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DESIGN FOR HEALTHCARE SUSTAINABILITY: ETHICAL IMPLICATIONS OF ECO-DESIGN RESEARCH

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ABSTRACT

The growing interest in environmental sustainability is the result of a new cultural awareness focused on the holistic conceptions of wellbeing and justice. However, this attention is also moved by economic considerations. The increasing awareness of the environmental impacts of medical treatments is a prompting example: the optimization of resource consumption and the reduction of wastes can lead to huge economic and environmental benefits. However, sustainable solutions might arise problems with regard to the patients' well-being. When talking about eco-sustainability, the ethics of design is usually considered as implicit; however, this carries the risk of not being able to create a system that is ethically right.

This study aimed to examine a practice-based approach to ethics in design projects addressing environmental sustainability in the healthcare field. Combining different theoretical approaches from bioethics, environmental and design ethics, this research determined a set of practical guidelines for the implementation and assessment of ethics into design practice.
We investigated the responsibilities of design towards all the stakeholders involved, on the basis of the Bivins' bioethical obligation items. Then, the ethical implications were analysed by the definition of possible scenarios, starting from the Triple Bottom Line theory. Starting from these scenarios, the design team was involved in internal brainstorming sessions to define the personal motivations and ethical limits within the project. This enabled the creation of a detailed set of guidelines in the form of open questions. This approach has been applied to a case study on hemodialysis sustainability, that allowed to test this ethical approach.

Keywords: environmental sustainability, healthcare, ethics, eco-innovation, systemic design

1 INTRODUCTION: ECODESIGN FOR HEALTHCARE

The growing interest in environmental sustainability is the result of a new cultural awareness focused on the concepts of wellbeing and justice in a holistic way, that identifies global sustainability as a individual responsibility (Jameton & Mcguire, 2001). However, the attention to the environmental impacts of products, processes and system, is also moved by economic considerations. The waste of resources and materials, both upstream and downstream of the usage phase, is uneconomical in the current macro and micro economic environments.

The increasing attention to the environmental sustainability of medical treatments is a prompting example: in Italy the National Healthcare Service

(NHS) accounts for 7.3% of the G.D.P. (Italy. Ministero della Salute, Ministero dell'Economia e delle Finanze. 2012). In a context of global economic crisis, the NHS is one of the earliest areas that meets budgetary cuts. In Italy, they currently total more than €6.8 billion for the 2012-2015 period (Legge 7 agosto 2012, n. 135 (Italy) 2012).

The need of reducing hospital expenditure dynamics, carries the risk of cutting across the board in public spending. This would affect the quality of healthcare services (Clemens et al, 2014), reducing the hospital bed ratio, the pharmaceutical supplies and the number of health treatments. Conversely, a qualitative vision of the subject is already endeavouring to approach economical sustainability from a point of view of selective reduction and optimisation of the resources, processes and supplies. The aim is to achieve savings while ensuring an equivalent level of quality, respectfully of the person and the environment (Evans, Hills, & Orme, 2012). The environmental awareness in the healthcare field is taking concrete form in the national and local policies that wish to foster a greater economic sustainability of the medical treatments, in the medium-long term: that concerns the promotion of proper waste sorting within the hospital facilities, (Grose et al, 2012); the implementation of Green Public Procurement schemes (Walker & Brammer, 2009); the establishment of educational programmes to train staff to behave more responsibly (Richardson et al., 2014). The scale of the objectives and the durability of results are distinctive features of an environmental approach and could positively affect the long-term economic policies.

In the European landscape, many research centres and programs are promoting sustainable healthcare. In the United Kingdom, many institute as the NHS SDU (Sustainable Development Unit, 2014) arose to promote new policy framework and sustainable development plans for NHS facilities. In Sweden, the Nordic Center for Sustainable Healthcare investigates communication and management strategies to improve social and environmental sustainability in clinical environments (Nordic Center for Sustainable Healthcare, 2014). Yet however limited, also the design research is now facing the environmental impacts of medical devices and healthcare (Agar, 2012).

When talking about environmental sustainability, the ethical value of design is usually considered as implicit in the project, however there is the risk of not being able to design a system that is ethically right. Many researches have analysed the ethical responsibility of designers in the product and system innovation (Celaschi & Celi, 2015), as well as in the filed of sustainability, where design can shift user behaviour towards more sustainable patterns of consumption (Lilley & Wilson, 2013). The ethical responsibility is all the more important when design research faces biomedical issues. Much research has focused on this topic from the educational point of view (Barakat, Sunny, & Hasan, 2014), but an alternative approach is necessary to implement the ethical approach to healthcare design.

The purpose of this study is to describe and examine a practice-based approach to ethics in design projects addressing environmental sustainability in the healthcare field. Combining different theoretical approaches from bioethics, environmental ethics and design ethics, this research determines a set of practical guidelines for the implementation and assessment of ethics into design practice. A case study is proposed to illustrate the practical application of the guidelines.

2 BIOETHICS AND DESIGN: METHODOLOGICAL FRAMEWORK

The research has started from the T.H. Bivins' (2000) ethical worksheet that provides a set of guidelines to assess the validity of different decisions in ethical matters. This approach was analysed according to the J. Elkington's (1998) Triple Bottom-Line theory, which is commonly recognized as being one of the most comprehensive definition of sustainability. The combination of the two approaches allowed to define a set of ethical guidelines to implement and evaluate ethical implications of a design project (see fig. 1).

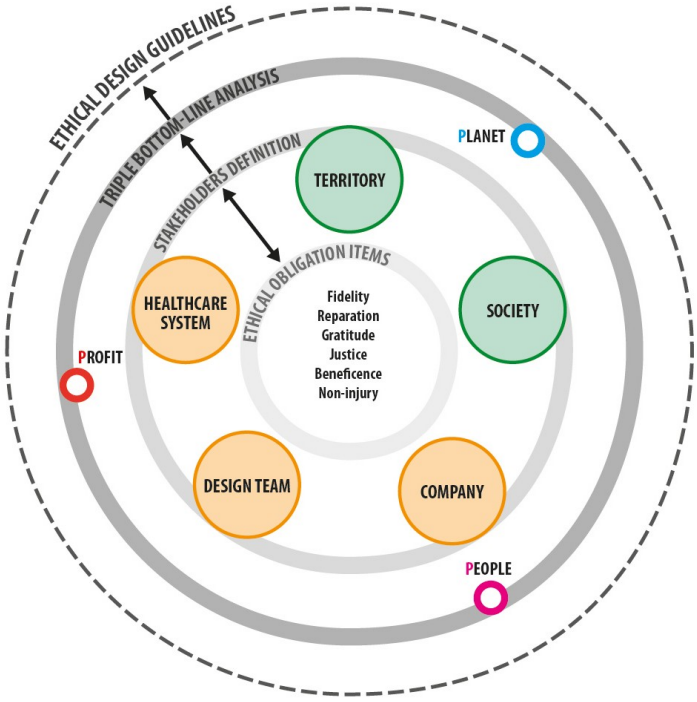

Figure 1 –Definition of a practice-based approach for ethical implementation and assessment of design projects in the healthcare field.

2.1 ETHICAL OBLIGATION ITEMS TOWARDS THE ETHICAL DIMENSION OF SUSTAINABILITY

Ethics and medicine are historically linked by the strand of research that, since the Seventies, is called "bioethics" (Potter, 1970). In the same years, the collective awareness of the environmental issues of our planet takes shape, together with the first theories of environmental ethics (Light & Rolston III, 2003). Environmental ethics and bioethics are soon characterized by mutual contamination, giving rise to different approaches to ethical decisions on environmental sustainability in the medical field: from the ethical anthropocentrism (ecosystem as a instrument for human health, according to a intra-generational and intergenerational logic) to the ethical holism (extension of human ethics to the biological community, recognizing the deep interdependence between human and planet health) as reported in the studies of Pierce & Jameton (2001) and Gruen & Ruddick (2009). Leaving aside the theoretical debate, ethics is unavoidable when the research aims to connect healthcare and environmental sustainability (Ehrlich, 2009). Justice, beneficence

and other ethical principles should be considered not only in the medical researches, but also in interdisciplinary studies facing design issues in the healthcare field.

The current investigation started from the methodological definition of T. Bivins (1992) and his ethical worksheet (Bivins, 2000), in order to define the ethical responsibilities of the main stakeholders involved in the design process, according to six fundamental ethical obligation items:

1. Fidelity (respecting the implied or express promises/contracts that links two or more stakeholders);
2. Reparation (correcting errors or compensating for damage caused by one stakeholder);
3. Gratitude (being grateful for something one of the stakeholder did for another one);
4. Justice (balancing roles and actions according to a merit scale);
5. Beneficence (defining who or what needs to benefit from the project);
6. Non-injury (avoiding harming anyone unnecessarily).

These six items are the basis of the ethical relationships among all the stakeholders: for each of them is important to understand which obligation items are prevailing and to whom they are addressed. This allows establishing the ethical priorities and understanding the relationships of subordination, cooperation or antagonism that could exist within the project.

2.2 TRIPLE-BOTTOM-LINE APPROACH TO ETHICAL SCENARIOS

The following step, according to ethics approach, is the definition of alternative courses of actions and of the best- and worse-case scenarios that these actions would cause. The goal is the definition of possible practical scenarios, in which different values and actors are prevailing. In order to pragmatically state the possible design choices, specific criteria for comparison were defined: this avoids simplistic scenarios that would split ethical consequences in sustainable (best case) or not sustainable (worst case). The starting point was the design principles that define the sustainability of a product, service or system. The Triple Bottom Line theory (Elkington, 1998), borrowed from economics and established in the field of sustainable design and production (Lee et al, 2012; Gimenez & Tachizawa, 2012), is especially well suited and versatile, because it puts into relation the three main aspects (the 3Ps) that determine sustainability:

— People (having responsibility of the people involved, and widening communities in which the project takes place);
— Planet (adopting sustainable environmental practices in order to minimize the environmental footprints of the project);
— Profit (designing a project that is economically sustainable, also including external costs).

Analysing the project according to the 3Ps, it is possible to define its ethical risks: this is not just a concept of presence-absence (full compliance or total default of the social, environmental or economical parameters), but it means to explore the ethical consequences of a shift in favour of one of the three aspects. Taking into account the ethical implications of this unbalance allows the definition of practical and feasible scenarios, which immerse designers in real situations, enabling an assessment of the potential ethical consequences of their choices. The goal of 3Ps balance must be shared by all the stakeholders directly

involved, also having regard to the role of the indirect stakeholders: the creation of a document of ethical guidelines, up-stream the design process, is an important tool for guiding the design choices (combining environmental care with social wellbeing and economic sustainability) and then for validating the intermediate/final results.

3 BIOETHICAL APPLICATION TO A PRACTICE-BASED DESIGN RESEARCH PROJECT

3.1 THE ECODIALYSIS PROJECT

The present analysis methodology has been applied to an existent research project: the EcoDialysis Project (Barbero et al, 2014) is carried out by the Department of Architecture and Design of Politecnico di Torino (Turin, Italy), in collaboration with the S.S. Nephrology of the San Luigi Gonzaga Hospital (Orbassano, Italy), and it involves an interdisciplinary team of professionals, aiming to improve environmental sustainability of dialysis treatment. Chronic hemodialysis is one of the most expensive medical treatments both in terms of resource consumption, wastes production and costs of care (Agar, 2012; Ferraresi et al., 2013). In many cases the choice of eco-friendly products and processes generates economic benefits. This is all the more the case in the medical field, in particular in nephrology: the optimization of water-energy consumption, but also the up-stream reduction of wastes (particularly with regard to the biomedical ones) can lead to massive economic and environmental benefits. However, many sustainable solutions might arise problems from the point of view of the patients' well-being, such as the controversial issue of the reuse of dialyzers and others medical devices (Rocha et al., 2014; Lacson & Lazarus, 2006). The complexity of this issue requires an interdisciplinary response: the cooperation between medicine and design aims to address environmental sustainability in different time horizons, providing a new holistic approach (Bistagnino, 2011). Many researchers belonging to different disciplines (medicine, design, engineering), hospitals and companies are involved, in order to draw up a multidisciplinary work program that can meet the needs of different stakeholders and face complex issues. The research requires the investment of economic and human resources and a cognitive effort for changing perspective in design (interdisciplinary approach) and behaviours (actions and treatment strategies with focus on the process sustainability). The pursuit of environmental and economic sustainability in hemodialysis treatments fits into a particular social context, such as a hospital, where doctors, nurses and, indirectly, patients are involved. The effort required and the sensitivity of the context in which the project is found, call for careful reflection on which ethical responsibilities the project took on: is the risk-benefit ratio ethically acceptable? Who are the stakeholders involved? What possible benefits or harms can be drawn? These are the questions to which this study has sought to provide answers.

3.2 STAKEHOLDERS' ETHICAL RESPONSIBILITIES

The first step was the definition of the stakeholders involved in the EcoDalysis project (see fig. 2), dividing them into five main categories; they include both the stakeholders directly involved in the project, and those who had an indirect role (related to the project outputs):

— Design Team: This category includes the professionals who make up the interdisciplinary design research team (designers, engineers, doctors and nurses).
— Healthcare System: it is the hospital and its administration, representing the NHS within the project.
— Company: it represents the biomedical company involved in the project and its economic and productive interests.
— Society: it includes the current and potential patients, which are the catchment area of the local hospital.
— Territory: this category includes the national and local institutional actors who have the task of preserving the local ecosystem.

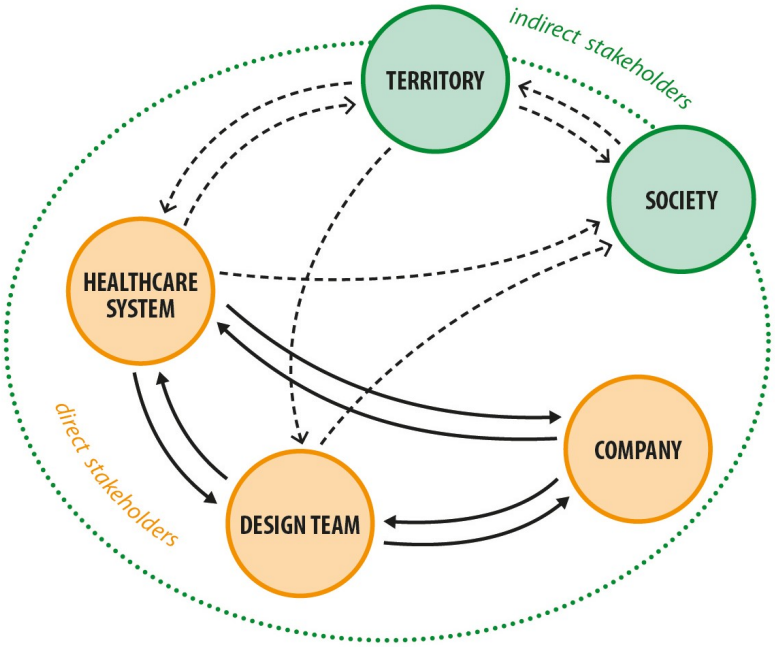

Figure 2 – Relationships among the stakeholders involved in the EcoDialysis project

Once the macro-categories have been detailed, a specific set of requirements and its associated bioethical obligation items have been defined for each stakeholder (see Table 1), according to the six principles highlighted in the ethical worksheet of T.H. Bivins (2000).

OBLIGATION ITEMS	DIRECT STAKEHOLDERS			INDIRECT STAKEHOLDERS	
	Design Team	**Healthcare System**	**Company**	**Society**	**Territory**
Fidelity	X	X	X		
Reparation					X
Gratitude	X				
Justice		X			

Beneficence	X		X	X	
Non-injury				X	X

Table 1 – Obligation items that are driving the stakeholders' ethical behaviour

3.2.1 ***Design Team***

The motivations driving the researchers of the EcoDialysis team were different since interpreted according to different cultural background: from the interest towards innovative experimentations, to the optimization of management, to increasing the economic sustainability of health processes. Although this diversity of approach, the common ethical responsibilities that guided the design team, focused on the principle of widely extended beneficence. This includes the benefits for present patients (by the hospital service) and for the future ones (preserving the ecosystem in which we live, that is considered as a basic factor in the pathogenesis of many diseases). At the same time there is a relationship of fidelity among the team members who decided to work together, and the implementation of commitments made to the hospital (disseminating the results and improving the sustainability of hospital treatments) and to the companies involved (providing concrete results in the field of biomedical innovation).

3.2.2 ***Healthcare System***

The ethical principle driving the Hospital administration's decisions in the project is the distributive justice: the economic and professional efforts aimed to pursue a fair and appropriate distribution of health services among the final beneficiaries. The decision to take part in the project arose from a personal feeling of the management team, but it is ethically bound to a long-term return by reducing waste and increasing savings. This would create new economic resources to be used for improve the quality of healthcare services. A relationship of fidelity exists between the researchers and the hospital, which takes the form of an employment contract between the NHS and the individual researcher. It is based on a meritocratic basis and provides for freedom of scientific inquiry, in accordance with the professional and ethical duties, resulting from the work contract and the control bodies.

3.2.3 ***Company***

The biomedical company has established a relationship of fidelity with the researchers, based on the interest in the project with a view to the benefit of itself and its users. The companies' goal is to anticipate users' (patients, health professionals, health administration) needs and meet their demands: in this case the extension of beneficence to as many users as possible is determined by economic interest, aiming to bring financial returns for the company.

3.2.4 ***Society***

Society, formed by current and potential patients, played an indirect role in the project as it interacted in a partial and limited way, without directly made its point of view known. However, it is the final beneficiary of the project and it is a

key player within the project. It is driven by the principle of extended beneficence, based on the request for adequate treatment of diseases (in this case the support of renal function) and the prevention of future disease. So the project should maintain the treatment quality (non-injury principle), acting to optimize resource consumption in order to allow hospitals to implement the service and prevent the environmental diseases.

3.2.5 ***Territory***

The territory, and the civil actors involved in its management, has had an indirect role in the project but it is the basis and the consequence of the project itself. The prevailing principle is the non-injury, for instance avoiding or minimizing the impacts caused by medical treatments in terms of resource consumption and waste production. The project is part of a global context in which we act to repair the damage caused to the ecosystem by human activity, knowing that the local actions have a deep impact on the global system.

3.3 POTENTIAL FUTURE SCENARIOS

Stakeholders interact with one another according to different decision-making hierarchies and to their ethical responsibilities. This set of relationships determines the design scenario (Lehoux et al., 2014), its internal dynamics and its external repercussions. Because of the complexity of the sustainable system that the project aims to realize, it is difficult to envisage a realistic scenario that is entirely positive or completely negative for all the stakeholders involved. The use of an ethical assessment, starting from the Triple Bottom Line theory, allowed defining three different scenarios that highlighted the risks incurred by the project when the economical, environmental or social values are prevailing.

3.3.1 ***First ethical scenario: Profit***

In the first scenario, the EcoDialysis project focuses on the economical value, designing environmentally sustainable products and system, which would make it possible to drastically reduce resource consumption, waste production and operating costs.

Thus, the system is able to maximize industrial competitiveness and the company patents it. Among the advantages of this scenario, it is to be stressed the "attractive sustainability": the economical benefit is an incentive for the company (and its competitors) to support research on environmental sustainability in the healthcare field. Also hospitals have a twofold benefit in the supply, which is cost-effective and environmentally advantageous. Instead, problems include the fully appropriation of the know-how by one private stakeholder: this limits the spread of knowledge and so the diffusion of a sustainable designing approach to healthcare.

As a consequence, the principle of beneficence is thought of in the order of sustainability/consumption binomial: economical and environmental advantages are provided only for those who would buy the system; expertise and benefits are not shared with the social community in its broadest sense. Finally, if the maximization of revenues is prevailing, there is a high risk of externalization of costs: in that way the eco-sustainable system would not take into account the social and environmental externalities of its life cycle.

3.3.2 ***Second ethical scenario: Planet***

In the second scenario, the project aims to minimize the impact on the ecosystems in all phases of the life cycles of its components, it would indeed compensate the environmental burdens and internalise all the external costs.

An advantage of this approach is the great environmental sustainability of processes and products, which would take the form of reparation and prevention of the damages caused by the medical treatment. The project is "environmentally significant" (Stern, 2000) as it is a best practice in the field of zero-impact systems. However, the lack of attention on economic sustainability (and the unavoidable trade-offs that the market demands) makes the system not easily feasible in large-scale production: if the best practice has not spread, it is "environmentally not relevant" because it is not capable of generating the environmental benefits that a massive change of perspective could cause.

Finally, if the social aspects of this issue would be neglected in favour of the environmental ones, there would be a huge lack of people's awareness: beyond the sustainability of the project, it is essential to promote the very concept of sustainability among the users, through communication strategies and interacting with eco- products and services (Daae & Boks, 2014).

3.3.3 *Third ethical scenario: People*

The focus on the social aspects of the project would lead to the creation of a new system based on the education and protection of the individuals involved in the supply chain. The prevention of diseases from environmental pollution is one of the main objectives to be achieved (Prüss-Üstün & Corvalán, 2006; Weidner, 2012); as well as the reduction of the environmental issues that cause them (air emissions and other pollutants) is one of the main criteria of assessment of the results.

The preponderance of social values leads to widen the concept of beneficence both to local and global population, with positive effects in education, employment and social health. In common with the "Planet" scenario, the lack of attention to the economic features of the project makes it a great best practice, but it would not be feasible in large-scale production. It is therefore an "environmentally significant" case study for the users involved (Steg & Vlek, 2009) but its inimitability reduces the environmental benefits.

Finally, while people are an active and vital part of the environmental system, overlooking the holistic vision that connects society and territory, means give to the environment an instrumental value: cognitive and behavioural efforts are required to users towards the ecosystem (Faunce, 2012), without this the environmental significance of the project loses effectiveness.

4 DEFINITION OF THE ETHICAL DESIGN GUIDELINES

The three scenarios demonstrated the ethical potentials and criticalities of the set of relations within the project. It was necessary to define them in order to reach the balance between economical, environmental and social values. However, this preliminary analysis of risks could not be considered sufficient to ensure the pursuance of ethical choices. So the last step was the definition of ethical guidelines, which pose concrete questions for providing tangible answers, in the different stage of the design process.

Starting from the previous scenarios, the design team was involved in internal brainstorming sessions to define the general motivations and the personal ethical limits within the project. This enabled the creation, with the support of an expert in bioethics, of a detailed set of guidelines in the form of open questions. The table below (see table 2) shows the three principles of project sustainability and the related macro-goal; for each one of them, some guideline-questions were posed in order to get the proposed goal. A set of sub-questions drove the design team in replying to the main questions.

PROJECT SUSTAINABILITY PRINCIPLES	KEY-QUESTION	SUB-QUESTION
PROFIT *Goal: Distributive Economic Sustainability*	Is the project replicable?	What economical efforts are required? What cognitive efforts are required? What is its potential scale of diffusion?
	Are the proposed solutions cost-effective?	How much is the saving in the production phase? How much is the saving in the consumption phase? How much is the saving in the disposal phase? Are the external costs taken into account?
	Is the know-how shared outside of this project?	Is it possible to share knowledge about the current State of the Art? Is it possible to share the design process steps? Is it possible to share the final results? Is it possible to share the final data of products/services? Are data, studies, reports and good practices provided as open-access?
PLANET *Goal: Systemic Quality*	What is the contribution of the project to the reduction of environmental impacts?	How much does the system reduce the waste production? How much energy does the system save? How much water does the

		system save? How much raw materials does the system save?
	What are the main benefits for the environment?	How much can the system reduce air emissions? What are the benefits for the local territory? What are the benefits for the territories in which the system's components are produced?
	Does the system promote systemic awareness?	Is the linkage between man's health and planet health promoted? In what way?
PEOPLE *Goal: Centrality of the Person*	Who benefits from the project results?	What impact has the system in the societies where the system's components are made? What impact has the system on chronic patients? What impact has the system on the healthcare staff? Will anyone be harmed by the project's results?
	Does the system promote sustainable behaviours?	What cognitive efforts are required to patients? What cognitive efforts are required to healthcare staff? Are popular channels used for disseminating the project?

Table 2 – Design questions to define the ethical guidelines

This guidelines document is, in turn, an important tool to brainstorm the main ethical issues and limits that a project may face. It has to be stated upstream of the design phase, then it is useful to carry a mid-term and final evaluation. This enables to understand ethical pros and cons that the team is fronting or could challenge in the future. The use of shared assessment tools is important both from an ethical point of view and in terms of 360-sustainability, in order to share expertise, foster new behaviour, and create eco-innovative products and systems.

5 CONCLUSIONS

The ethical design evaluation, shared by all the team involved in the project, allowed to set specific aims of sustainability, justice and extended beneficence. The previous analysis of potential scenarios showed that the contribution of companies is essential but at the same time it may impose limitations in sharing know-how and best practices (Wong & Noe, 2010).

The sharing of goals and limits is a common action in the relationship between designers and companies: the extension of this action to ethics is an innovation in Corporate Social Responsibility, especially in a cross discipline context. In addition to taking the project briefing into account, the ethical brainstorming allowed to freely share motivations and expectations and develop a common vision of ethical issues. This is essential to set effective limits for pursuing environmental and economical sustainability without undermining the patients' beneficence.

There has been a particular focus on knowledge sharing that is one of the key-elements of research. The dissemination of results offers the opportunity for dialoguing with scientific community and users, deepening questions, needs and promoting a new ethical and sustainable approach to design. Raising awareness and interest in these topics means to open a new promising market, even for the innovations realised within the project (Connor, Mortimer & Tomson, 2010). In this sense, the ethics of design could become a tool to boost and implement the corporate ethics (Stevenson, 2013), looking at emerging issues: the sharing of data; the use of informal channels to share know-how; the definition of instruments to internalise external costs.

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