, allow the creation of artifacts without natural resources depletion, thus not affecting the carrying capacity of the Earth. As generative, new technologies inspire shared design practices;

- generate the production costs fall, translating the centrality of investment from production to research;
- are inseparable from the scale effects, and then confirm the essential role of urban concentration and, with it, the positive reading of the metropolis and globalization phenomenon;
- are based on organizational models of relationship symmetry, on collaboration and not competition.

If the project driving forces are human resources, as shown in figure 1, then the development must also take into account the role of human augmented intelligence thanks to cybernetic processes, a phenomenon that enhances the project as a cognitive construct, based on the iteration between users, their thinking and point of view about humans and built forms.

On the other hand, the processes of augmented intelligence could lead to a complete robotization of society and the city, so the wonders of a smart city could be accompanied by uncontrollable increases in unemployment rates. This is an issue that invokes the need for a strong public leadership in the project formulation and management, to avoid social catastrophes.

![Figure 1. The Driving Forces of Development on the Basis of Inclusive Wealth Report (UNU 2012)](image1)

**Resources Depletion**

This topic has its driving force in the work of the Club of Rome, in addition to those of the Wuppertal Institute and of the Stockholm Environmental Institute (Rockström et al. 2009). These institutions have monitored the resources depletion and inspired the accountability of the international environmental conventions and EU programming defining processes. Figure 2 shows that the aim is to limit the environmental load by controlling the raw materials consumption and the substitution of semi-finished products and processes with high material consumption. The result is the reevaluation of bioproductivity thanks to the exploitation of natural resources and, as Roengen had expected, the end of bulky eso-machines design in favor of a metabolic design that replaces mechanical technologies with biological ones.

![Figure 2. The Evolution of the Metabolic System of Production on the Basis of Wuppertal Institut Agenda](image2)

The exploitation of natural resources has its driving force in the Millennium Convention. The Convention is focused on the ecosystems role, the biodiversity rehabilitation, and, very important, the economic value assessment of goods and services produced by ecosystems. In this vision, the environment is no more considered in the romantic idea of garden as mitigation of the negative externalities, or as center of citizens loisir, and becomes the most important among production factors (as depleting goods), whose value has to be added to the economy traditional goods and services, as shown in figure 3.

![Figure 3. Partha Dasgupta and Anantha Duraipapp: Metabolic Model of Development](image3)

Thanks to the Millennium Convention, the value of the environment has to be incorporated in all development decisions, and the reevaluation of the
environmental heritage (which includes the value of historic settlements) must be at the center of project operations. The Millennium Convention also marks the decline of the man's claim to guide and control the living world according to the culture of the Neolithic period, in favor of a 'revolution of living', that is the ability of humanity to take control of their own 'production', after gaining the control of their own reproduction, that is to develop in synergy with the natural resources.

Technological Innovation
Following on from the previous paragraph, technological innovation affects both urban projects, and infrastructure and buildings design, following the path defined by the Wuppertal Institute and made operational by the decoupling rules. Decoupling, as described in figure 4, is the increase in productivity by reducing raw materials consumption. Its speed forward is given by the application of the environmental standards of the international conventions through the EU budget policies (Fischer-Kowalski 2011).

**Figure 4.** Stylized Representation of Resource Decoupling and Impact Decoupling

The table below shows how the design is influenced by new processes testing low material consumption, thanks to research in the field of renewable energy, to the creation of an effective agenda for dematerialisation including TLC, big data, high connectivity. The EU politics lead towards a metabolic model of development.

**Table1.** Metabolic Development and Decoupling: The Objectives of FP8 (ERT 2010)

<table>
<thead>
<tr>
<th>Reduce the EU’s raw material dependency</th>
<th>Reduce the EU’s raw material dependency, including investing in R&amp;D in technologies that reduce raw material needs and in new recycling techniques.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devise programs to implement energy efficiency and climate change reduction:</td>
<td>New targets for energy efficiency need to progressively adapt to technological developments on the basis of a full life-cycle analysis, also taking into account resource, environmental, social and economical aspects. The use of low-carbon alternatives is encouraged.</td>
</tr>
<tr>
<td>Pursue energy efficiency</td>
<td>Make all the related efforts fostering private investments.</td>
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<td></td>
<td>Encourage the continuing development of a global carbon market by taking steps towards linking the EU Emissions Trading System (ETS) with other developed country systems (notably the USA).</td>
</tr>
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<td></td>
<td>Follow a course of energy policy development that encourages full use of EU indigenous energy sources, setting the parameters within which the market operates rather than defining the market structure.</td>
</tr>
<tr>
<td></td>
<td>Ensure that the necessary grid and infrastructure developments proceed in tandem with the required change in EU energy supply to meet 2020 targets and beyond, including smart electrical grids, enhanced natural gas networks to support expanded access and CO2 transport pipelines.</td>
</tr>
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<td></td>
<td>Promote and develop sustainable modes of transport and innovative infrastructure designed to enable low-carbon mobility of people and goods across Europe. Integrate transport and land use planning and use EU structural funds to promote high-technology infrastructure solutions. The Energy 2050 Roadmap has been delayed. The impact of the Green Car Initiative and the Transport White Paper and the coherency of policy and funding is not clear.</td>
</tr>
<tr>
<td></td>
<td>Develop a digital agenda that allows the EU to make full use of the possibilities of information and ICT to achieve the EU’s policy priorities.</td>
</tr>
<tr>
<td></td>
<td>Reduce CO2 emissions by using all available technologies, including 'green ICT'.</td>
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<tr>
<td></td>
<td>Boost productivity by putting in place policy frameworks fostering private investment in broadband networks, digital services and applications.</td>
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<tr>
<td></td>
<td>Foster societal well-being by using state-of-the-art technologies in health, education and transport. The Commission has launched consultations on these issues, putting e-Health high on the political agenda.</td>
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<tr>
<td></td>
<td>Make all the related efforts fostering private investments.</td>
</tr>
<tr>
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</tr>
</tbody>
</table>
Current innovations radically transform urban design driving forces and redefine the ecosystem of Public Administration and businesses, as the concept of value and the models of public and private organization, generating new relationships and new urban processes. This process is called 'disruptive' (see table 2, figure 5) because it produces effects not envisaged by stakeholders, who tend to see the future primarily as a linear projection of the past.

**Table 2. The Main Disruptive Innovations Expected to Meet the Project World (McKinsey 2013)**

<table>
<thead>
<tr>
<th>Field of innovation</th>
<th>Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer simulation of human mind</td>
<td>Neuronal computer</td>
</tr>
<tr>
<td>Generator</td>
<td>Automation of knowledge work</td>
</tr>
<tr>
<td>Dematerialization</td>
<td>Cloud technology Mobile Internet The internet of things</td>
</tr>
<tr>
<td>Producing in harmony with nature</td>
<td>Next generation genomics Protection of natural products and services</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field of innovation</th>
<th>Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy from renewable sources</td>
<td>Renewable energy</td>
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<tr>
<td></td>
<td>Energy storage</td>
</tr>
<tr>
<td></td>
<td>Advanced oil and gas exploration and recovery</td>
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<tr>
<td></td>
<td>Grid scale storage</td>
</tr>
<tr>
<td></td>
<td>Digital power conversion</td>
</tr>
<tr>
<td></td>
<td>Compressorless air conditioned and electrochromic windows</td>
</tr>
<tr>
<td></td>
<td>Clean coal</td>
</tr>
<tr>
<td></td>
<td>Biofuels and electrofuels</td>
</tr>
<tr>
<td></td>
<td>Industrial applications</td>
</tr>
<tr>
<td></td>
<td>Advanced robotics</td>
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<tr>
<td>Advanced robotics</td>
<td>Autonomous vehicles 3D printing Advanced materials</td>
</tr>
<tr>
<td>Regeneration of the city as a closed metabolic system</td>
<td>Neighborhood energy self-sufficiency</td>
</tr>
<tr>
<td></td>
<td>Neighborhood food self-sufficiency</td>
</tr>
<tr>
<td></td>
<td>Water savings (-77%)</td>
</tr>
<tr>
<td></td>
<td>Buildings with high connectivity (100 Mb and services in the cloud)</td>
</tr>
<tr>
<td></td>
<td>Increasing the biotic components (43% biobased materials)</td>
</tr>
<tr>
<td></td>
<td>0 emissions</td>
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</tbody>
</table>

**Figure 5. Main Innovations Involving Building Design**
Resilience
These changes imply that the project construction is resilient, that it is able to adapt in the face of unpredictable changes in environment (e.g. climate change), technology (see disruptive technologies) and society. This draws a new holistic model of relations based on the principle that we are not simply faced with the need to renew scientific disciplines, but we must realize that we are, in fact, manipulating a system of social disciplines. As a result we need to overcome the passive project implementation, as it happens in the language of business (planning, targets, methods, procedures) on behalf of decision-making systems in which the designers' leadership is supported by technology, increasing the understanding and incorporation of foreign cultures. The result is a project structure based on the principle of inclusion and cohesion, in order to appropriately absorb the diversity, to experiment new models of social, environmental and economical organization (Ciborra 1992; 2002).

This project model is based on:
- The deep knowledge of resources, supported by the potential of the new infrastructures such as cloud computing and big data;
- Scenarios, feedback and approximation, acting to promote cohesion and inclusion and the development of human resources;
- Complex platforms, connecting local and global networks of social actors, companies, researchers, organized on the basis of the courtesy principle;
- Improvisation, to give pragmatic answers to specific situations.

This project idea replaces the certainty of thinking with a creative tinkering to generate inclusive innovation.

Towards a Model of Social Responsibility

In synthesis this paper shows the main driving forces of an organic model of social responsibility.

Table 3. The Elements of an Organic Model of Social Responsibility Design, Coherent with EU Topics in the Design Field (Fenn et al. 2013)

<table>
<thead>
<tr>
<th>Holistic approach</th>
<th>It leads to multiple savings that can support each other and achieve an overall more significant impact. This approach also means that any stakeholder can be involved.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple agencies/organisations involved</td>
<td>It provides a wider perspective and potential for co-ordinating support to stakeholders in a holistic fashion, it creates synergies and enables the achievement of cumulative effects across a region.</td>
</tr>
<tr>
<td>Overcoming the vision of the project as a product, increasing the focus on services</td>
<td>Anthropocentric design vision must reevaluate the natural resources services. The project's aim is also to increase their productivity.</td>
</tr>
<tr>
<td>Long-term vision and support</td>
<td>It provides longer periods for beneficiaries to access advice and support. Long-term support increases the potential to establish long-term relationships.</td>
</tr>
<tr>
<td>Collaborative approaches (including peer-to-peer learning or involvement of peer-to-peer networks)</td>
<td>Collaborative approaches and peer-to-peer learning can be more effective than manual or classroom based learning. The involvement of peer-to-peer networks increases credibility.</td>
</tr>
<tr>
<td>Evaluation of environmental, social and economic externalities</td>
<td>The evaluation of environmental, social and economic externalities increases the design generative impact.</td>
</tr>
<tr>
<td>Free data-base access</td>
<td>Information accessibility is a key factor for the development.</td>
</tr>
<tr>
<td>Long life cycle design</td>
<td>It multiplies the positive aspects for the people involved.</td>
</tr>
<tr>
<td>Multiplicity of funding sources</td>
<td>It increases the likelihood that the program remains active, even if one of the sources of funding will be stopped.</td>
</tr>
<tr>
<td>Exportable projects</td>
<td>Overcoming the projects local vision in favor of a generative philosophy, able to expand networks and increase wealth.</td>
</tr>
</tbody>
</table>

The organic model of responsible design is articulated in the following elements (figure 6):
- Limitlessness of human creativity, it is given by the potential of human resources increased by cybernetic technologies.
- Intangibility of natural resources: it is given by the conservation of natural resources and the optimization of metabolic processes.
- Dematerialization and connectivity: it leads to the conservation of resources and the improvement of human relations. In this way, the project material becomes, according to the definition of Nicholas Negroponte's, 'atoms and bits'.
- Resilience and inclusiveness: it concerns the governance model, that should be at territorial/metropolitan scale, in order to accommodate the new flows of culture and knowledge, and to be able to adapt to unpredictable social and environmental events.
A Design Experience: Horizontal Farm, New Delhi

The Horizontal Farm (HoF) is an ideation for an urban development plan involving 150,000 inhabitants in the New Delhi megalopolis, in a semi-central area of 30,000 square meters. The project is envisioned as an integral part of the corridor Mumbai - New Delhi (Knowledge Based Infrastructure in DMIC 2014), the great experimental project for a megapolis development promoted by Indian Government with Japan financial support (100 mm. dollars) and with the technological support of 'Smarter City' program (IBM 2014). This project is based on the feedback between people, human resources reevaluation, new light technologies opportunities.

**HoF is a Generator of New Capabilities**

The project is inspired by Amartya Sen (Sen 2003) and Martha Nussbaum (Nussbaum 1999) thought, identifying in the population growth (in our case, mostly low-income, young and digital natives), as driving force for a new and democratic development. The capability growth on the one hand is connected with expectations of greater opportunities, and on the other has to deal with the awareness of the new values that should guide the community and the megalopolis development: cohesion, for an harmonious development in an environment marked by diversity; resilience, for an adaptation to an environment with scarce natural resources and rising unpredictable events. The project then takes as driving forces the development of human resources and the natural resources defense, in a propulsive dynamic setting, that has no precedent in the history of mankind.

The design key element is sustainability, intended as a feedback between man and nature, in an anthropocenetic vision of development (Brugmans and Strien 2014), aware of the limit of resources and able to review obsolete design practices.

**The New Design Rules**

These principles lead to the building of a design abacus, as shown in figures 8, 9, 10, 11, characterized by these key-words:

- 'critique waterfalls' (Chen 2012): the aim of the project is to produce 'critique waterfalls', i.e. it must go beyond the mere satisfaction of needs in one place, and be generative (Cedric Price: Fun Palace), capable of producing exportable development processes. For this reason, the HoF design solutions and organizational strategies are repeatable, and help to transform the way people live in new cities or new spaces on a global scale;
- human capabilities: the main driving force of the project is the growth of human capabilities, in...
order to increase creativity, flexibility and innovation skills. Human resources organize in structures characterized by differentiation, adaptability, cross-interaction, to promote and manage innovative and flexible systems.

- **metabolism**: the project is based on the optimization of resources metabolism, minimizing the input of raw materials, taking advantage of the opportunities offered by the dematerialization processes and exploiting waste flows to achieve processes of productive transformation. The metabolic (Longhi 2009) system is consistent with the rules of decoupling (Fischer-Kowalski 2011) and of man and environment synergy, so that for each physical realization there has to be an equal growth of natural resources. This principle allows the project to come together with the quality parameters of the settlements proposed by international conventions on human and environmental development. The physical infrastructures become tools to produce capability, relationships, energy, food;

- **biology**: the technologies employed are inspired by organic models, they have a low price and a high connectivity, in order to promote highly industrious processes in an environment characterized by the lack of capital.

The elements that make up the agenda of the HoF project are now undergoing great and rapid changes, and their effects aren't predictable. The design model is hit by a series of tsunami (Caldwell 2012; Dua 2013; Lavery et al. 2013; Bower 1995):

- the abandonment of the project as a series of physical 'stable' products in favor of a system of 'meshed' flows, composed of atoms and bits,
- the transition from a system of design rules inspired by the laws of mechanics to a system inspired by the rules of biology, of self-generating processes at zero resource consumption,
- the crisis of sedentary and passive education towards online and interactive organizations,
- the crisis of the historical production cycle, characterized by a multiplicity of passages in favor of the short chain ideation-product, with low cost plants, where everyone is an entrepreneur,
- the realization of the cloud, i.e. memory stores,
- the transformation of governance rules, towards the equalization of social relationships thanks to new technologies and to the availability of more and more capable clouds,
- the transformation of public administrators in 'urban mechanics', providing tools and assistance to citizens to creatively regenerate the city.

![Figure 8. Hof: An Antropocenetic Design Supported By New Technologies](image_url)
Figure 9. Hof: The Design Genoma

Figure 10. HoF: A Tool System Implemented by the People
Conclusions

This article re-evaluates the change of the design principles, which took place from the end of the 60s thanks to the contributions of Robert Solow and Jane Jacobs. They replaced the priority of physical capital with the priority of human capital, resulting in a pattern of 'social responsibility' in which the engine of the project, both urban and architectural, is the development of human resources against the depletion of resources, by exploiting the opportunities of new technologies, based on miniaturization, immateriality, biodiversity, reducing the consumption of natural resources. The variables of the model works in conditions of great uncertainty, thus it needs to be operationally developed according to the principles of resilience.

But the meaning of resilience is not unique. In the technical culture it means the ability of the material to resist forces of change. In the humanistic psychology it means the ability to cope in a positive manner to traumatic events, to give positive answers to difficulties. These fundamental differences in the design remind the difficult coexistence of two souls, the humanistic-creative and technological one. The first aims to re-evaluate the uniqueness and specificity of cognitive systems and to explore the future to stimulate change, the second aims at hyper rationalize the existing to maximize its effectiveness. Two differences that must be read in the social reality of the modern project. As noted by Rem Koolhaas (Koolhaas 2014), we must note that the thrust of ‘fraternité, liberté, égalité’ has run out and has been replaced by ‘comfort, safety, eco-efficiency’.

Hence the urgency of the recovery of corporate social responsibility: the center of the project must be the search for the balance between values and techniques, the strategic task is the re-evaluation of values.

This involves reviewing the disciplinary structures, mainly by replacing the historical idea of projects as absolute (in the name of creativity of the architect or 'objective technique' of the engineer) with a new approach respectful of cognitive constructs, based on the iteration between users, their way of thinking and seeing humans and the built form. It also implies the transition from treating 'exclusively physical objects' to deal with interdependencies. It promises to be a very different way of observing and thinking, as there is the possibility of powering the design of physical spaces with the interdependence of these flows:

- biotic, i.e. those generated by natural resources and the atmosphere;
- the noosphere, i.e knowledge, culture and technology;
- the cybersphere, that enables connectivity and augmented intelligence.

The designer has to become both a practitioner and an internist, to manage the potential of augmented intelligence, implying a radical renewal of the professional skills (Forrester 1969).

The potential of these changes in the empirical experience is applied to the project HoF - Horizontal
farm in New Delhi, developed collaboratively by the students of the course Fundamentals of Sustainable Design at IUAV (2012/2013).

The project experiences the new design keywords, emphasizing the opportunities of new technologies and new production models, which require an initial capital significantly lower than in the past. The project thus becomes an opportunity for proposing a waterfall of creative solutions that combine the resilience with the hope of getting out of poverty thanks to the ability to use new tools and experiment new models of coexistence. The action of social responsibility that is proposed is based on investment on poor social classes, according to the lesson of Jay Forrester (Forrester 1969) in the occasion of the plan for the historic center of Boston, that is the more productive decision for urban regeneration.

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