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INFRASTRUCTURING KNOWLEDGE AS PARTICIPATORY INTERVENTION
TECHNOLOGICALLY ENHANCED ENVIRONMENT

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Abstract

Over the last twenty years, Digital Interactive Technology (DIT) has been extensively introduced in museum contexts. Providing guidelines for aware introduction of DIT in museum, this thesis aims to encourage a participatory experience regarding the creation of knowledge in museum.

Believing that creating knowledge is a complex process that simultaneously involves multiple actions, actors, actants, and situations, I adopt the concept of Infrastructuring Knowledge *for describing the participatory dynamics among human and technology for creating knowledge and for museum to be places for memories, amusing and sharing experience.*

Ethnography in museum environment provides first hand information for understanding the museum visiting experience. Such understanding provides three key stimulus for DIT to Infrastructuring Knowledge: firstly, stimulating people's dialogue; secondly, supporting people's cooperation and participation by providing occasions for sharing information and creating knowledge; thirdly, people re-frame the use of DIT when needed.

Designing DIT for museum may follow some specific lines and principles for addressing challenges related to overwhelming and overstimulating spaces, and for promoting a sustainable future in respect of the production (or not) of new technology. Following lines and principles for reacting to the overwhelming and overstimulating adoption of technology in public space, I propose an -ing approach to design. This approach aims to stimulate a design for people to adopt a subjective and participatory interpretation of Digital Interactive Technology.

Keywords
[Interaction Design, Museum, HCI, Infrastructuring Knowledge]

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Preface

This thesis is the outcome of combined theoretical and empirical studies on the pervading contribution of Digital Interactive Technology (DIT) to trigger information, support knowledge, improve social life. A critical topic for the Human-Computer Interaction community lays on interactions among DIT, humans, and context. Very often research discourses focus on designing new technologies rather than on ways people potentially can re-interpret, use and adapt DITs for their needs. In this direction, this thesis provides an interpretation of design that aims to encourage participatory and interpretative interactions among people. Underlining the dynamic features of interpreting technology, this interpretation of design stresses the **-ing** side of people's interactions. This interpretation of design is informed by an ethnography conducted at the Museum of Science (MUSE) of Trento. At the MUSE, I could observe how DIT potentially enhances and challenges interactions among people and I could develop some guidelines for designing DIT to collaboratively interpret information.

Working at the museum was a wonderful professional and human experience. For this, I shall thank the visitors with whom I talked and from whom I learnt a lot; the Pilots of the museum, who are brilliant scientists and people; and, the museum management, particularly represented by Rosaria Viola and Samuela Calliari.

However, this thesis wouldn't be like this without numbers of talks and discussions with researchers with very different point of views and backgrounds. I may thank: Lily Diaz, from whom I got to know museums from the very inside; Jesper Simonsen for informal chatting and for having organized Designing Human Technology - Summer School; Judith Gregory and Geoffrey Bowker for precious hints; Bonnie Nardi for inspiring to use "technology with heart". I should thank my colleagues and my desk mates for the coffees and the useful discussions; special thanks go to Giacomo Poderi, Michela Cozza, Cristhian Daniel; to Jyrki Messo and Mariana Salgado; to Sen Hirano, Lynn Dombrowski and Six Silberman. Last but not least, my advisor, for having advised me and for letting me to learn to deal with flexible time-schedules.

Of course, other people in a way or another helped me to finish this doctorate, and since they know how much they did for me they can share all my happiness and smile.

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Chapter 1

Creating Knowledge through Technologically Enhanced Environment (TEE)

> [...] Kindness and good nature unite men more effectually and with greater strength than any agreements whatsoever [...].
>
> ———————————————
>
> Thomas More - *Utopia*

A big question I have in mind is about understanding if/how/where/when new technology is pushing us - humanity. A question like this is more *science-fiction* than actual research. Thus, I shrink my research question in a smaller box, and focus on designing Digital Interactive Technology (DIT) for people creating knowledge in museums Technologically Enhanced Environment (TEE). For identifying guidelines for designing DIT for TEE, I conducted my research with the aim to understand the role played by DIT in supporting the creation of knowledge in museums. In this direction, I identify an interpretation of interaction design that I will present as -Ing design.

The focus on museums comes from the current extensive introduction of a broad variety of DIT in museum spaces, meant to engage visitors and to improve the educational and amusement purposes of museums.

This first chapter introduces the research frame I am diving into, my research interests, and concludes describing the structure of this thesis: the following section synthesizes the discipline of Social Informatics focusing

on the importance of computing and information technology; therefore, the chapter follows with the introduction of the core issues related to knowledge, TEE and sustainability, and design (a theme I delve into Chapter 2). The chapter concludes with a summary of the structure of the thesis.

1.1   Dealing with computing and information research

Nowadays, questions about the implication of technology in human's life are flying around academics. Importantly enough for dealing with this kind of questions, the implications of social changes, related to the computerization of society, spread across environments, context, people and research disciplines. Moreover, the implications of the computerization of the social life rise questions related to the affection of Information Communication Technology (ICT) in respect to sustainability, design, and, broadly speacking, policies [Kling et al., 2005, Kling, 2000, Fry, 2009, 1999, Tomlinson, 2010, Bardzell, 2010].

Welcoming multidisciplinary questions in the direction of understanding and (re)designing computerized environments has been the base of the Social Informatics (SI) discipline that, indeed, investigates the implications of design, development and the use of ICT into a societal context.

SI brings together different areas of human life and, of course, research. Since 1996 when research debates and workshop discussions brought the term *Social Informatics* to the academic world, the interest on this field of study indefinitely increased and spread over the countries stimulating the foundation of new research groups with new research interests [Kling, 2000]. This discipline refers to a body of knowledge based on empirical research and keen on investigating the effects of ICTs on social behaviors of significant aspects of human life. Of course, SI research evolved during the years involving a great variety of aspects of individual and social life, while the first epoch of SI focused on organizations where ICTs were mainly introduced and used in the last decades of the 20th century. Nowadays, SI focuses on the creation of ICT for differentiated areas of people?s lives.

Moreover, the role of ICT as a research topic and as a research tool is also relevant for the evolution of SI itself For instance, more than often,

ICT facilitates the collection and the creation of data, and supports the transformation of data (*information*) into knowledge [Hakken, 2003]. In fact, computing technology intervenes in dynamics of social and cultural preservation and regeneration providing spaces for increasing amount of differentiated contents while creating occasions for people to create a network for making sense of *raw* data. In this direction, ICT provides new ways and opportunities to impact cultural reproduction. Thus, while *information systems* and the *cyberspace* represent the evidence for networking information and support for creating knowledge, **DIT** happen to be more than tools for storing raw data. In this context, I refer to DITs as computing enhanced objects *"with some level of interactivity"*, [Stolterman et al., 2008].

DITs embed potential, in-time and contextualized actions for supporting people's participation to the creation of knowledge. In this respect, DITs have a core role in stimulating and supporting people's actions for improving the present and looking forward to the future. The effects of current DITs on the future can be considered in relation to the sustainability of designing and using technology [Fry, 2009]. However, as Tomlinson [2010] underlines the most problematic aspects of discussions about sustainability are about *"comparing the impacts of different types of actions"*. Following Fry [2009] and Tomlinson [2010], the sustainability of DIT deals with culture, knowledge and practice. Certainly, interrogations about sustainability are countless and might touch several aspects of knowledge issues, nevertheless linked to the productive and economic process [Knorr-Cetina, 1981]. Thus, willing to overcome the current economical distress around knowledge *creation*, I attempt to disentangle the process of sharing and creating knowledge in the specific context of museum, an environment that over the last ten years faced a quite substantial *technological evolution* (see Chapter 3).

How does knowledge occur in museums? Which kind of context is the one of museums? Who participates in creating knowledge in museums? Which are the dynamics that influence the creation of knowledge? Does the design of the environment influence the creation of knowledge? These questions, taking into account the role of DIT in mediating, stim-

ulating, motivating, or even interrupting interaction, aim to unpack the following research question:

> *How to design DIT for actively supporting the creation of knowledge in public environments?*

Going through the above questions provides understanding for informatics researchers and interaction designers to responsibly foster upcoming opportunities for designing - or not - DITs. The massive and pervasive incidence of DITs in people's everyday life stimulates and encourages an increasing number of scholars to investigate the long-term effect of the frenetic phenomenon of designing and producing new technologies [Fry, 2009].

While this first section builds on the overall frame of discussion for this thesis, the following sections focus on the concept of knowledge and on the conceptual tools that I adopt to go through the research question above.

1.2 Attempting knowledge

Knowledge is a complex domain that matters and crosses different disciplines. Researchers adopted multiple theories and concepts such as *boundary objects*, *actor network*, *intermediary objects* for dealing with social processes that happen among people, technology and context. Looking at knowledge as a social process intersects features that I hereby describe through the notion of *Infrastructuring*. In this direction, Infrastructuring Knowledge (IK) links together physical and tangible aspects of knowledge and, values, cultural and social features.

Discussing the topic of knowledge in the context of museum field, frames the topic in a specific social environment that became increasingly open and inclusive over the last three decades. The combination between social changes, the increasing development and introduction of digital interactive technologies, digital platforms and information systems extend the museum possibilities, potentials and perimeters. Hence, the concept of *Infrastructuring* helps to clear the relationships and mutual influence among humans, DIT and the context. This concept emphasizes the interrelation and mutual affections between different elements that concur to the creation of knowledge during a specific time and in a specific space. More

specifically, *Infrastructuring* refers to processes, actions and dynamics of the *Infrastructure* that happens to be a changing and evolving *thing.* Thus Infrastructuring refers to *"thing and on strategies for making this thing public"* [Ehn, 2008] and to empowering connections and participation among agents and, the so called, *actants* in a specific context. Even though the term actants describes *"something that acts or to which activity is granted by others"* [Latour, 1996], I shall underline the involvement of people in the creation of knowledge through the use (or not) of DIT. In this respect, *Infrastructuring* is about enacting the infrastructure itself. Therefore, *IK* intersects the ability and the power of creating knowledge *in* and *through* infrastructures, and of people being part and participating within museum activities.

My understanding on knowledge suggests to consider this topic a universal and inclusive effect of human beings, with personal and collective intellectual abilities and skills. Should we consider this as Utopia? Can knowledge be such a thing that is or can be universally and equally distributed and improved?
The concept of Utopia embodies the issue of collective participation for the creation of knowledge. Thus, I dare say that IK can be described as the outcome of people participation and example of *"extraordinarily modest, [...] no artifice, and yet [...] prudent simplicity"* [More, 1516]. Moreover, participation and extraordinary human qualities introduce the discussion in a frame of references that include equal opportunity and equal rights among people to share knowledge as an example of commons. The concept of IK inscribes a variety of features related to the fact that knowledge and information are sources that belong to everyone [Hess and Ostrom, 2007] and, that are affected and influenced by each other's participation. Commons is about an inclusive assignment of resources; and turn from the market paradigm into a social and shared ownership of resources [Bollier, 2007]. The subject of commons is a diverse and dense set of resource systems and units that include *the* knowledge. Discussions and investigations about knowledge as a commons, intersect human and non human resources that Hess and Ostrom [2007] describe as: *facilities*, *artifacts* and *ideas*. In the authors' description, knowledge is made by a physical and/or digital

context for storing artifacts. Knowledge artifacts are *"discreet, observable, namable representations of ideas"* that might be books, digital files, maps, web pages [Hess and Ostrom, 2007]. Additionally, the represented ideas are intangible concepts, mental images, visions, and information.

1.2.1 Knowledge as contextual: the discourse of museum

As introduced previously, I approach the concept of knowledge as a contextualized, ongoing and in-time *realization.* I share David Hakken's opinion about the *"social process through which something becomes acknowledged as known"*[Hakken, 2003]. Thus, the focus is on the participatory process of sharing knowledge and creating knowledge through interactive technologies.

When thinking about computing environments, there are uncountable ways and methods and techniques for making something *visible.* Moreover, relationships between people and human practices blur with DIT occupying an influent role in the creation of knowledge and configuring the space as a TEE.

Academic interest on the implication DITs in our society spreads across communities, including theoretical approaches that support shared analysis of people and technology participating to the sustainability - *reproduction* - of society. Therefore, research fields on museums are extremely polyhedric and conducted under multiple lights. Multiple extended projects include *the* design, *the* production and *the* introduction of ICTs and DITs in the context of museum (see Chapter 3), that aim to amuse and entertain visitors [Schavemaker et al., 2011]. Additionally, a variety of projects are meant to stimulate the participation of visitors to the creation of virtual and non virtual exhibition (see for example the work on virtual exhibition by Ciolfi [2013] or the participative exhibition design experiences described by Simon [2010]).

An increasing interest is moving around the museum topic for several reasons that we might connect to the openness of the modern concept of museum [Bennett et al., 1996, Fisher, 1996] and to the possibilities for researchers and designers to use museums as experimental environments [Bennett, 2005, Macchia and Salgado, 2014]. And this work examines the

dynamic for sharing and creating knowledge between people in the context of museum.

Still, through uncountable ways and forms, museums have the responsibility to maintain and preserve culture, and to stimulate the creation of knowledge [Bennett, 1995]. Moreover, these institutions are challenged to follow the changing rhythm of an historical moment in which computing and evolving media pervade the everyday life modifying and influencing traditional and new platforms for stimulating and triggering knowledge.

Museums are involved in a *technology rush*, visitors and museum staff are participating in creating and sustaining knowledge that in many different cases can be supported (...or not?) by the introduction interactive technologies. Interactive technology, as considered in this work, is everywhere, it exists, has a form, a time, and a reason for extending human capacity [Gibson, 1986, Latour, 2002]. According to this description, interactive technology enables and allows a connective experience.

This work is about tracking node paths for looking at the *creation* of knowledge as in-use and everyday and while-using design. Reasons for emphasizing features of *making* and *crafting* as essential activities for *creating* knowledge focus on people's competences and skills of making of everyone the author of each other knowledge. Creating knowledge, implies embedded and contextualized experiences, skills, and competences, that through common and shared practices produce novelties [Corò and Micelli, 2006]. Thus, *design* and *knowledge* refer to the complex and potentially collective action of sharing knowledge for looking at things through new perspectives and create novelty. Thus knowledge is a commons that belongs to everyone and that silently carries a *sustainable* future.

The concept of sustainability commonly refers to desired and desirable futures that are informed by a comprehensive overview of collective and integrative actions, rather economical, social, technological and ecological [Robinson et al., 2006]. In such terms, sustainability is hanging around with development and, in the beginning of 1980s, recalled and emphasized the struggle of connecting *"environmental concerns about the increasingly evident ecological consequences of human activities and socio-political concerns about human development issues"* [Robinson, 2004].

In a different way, we can adopt the concept of sustainability, as well, in

relation to the constant creation of knowledge that we can make through multiple channels.

1.3 DITs for TEE and sustainable design

The concept of sustainability fits with the need to look at Infrastructuring Knowledge (IK) as a process that interweaves human, technologies and environment.

IK address an enduring construction of a basic need for integrating and sharing knowledge for combining idiosyncrasies over people with different expertise and competences. The concept of *sustainability* moves steps further from the relation to conservation and balance of resources for avoiding resources depletion. Rather, sustainability refers to the need to incorporate and embed new forms of resources and knowledge frames, for contributing to the general wellbeing, affecting future changes. In this respect, sustainability refers to multiple aspects of everyday life and social changes, including economical and environmental changes, or else technological and educational [Reed, 1996, DiSalvo et al., 2010].

Following the map proposed by DiSalvo et al. [2010], this work shares the principles of *sustainability* as a conceptual tool for rethinking the role of design. DiSalvo et al. [2010] identify a cluster of research on sustainability that set methods and approach applied to interaction design. In this cluster of application, designers are actively involved in reducing *waste* and designing, otherwise, endurable products, meant for avoiding immediate dissipation and contain the effects of *"built-in obsolescence"* [Woolley, 2003]. As Woolley [2003] underlines, several products have a life-span of five years that dramatically impacts the innovation cycle.

Similarly, the idea of *disposable* knowledge - or quick-term knowledge - reflects the effects of built-in obsolescence. However, I rather prefer to allude to the overload of information. For instance Hakken [2003] refers to a *"wider access to an increasing number of information sources"*. And, Bawden and Robinson [2009] refer to *"a much more rich and complex information environment"* that, providing different information through various channels, causes anxiety and what the authors called *"the para-*

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dox of choice". The *"paradox of choice"* includes the concept of information overload, that describe a deficit of efficiency for using in a relevant and useful manner the information available. However, Hakken [2003] and Bawden and Robinson [2009] mainly refer to the web sphere rather than to a physical *off-line* context. The *"paradox of choice"* and the overload of information link also in our everyday environment. In this frame, relating to the overload of information is a stimulating challenge in relation to the theme of IK.

IK relates to the inclusive and relevant role played by the introduction of Information Communication Technologies (ICTs) in our everyday life that amplifies both, the production and the access to Knowledge. Additionally, Interactive and ICTs impact and inform the way in which people relate, share and create Knowledge. In this respect, there is the need for examining and analyzing the involvement of interactive technologies in connecting people and generating fertile ground for sharing expertise, experiencing and understanding. In this respect, we look at TEE as potential stimulator and conductor of sharing knowledge.

1.3.1   TEE and the ecology of technology

For designing and coordinating DITs for a specific space, there is the need for understanding the relationship between human and interactive technology in respect to the environment. Hence, the core idea that interweaves this approach more than designing something new, refers to the interaction and the ways to design and introduce DITs into a specific environment [Kaptelinin and Bannon, 2012].

Kaptelinin and Bannon [2012] discuss about the tie connection that exists between the design of the space, the human communication and interaction. In other words, the two authors argued about the need for an *"ecological turn"* in the field of interaction design, emphasizing a co-relation between space, artifacts, practices and people. In these terms, Kaptelinin and Bannon [2012] and Nardi and O'Day [1999] highlight and take into account the ecological perspective for discussing interactive technology. This perspective focuses on the potential nature of technology and emphasizes the meaning of *enhanced activity spaces*. Interactive technologies stimulate

and allow transformations on the interpretation and use of a space through situated configuration of technologies.

What is called *ecological turn* deals with a vision of interaction design that faces and explores strategies and methods for introducing and using interactive technologies while improving possibilities of a specific environment and encouraging different vision about it. The different vision and interpretation of the space is rather possible since

> *"people are adaptable and resourceful creatures - they invent many workarounds and quick fixes to problems, and then forget they invented the workaround."* [Holtzblatt and Beyer, 1993]

This discussion related to TEE takes into account the potential space changes embedded in interactive technologies: the embedded changes in DIT are about the support provided by technologies in structuring and probing activities in the space. We can comment that every space is an *"opportunity space"* [Hornecker et al., 2006] that has potential for augmenting and enhancing common and recognized practices. The concept of *"opportunity space"* supports and helps designers to understand the implication of introducing interactive technology spaces where embedded opportunities - in terms of relationships and values - provide a new interpretation of the space itself. Meanwhile, the concept of TEE includes a likely change and potential re-configuration of the organization of the space, and describes the space as active here and now because of people and of technologies. In some respect, a concept of TEE inscribes a reinterpretation of a *place*. There is a moment in which a *space*, provided by things and objects and perimeters, becomes a *place*, since the space become alive, reinterpreted and reconfigured by people [Harrison and Dourish, 1996, Dourish, 2006, Binder et al., 2011]. TEE is about integration of practices and construction of new configuration of the space.

In relation to the discussion on designing DITs for TEE, there is an increasing need for combining research and design for responding to design challenges and grasping new opportunities for the future Bærenholdt et al. [2010], Cross [2006, 2001], Lawson [2005]. However, the discussion about design is not only a matter of knowing but also a matter of doing.

1.3.2 Design and the ecology of DITs

From a personal point of view, intersecting and crossing design and research is very often about mediating dialogue between two voices. This is because both research and design are *ways of knowing* in the first case about *"natural world"* and in the second case about the so called *"artificial world"* [Cross, 2006].

In this context the Participatory Design tradition embeds the interrelation between research and design, while emphasizing mutual competences and responsibilities for looking at the future. To go through this thesis, I adopt a Participatory Design theoretical framework, based on an evident and manifested political implication [Ehn, 1992] of equality and social inclusion. In this perspective, Participatory Design provides an intellectual framework for informing the discussion on IK. Participatory Design is described as

> *"a process of investigating, understanding, reflecting upon, establishing, developing, and supporting mutual learning between multiple participants in collective 'reflection-in-action'. The participants typically undertake the two principal roles of users and designers where the designers strive to learn the realities of the users' situation while the users strive to articulate their desired aims and learn appropriate technological means to obtain them."*
> [Simonsen and Robertson, 2013]

Moreover, Participatory Design focuses on the relationship between people and DIT, which is the effect of re-configuration and re-interpretation of the hierarchical vision of organizations. Thus, the Participatory Design supports and serves as an intellectual tool that describes and inscribes the notion of power in the mutual process of making knowledge in a TEE.

The process of understanding and figuring out how knowledge arises in Technological Enhanced Environment, points out some main key elements that contribute in terms of: (1) **methodology** for the study of TEE; (2) **understanding** of the connection between people, digital interactive technologies and context; (3) **design** as an activity that goes together with

everyday life and is a contextualized experience for IK. In this context, this research contributes on two main directions: on one side, in terms of methods and methodologies applied in the context of museum rather other cultural institutions; to the relation between human and technologies; to provide additional understanding on role of technologies.

1.4   The thesis in a nutshell

Through this research I build an understanding of TEE adopting the lines of *Infrastructuring* (see Chapter 2) for developing a set of guidelines for designing DITs for public spaces. However, the concept of *Infrastructuring* rather than being a material description of museums as *mere* institutions, is a methodological outstanding that, growing from *identities* and *differences*, takes into account design as an everyday and participatory experience [Macchia et al., 2015b]. The everyday and participatory experience involves daily actions and dynamics through which humans and DIT attempt on creating knowledge. This idea poses a challenge for a critical interpretation of design as a collaborative, mutually experienced, and in-time activity, more than an exclusive and only professional activity. I propose to discuss this interpretation of design in respect to the -ing feature of it (please, consider Chap 8). The main feature of the -ing lays on the suggestion of a network of relationships that connects to the principles of Participatory Design, adopting additional emphasis on mutuality of the interactions (for details on these principles please consider Chapter 3). Moreover, this emphasis aims to stimulate an open (and active) interpretation of design as enduring within and for sustainable environment (for details on this consider Chapter 5). This interpretation of Infrastructuring is endorsed by the analysis of the dynamics that influence and lead the museum context. The influence that DIT might have in supporting knowledge is discussed in Chapter 7 and Chapter 6.

In the process of understanding museum and knowledge I have been involved in a media design project that stimulated first reflections upon the relationship between people and DIT [Diaz and Macchia, (Forthcoming]. In respect to the idea of design as a continuous and Infrastructuring ac-

tivity, the role of designers blurs with the role of the other stakeholders and of users to whom I refer over this thesis as **people** rather than users, indeed.

To go through the domain of investigation in the context of museum, I intersect the intellectual frameworks of:

Knowledge Infrastructuring in order to stress the networking relationships between objects and people, in continuous interchange that occurs through practices and mutual interdependence;

Technologically Enhanced Environment to emphasize first, the stress on the *"ecological turn"* in the field of interaction design, that emphasizes the correlation between the space/place, artifacts, practices and people; second, to focus on the need to face and explore design strategies for the future;

Participatory Design to underline the political and participatory involvement of people for creating knowledge - adopting a design perspective.

The thesis is organized into two main parts: a first block discusses: the concept of TEE in connection with the concept of IK (see Chapter 2); feminists and critical theories behind the study of technology in museums (see Chapter 3); and the ethnographic method and techniques adopter for collecting and analyzing datas (see Chapter 4).The second block of the thesis dives into the observations and dynamics that arose through the analysis of data. The Chapter 5 discusses about the way people used the space through technology in order to generate a dialogue. Continuing the discussion on space and technology, the Chapter 6 examines and describes the relationships people trigger through the use of technology. The technologically triggered relationship is a matter of discussion in Chapter 5 where I introduce a discussion on how TEE is a complex combination between people and technology. The Chapter 7 takes into account the relationship between environment, technology and people through a sustainable design perspective focusing on a reinterpretation of what actually technology serves for, and on how we, as researchers and designers have the

responsibility to set a basis for engaging a sustainable future. The subsequent Chapter 8 looks at design challenges in respect to a sustainable interpretation of DIT. This sustainable interpretation of DIT refers to the possibility to design for stimulating and engaging people's participation to the creation of knowledge. This interpretation of DIT refers to the one I call -ing design. The conclusive Chapter 9 recalls the subject of IK as an example of unprofessional people design experience with the aim to provide a set of principles for designing TEE.

Chapter 2

Enduring Knowledge: Infrastructuring in museums

> I am talking about human race, people. If I say man kind or human kind, he/she or it, I am still talking about human being.
>
> Margaret Mead - *The Future as Frame for the Present*
> 7th July 1977

This Chapter describes the main theoretical lines of this work. I adopt studies on infrastructure and infrastructuring as intellectual tools for understanding dynamics around information and knowledge. Thus, considering knowledge as a grounding subject of this work, this Chapter begins with an overview on the concept of knowledge from the point of view of Technologically Enhanced Environment (TEE) and illustrates the conceptual framework and the tools that I adopt for unpacking the complexity of the discussion about TEE and Knowledge.

I adopt a feminist approach for interpreting and looking at the interconnection of museum ecology as a whole in which identities and differences are supported, encouraged and stimulated (see Section 2.1.2 Page 20). The ambition of combining the materiality of infrastructure to feminist approach is to visualize the complexity of the human-technology interaction that crosses the idea of boundaries, in favor of a synergetic alliance between different elements. Accross this direction Science and Technology Studies interlace and cross disciplines for developing *"critical understandings of the*

sociality of science and technology, both historically and as contemporary projects" [Suchman, 2008]. As the author recalls, the feminist approach focuses on issues rather than disciplinary conventions, and *"comprises an open-ended and heterodox body of work"*, providing a reading language for complex phenomena and conditions.

The following Section 2.1 unpacks the concept of knowledge as a result of the process of making sense of information in multifaceted context, such as museums. Further on, the discussion continues on the relation between *insider* and *outsider* through the feminist approach that goes toward *"agency, fulfillment, equality, identity, empowerment and social justice"* [Bardzell and Blevis, 2010] (see Section 2.1.2 Page 20). The Chapter continues with Section 2.2 with the focus on infrastructure and infrastructuring for providing a conceptual tool able to explain relationships and balances in museum ecology.

This Chapter means to provide a cross-section of the growing interpretation of interaction design for a better future.

2.1 Making sense of information

Knowledge, as a process that combines different research perspectives and interpretations, is a multifaceted and messy subject that can be observed, considered and explained through different areas of study. Struggling around the concept of knowledge, over the centuries, scholars studied and defined knowledge in different ways, underlining the various nuances and features that characterize the concept of knowledge[1]. Each discipline has a slightly different definition of knowledge and deals with its complexity focusing on different aspects. In this work, I adopt an interpretation of *knowledge* that takes into account the social and collective construction of heritage [Gheradi and Nicolini, 2001]. Moreover, I am adopting a frame for discussing knowledge as people's *"own local ecology that is inaccessible to anyone outside them"* [Nardi and O'Day, 1999]. Following Nardi and

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[1]Countless scholars focused on knowledge, from Plato with his *Allegory of the cave*, or Kant with his *Critique of Pure Reason* and Rousseau with *The social contract*. Currently, over others scholars, we could cite Polanyi and Foucault. However, the list of literature about knowledge is far too long to do not be a thesis itself.

O'Day [1999], *knowledge* is about impacting and being active in a particular local environment providing opportunities for framing the way of using and interpreting the environment. Nardi and O'Day [1999] continue pointing out the role of ICT in supporting the creation of information and providing occasions for shaping knowledge while enhancing environment. The introduction of ICTs and interactive technology in various environments, impacts the policies around which an environment is organized, valued, perceived. Thus, knowledge, that is making sense of information, depends on multiple factors: personal idiosyncrasies and ecological factors as well.

Making sense of information is about questioning, reflecting, and creating connections to previous experiences and knowledge. In some respects, making knowledge is a creative and critical thinking. Creativity is an *"imaginative process"* [Fisher, 2002] that realizes ideas and new values [Gruber and Wallace, 1999]. Therefore, making sense of information implies creative and critical components for understanding the nature of problems, where criticality concerns the ability to analyze and evaluate [Cross, 1982]. Creating knowledge is a reflective process that implies analysis, evaluation and the creation of new values [Forrest, 2008]. Making knowledge interweaves creative and critical thinking, it is about reflectiveness. Reflection is a common situated learning process that is about evaluating the current conditions and re-framing and accommodating the evaluations in respect to new purposes and contexts [Schön, 1983, Boud et al., 1985, Eraut, 2004]. Reflectiveness is part of the learning experience

> *"in which individuals engage to explore their experiences in order to lead to new understandings and appreciations. It may take place in isolation or in association with others."*[Boud et al., 1985]

Knowledge is the outcome of the learning, reflecting and sharing process that informs people about each other's actions through contexts. Thus, the process of making knowledge is continuous and extended in time and in space, such that *"we can know more than we can tell"* [Polanyi, 1966]. In his discussion about *tacit knowledge*, Polanyi [1966] emphasizes the controversial nature of the concept of *knowledge* since we can search for things that we already know, because those that we don't know we can not expect

to know. Following the description of Polanyi [1966], knowledge depends on what we already know, on external inputs and on others' knowledge. Hence, knowledge is a complicated subject that into an analytic chain of process is about *"verify information"* [Hakken, 1999]. Moreover, the notion of knowledge is situated and related to individual interpretation. In fact, Haraway [1988] describes knowledge as a *"condensed node in an antagonistic power field"*. Thus, what counts in knowledge, Haraway [1988] continues, is more than *"describing and discovering"*, knowledge rather occurs through contexts and mediation between experiences and objects. In her description of knowledge, Haraway [1988] takes into account the intricate, confuse, divergent, contrasting relationship between insiders and outsiders, arguing that *"no insider's perspective is privileged"*. This definition of knowledge features is relevant in terms of connections and translations among different *"and power-differentiated communities"* [Haraway, 1988]. Thus, knowledge is a subjective translation - e.g. interpretative, critical and partial - that occurs through interpretations among groups and describes collaborative creations rather than individual production. Knowledge is about community and situations, and describes a unique and multidimensional body that

> *"is partial in all its guises, never finished, whole, simply there and original; it is always constructed and stitched together imperfectly, and therefore able to join with another to see together without claiming to be another."*[Haraway, 1988]

The outline of this kind of understanding of knowledge describes the creation of knowledge as an **unfinished**, **continuous** and **integrated** process. Specifically, the creation of knowledge is related to individuals, social context and the way that the context is structured over power relations [Buzzanell et al., 2004, Huncileby, 1998]. Collins [2000] discusses the relations between groups and powers, focusing on groups sharing their partial knowledge, these groups create an input for generating and stimulating new and diverse knowledge. Thus, inter-sections of self and other's participation, interaction and collaboration is at the basis for creating new knowledge. However, the discussion of knowledge as a situated, subjective and participatory process recognizes a framework of expertise and experts

bodies that *"possess relevant knowledge that non-experts lack* [Sismondo, 2008]. Thus, context meant for stimulating the process of creating knowledge - e.g, educational institutions - stresses on the balance of legitimacy, since expertise is real and embeds genuine knowledge within its domains [Collins and Evans, 2003].

Meanwhile, knowledge embeds and is related to the convergence of different interpretations of the context [Haraway, 1988]. Knowledge is contextualized in respect to the potential inputs the environment can offer to groups of people, and reflects the experience and the interactions that can happen in a specific situation that is not standard. The non-standard-knowledge rises when situation might be puzzled and new [Schön, 1983]. Thus the figure of the expert has to relate to the context and to the response to the puzzled situation. In this context, the role of designers and experts is about affordance of artifacts and services that provide people with new stimuli [Norman, 1988]. In the case of museum the experience - and the creation of knowledge - is about materials and about the iterative dialogue that arises between multiple actors [Haldrup and Bærenholdt, 2010].

2.1.1 Dive in TEE

In this Section, I suggest a specific interpretation of knowledge related to the power of communities. The theoretical tradition behind this understanding can be identified as *feminism*, which focuses on differences between and among groups and on the institutions that frame these conditions [Olesen, 2000]. Over the last decade discussions on technologies and the symbiotic relation with humans have been often related to feminist approaches, emphasizing the blurring of boundaries between technology and human [Kember, 2003].The challenges of feminist traditions have different directions and include subjects that position this theoretical perspective on a qualitative area of actions. The inclusion of several subjects under the umbrella of feminism drives scholars to interrogate on the concept of feminism itself [Felski, 2003, 1997, Hooks, 1990, Minh-Ha, 1989]. In this respect, some scholars seek to give sense to *differences* within the subjects and the *connection* between the subjects as well. Thus, the focus of feminists' discussion includes and recognize the importance of both *identities*

and *membership*. This theoretical framework brings the research into an inclusive political agenda and investigate for improving - and changing - issues that impact social and everyday life, as such can be climate change, work environment, alienation or inequality, health. However, the current feminist tradition refers to multiple subject, the basis is about *"to clear the ground in order to plant the seeds for other ways of configuring technology futures"* [Suchman, 2008].

The adoption of a feminist approach helps to underline and emphasize design as a shared process in which no one should be identified as an insider or an outsider. More precisely, the process of knowing includes museum professional expertise as well the everyday life knowledge. Hence, the focus is on people who participate to the museum experience as equal participants to the collective creation of knowledge.

2.1.2 Cyborgs and feminism for understanding Knowledge in TEE

This Section of the Chapter, I focus on the feminist perspective that underlines both inclusion and exclusion of group's participants. According with Felski [1997], *Postcolonial Feminism* addresses dynamics of cultural understanding and maturation of identity that seeks to *"crystallize the conceptual and political ambiguities of differences"*. The postcolonial feminism deals with difference and sameness that challenge the status of *community* shifting the paradigm through inclusiveness and exclusion. The contribution of feminism for understanding relationships in the creation of knowledge is related to the concept of cyborg that helps to understand combined entities on the participation for creating knowledge. One specific direction of feminist tradition refers to the inter-sections of bodies and technologies taking into account the relation with technology and human on the mutual embodiment and reinforcement. This tradition focuses on associating social identities and materiality, for informing about inclusions and exclusions and building a related narrative. The inclusive/exclusive interpretation of technology and human can be reconnected to the Cyborg Manifesto from Donna Haraway [1991]. She describes cyborg as a *"cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as*

Table 2.1: Evolution of feminist theories: between rights and needs.

a creature of fiction" [Haraway, 1991]. The *cyborg* is metaphor of change and consciousness of self identity. Moreover, the author emphasizes the cyborg as a representation of the *"appropriation of nature as resource for the productions of culture"*. This mythological figure recalls an organic integration between natural and technological differences. The cyborg at the same time is about consciousness of exclusion, being human *rather than* being machine, and of inclusion, being human *and* machine. It is about *identities* and *contradictions*, similarities and differences.

Since the first time I read Cyborg Manifesto [Haraway, 1991], I was fascinated by this paradoxical figure: a figure made of two opposite sides and, which, at the same time is a distinct whole. A figure which is simultaneously inclusive and exclusive. Fascinated because both sides - the human and the technological - mutually interweave maintaining their own identity and being an only one. In a similar view, I am fascinated by the interpretations that we can do about technologies in our everyday life. For instance, Science and Technology Studies pay attention on an evolving interpretation, of *"bodies and persons, of resemblance and difference, and of relations across the human/machine boundary"* [Suchman, 2008]. Following the author's interpretation, the exploration of human-technology relationship leads to different and diversified contexts that are based on

the evident assemblage and interconnection between human and technology. The aim of such exploration is about understanding the intimate connection between subjective needs and technological reaction. According with Schull [2005], who discusses about gambling games in Las Vegas, the intimate connection between human and technology translates input and feedback maintaining the connection between the body's movements and actions and technologies.

The cyborg figure of human and technological assemblage helps to keep associations between humans and technologies as the basic unit of analysis; interweaving the mutual interdependency in terms of action in the relation *intra-action*, and between the relation *inter-action*. This relationship emphasizes connections between artifacts, social practices, relationships, systems of knowledge, institutions, and so on. The complexity of blurring artifacts, social practices relationships, systems of knowledge, institutions, and so on, interweave the observer perception Barad [2003].

> *""[P]henomena do not merely mark the epistemological inseparability of observer and observed, or the result of measurement; rather,* phenomena are the ontological inseparability of agentially intra-acting components.*That is, phenomena are ontologically primitive relations without preexisting relata. The notion of* intra-action *(in contrast to the usual "interaction", which presumes the prior existence of independent entities/relata) represents a profound conceptual shift. It is through specific agential intra-actions that the boundaries and properties of the "components" of phenomena become determinate and that particular embodied concepts become meaningful."* [Barad, 2003]

The iconic cyborg figure helps to augment and underline the extension and interrelation between bodies and the mutual embodiment between human and technology, into an *harmonic* sociomaterial assemblages. Thus, the human and technological relation has to be include into the sociotechnical system of reference for criticizing a circumscribed technological production, and expanding the intervention agenda. According to these lines of interpretation and analysis of human and technology relations, the contemporary feminist approach reframes techniques and practices that aim

to unfold and disentangle the complexity of sociotechnical systems [Suchman et al., 1999]. However, the figure of cyborg recognizes the intimate connections between culture, social construction, materiality, and technology. In the meanwhile the sociotechnical systems configure a particular way to incorporate, design and use together humans and machines.

Thus, recognizing systems and relationships between human and technology finds room in the Human Computer Interaction (HCI) agenda, stimulating a critical interpretation of the subject of interaction and interactivity. DIT pervades people's life engaging critical research and design perspectives for revealing the *"unspoken values within the HCI's domain"* [Bardzell, 2010].

2.1.3 Feminism and HCI: methodology for designing DIT for TEE

As introduced in the beginning of this Section, the feminist tradition focuses on differences, identities, connections, relations and later on on the relation between human and technologies. This tradition emphasizes the relationship between researcher and researched subject. The analysis of social world as a mixture of contextual relationships and values, which integrate unstructured data to the place and the human ecology [Clarke and Star, 2008] understandings the composition of groups and communities, and revealing maps of actions and interactions.

The outcome of such kind of research view and relational priorities mainly account *experiences*, *collectivities*, *identities* and *situated knowledge* [Hardin and Whiteside, 2010, Bardzell, 2010, Hakken, 1999]. *Feminist research* embed critical and constructionist approach, involving that the notion and the role of power in societal process. This approach to research frame the analysis upon relationships and political understandings through which the feminist approach connect to the concept of *other* [Hardin and Whiteside, 2010]. The notion of *others* blurs with the notion marginalization. Combining the notions of *others* and *marginalization* helps to avoid singular account of social life [Bardzell, 2010]. In this respect, the feminist approach supports and stimulates alternative interpretations to consider phenomena and their social implications.

Therefore, feminist approaches bears the tough and evolving researches on digital interaction technology and on interaction design that is deeply related to multiple disciplines. Human Computer Interaction deals with the concept of pluralism, envisioning *design processes* in respect to *equality* and *needs* of human [Bardzell, 2010]. The feminist approach goes through the democratization of design that faces potential *"challenges of hegemony"* Binder et al. [2011]. Thus, bending feminism and HCI deals with *polyphonies* of groups, with culture and the qualities of computing technology that blurs into everyday life [Bell et al., 2003, Weiser, 1993].

Differentiation and multiple perspectives encourage multiple viewpoints and stands engaging towards the multiplicity of them. Relating multiple expertise constituted a relevant intellectual source for understanding needs and design potentials [Campbell and Eubanks, 2004]. Thus, adopting feminist approach for looking at HCI domains helps to understand social phenomena that include multiple people and supports the identification of differences, equalities and spatial needs, as well. In this respect, the *knowers'* experience grounds on contexts and on differences taking distances from universal approaches [Bardzell, 2010]. Feminist instances argue that *"the crux of value-explicit design is that there is no neutral position or "view from nowhere" untouched by materiality, context, and identity"* [Hamraie, 2013]. Thus, *universal* approaches delegitimate and reduce differentiation and identities, preferring a design meant for all people. This discussion recalls the still open debate described by Felski [1997] that refers to the focus on both: community membership and individual identity. Thus, personally I argue for universal approaches to illuminate equalities and to emphasize differences that matter.

In terms of Digital Interactive Technology (DIT), the feminist view allows a conceptual understanding of relationships that tangles human and technology in respect to the ecology of the interaction and the participation of people. People's participation in the design of DIT aligns with the feminist approach that indeed implies *"sense of relationality, obligation and connectedness"* [Light and Akama, 2014]. Moreover, Light and Akama [2014] emphasize the *uncompleted* feature of design in respect to intangible and on-going relation of people's participation that spreads across limits (*boundaries*).

Participation, mutual understanding of needs and democratic approach to design DIT and information systems carry conflicts that nevertheless stimulate the dialogue and the ecological interconnection between and within people and technology, triggering differentiation of opinion [Bodker et al., 2004].

The extension of feminist theory to enhance the participatory design activity embeds the relevance of the ecology of technology. For instance, the feminist approach informs and looks through the relationships among technology in the specific context, underlining and emphasizing connections between features of artifacts and people related to the artifacts. The feminist approach focuses on understanding differences and acknowledging differences among communities understanding different needs. Thus, design application within the feminist theory aims to balance and equalize rights among groups [Coleman et al., 2003]. For instance, inclusive design and universal design rebuild groups and memberships reframing needs assuring rights and fulfilling needs. While the universal design expands the *"target group of product or service to include as many users as possible"*, the inclusive design aims to *understand and respect the needs of a diverse range of users"* [Coleman et al., 2003]. Yet, the meaning of other together with the notion of power, refers to the broad group rather than to the peculiarity and the valuable differentiations between people. Including feminist approaches within design research helps and supports the shift of mentality and the change our evolving society needs. In this frame, feminist approaches reconfigure design understanding of human and technology interaction concerning ethical limits of using technology [van der Velden, 2009].

Feminism and design experience advocate political features with the aim to open dialogue between different groups of people for bringing new valuable insights and benefiting from each others contributions to the design process. The contribution of feminist approaches deals with the analysis and understanding of design rather than to generate contributions focusing on the ecologies of differences and equality.

Both feminism contributions to the HCI community lead to an understanding of technology embedded into human needs and actions (see Table 2.1 Page 21). Hence, feminist approaches helps to uncover values and powers

that characterize relationships between context, technology and humans. Through our experience at the Museum of Science in Trento (Italy) (see Chapter 4), we observed commonalities on participatory behaviors between people. People in museums act and stimulate each other for understanding the surrounding environment. Additionally, people in the museum are open to unstructured re-interpretation of the environment through the use of technology. The following Section of the Chapter focuses on the concept of infrastructure and infrastructuring as a conceptual tool for integrating feminist approaches within the field of critiques-based design. The *infrastructure* tool provides understandings upon human and technology relationships, power, rights and needs.

2.2 Intellectual tools for understanding knowledge: from infrastructure to infrastructuring

This Section delves with the intellectual tools of infrastructure and infrastructuring, which provide an interpretative frame for integrating design and feminist approaches in relation to museum contexts.

As Bardzell [2010] underlines, the feminist approach has huge potential for understanding the potential of Human-Computer Interaction. In the meanwhile, the intellectual tool of infrastructure and infrastructuring stress on relationships, and environmental and time context, which are elements the feminist approach cares about. In the context of museums, the infrastructural approach deals with the complexity of the interaction in cultural and relational hubs - such museum is. The description of infrastructure encourages the exploration of social worlds as a unique nature of differentiated social arenas [Star and Ruhleder, 1996, Neumann and Star, 1996], providing an interpretation of museums as factor of an *infrastructure* and of the knowledge and cultural elicitation as a set of processes and dynamics that I discuss as *Infrastructuring.* Thus, the discussion about the intellectual tool of infrastructure and infrastructuring focuses on

the concept of Cultural Infrastructure (CI) is about the set of relationships and factors included in the museum-system (see Figure 2.1 Page 29);

the concept of Infrastructuring Knowledge (IK) stresses on activities, relationships and interactions that happen in the CI.

This twofold approach helps to simplify the discussion about designing for museum institutions, which are an ensemble of artificial and natural subjects involved and joined in a whole [Le Moigne, 2015, 1977]. Moreover, looking at CI and KI helps to understand the social factors and the interconnections between agents (human and technology) emphasizing contextual relationships: time and place.

During the last twenty years, infrastructure and infrastructuring have been used to address information systems and interactive experiences. In this direction, this intellectual tool provides useful interpretation about the impact of information systems to the interaction between human and non-humans. Various scholars focus on multiple features of infrastructure and infrastructuring. For instance, Bowker and Star [2002] trace guidelines and directions for understanding and studying Information Systems (see Table 2.2 Page 28). Marttila et al. [2013] propose an explanatory understanding adopting the concept of commons to underline the socially connected and belonging nature of infrastructure to make sense of infrastructure. Binder et al. [2011] focus on the *designerly* nature of infrastructuring as an expression of sociomaterial relationships. Similarly, Karasti and Syrjänen [2004] and Simonsen et al. [2015] discuss infrastructuring as *"community design and processes through everyday materials"* [Macchia et al., 2015b].

These perspectives have in common the ongoing and relational involvement of people in the process of modifying and creating something new. Hence, the discussion on infrastructuring relates to common goods, *"as a process for sustaining and/or activating mechanisms for sharing knowledge in cultural context"* [Macchia et al., 2015b]. The process of infrastructuring deals with inputs of the context, practices and people's participation to the process. As my colleagues and I wrote *"the temporal and sustainable features have a central role in the discussion. The* on-going *and progressive peculiarity of infrastructuring challenges scholars on understanding the design dynamics that continuously connect to context, people and social practices"*.

Features of Infrastructure

Embeddedness Infrastructure is "sunk" into, inside of, other structures, social arrangements and technologies;

Transparency Infrastructure is transparent to use, in the sense that it does not have to be reinvented each time or assembled for each task, but invisibly supports those tasks;

Reach or Scope This may be either spatial or temporal infrastructure has reach beyond a single event or one-site practice;

Learned as part of membership The taken-for-grantedness of artifacts and organizational arrangements is a sine qua non of membership in a community of practice (Lave and Wenger 1992; Star, in press). Strangers and outsiders encounter infrastructure as a target object to be learned about. New participants acquire a naturalized familiarity with its objects as they become members;

Links with conventions of practice Infrastructure both shapes and is shaped by the conventions of a community of practice, e.g. the ways that cycles of day-night work are affected by and affect electrical power rates and needs. Generations of typists have learned the QWERTY keyboard; its limitations are inherited by the computer keyboard and thence by the design of today's computer furniture [Becker, 1982];

Embodiment of standards Modified by scope and often by conflicting conventions, infrastructure takes on transparency by plugging into other infrastructures and tools in a standardized fashion.

Built on an installed base Infrastructure does not grow de novo: it wrestles with the "inertia of the installed base" and inherits strengths and limitations from that base. Optical fibers run along old railroad lines; new systems are designed for backward compatibility; and failing to account for these constraints may be fatal or distorting to new development processes [Monteiro and Hanseth, 1996]

Becomes visible upon breakdown The normally invisible quality of working infrastructure becomes visible when it breaks; the server is down, the bridge washes out, there is a power blackout. Even when there are back-up mechanisms or procedures, their existence further highlights the now-visible infrastructure.

Table 2.2: Description of Infrastructure [Star and Ruhleder, 1996]

2.2.1 Looking at museums through the lens of Infrastructure

Discussing museums in the domain of *Infrastructure* aims to stress those traits that characterize and standardize these cultural institutions. The recognized standards are associated with convenient and shared practices and, in the opposite, to sanctions [Busch, 2011]. Therefore, Cultural Infrastructure (CI) refers to the *"context, norms, customs, processes, members (who is in and who is out), and language"* [Macchia et al., 2014]. This approach to museum investigation and understanding serves to represent and make explicit the features of the institution (see Figure 2.1 Page 29). For
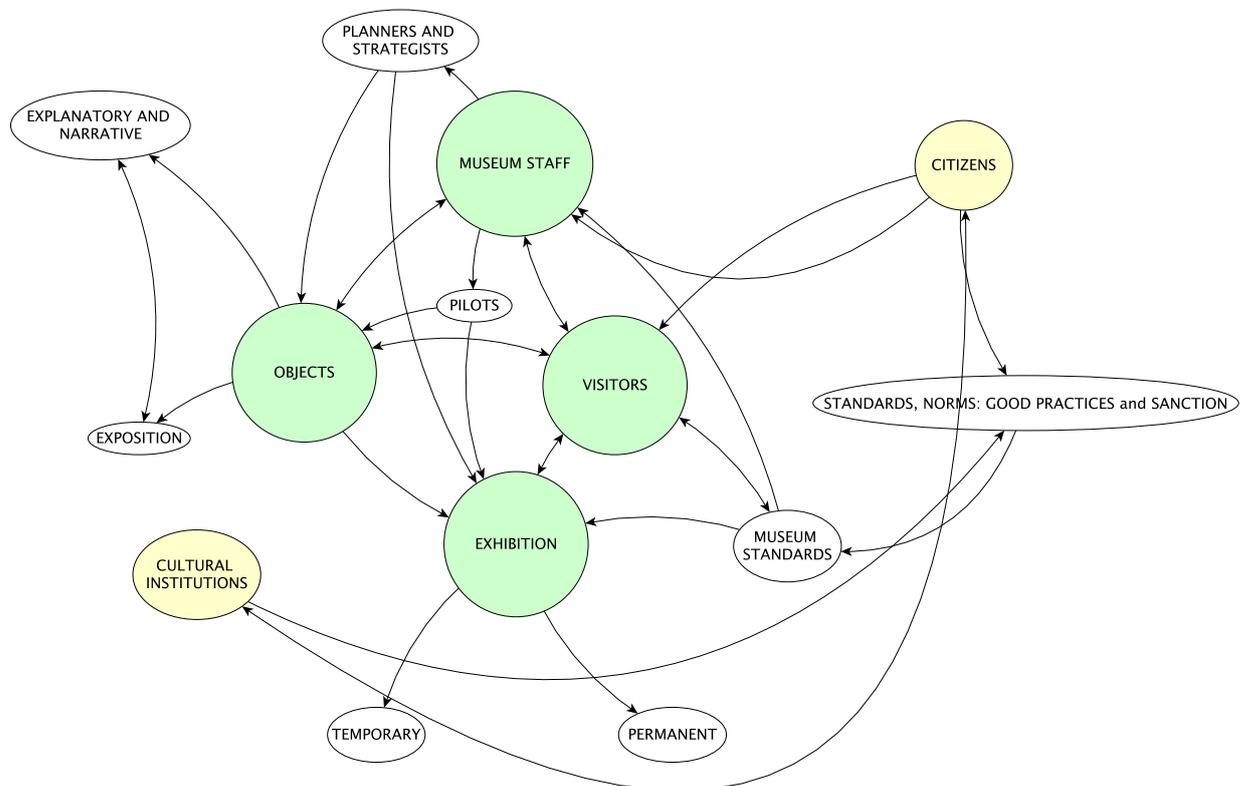
Figure 2.1: Cultural Infrastructure: relationships, components and structure developed through the arrangement of Hess and Ostrom [2007] of the Institutional Analysis and Development framework and the empirical observations of the Museum of Science in Trento (see Chapter 4 Page 47)

drawing the core objects and the connection between the components highlighted in Figure 2.1 (Page 29), I adopted a phenomenological approach. The grid of components and relationships of Cultural Infrastructure (CI)

interweaves literature about museum together with the analysis done by Hess and Ostrom [2007] on institutions. The Figure 2.1 Page 29 describes museums as one of those cultural institutions that participate to the development of the society, and embeds norms and practices that mutually impact the social and museum growth. Thus, the concept of CI implies *"a process of association, estimation, and judgment about the elements that characterized the infrastructures themselves and the circumstance"* [Macchia et al., 2014]. This understanding of Infrastructures recalls a *ready-to-hand* interpretation of theories that depend on practical relationships. Positioning the interpretation of standards in connection with the notion of *ready-to-hand*, I emphasize the process of curating and designing within and for museum, to reproduce the meaning of the institution. Curating and designing museum exhibitions relates to the embedded features and components of the infrastructure (see Table 2.2 Page 28 and Figure 2.1 Page 29). Combining *"social, political and economic work"* [Bowker and Star, 2002] and the actual components that involve social, political and economic works make the infrastructure possible and sustainable in relation to the context in which it exist. The infrastructure is tangled into the context and it evolves as a whole of different component and relationships; it is visible in the very moment it *broke*, or in other worlds, when standard values and understanding change and are not mutually recognized. Infrastructures embed shared meanings and purposes; meanwhile dynamics of infrastructure stimulate and self-involve to the creation of community of practices shaping the infrastructure itself. The concept of *community of practice* describes arrangements of people with common and collective practices, and shared identity [Wenger, 1998][2].

The components of infrastructures hold various functions: for instance museums deal with educational and amusement purposes. Moreover, the function of components of infrastructure, for the nature of the infrastructure itself, changes over time. Purposes of museums changed together with the evolving processes museum institution faced over the last century, which emphasize new ethical values and inclusive purposes of the

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[2]The concept of infrastructure includes informal grouping of participants based on people's engagement and active involvement. At the same time, constructing a community of practice requires long-term involvement and sharing memories that make the infrastructure a permanent social experience.

modern state [Bennett, 2013]. New Digital Interactive Technology (DIT), like digital tabletop, interactive walls, kiosks and mobile applications, goes in this direction engaging and connecting different actors through alternative interpretations of the exhibition (further discussion about this in Chapter 3). The introduction of ICTs fulfills the request for additional information and stimulates collaboration between visitors for sharing concepts, ideas and new understanding[van Dijk et al., 2012] stimulating our critical and creative skills to build *ex novo* interpretation of the context [Boud, 2006]. In fact, dialogues and collaborations museum environment encourages creative and critical thinking: while *creative thinking* triggers new values and ideas, *critical thinking* concerns analysis and evaluation. Together, creative and critical thinking stimulate new assessments and situations [Baumer et al., 2009]. Combining creative and critical thinking people can re-interpret the context and are stimulated to re-configure the context and are able to re-designing future actions [Boud, 2006]. Hence, experience grows through the re-interpretation of the context and is about reframing puzzling situations [Binder et al., 2011, Dewey, 1969]. *Reflectivness*, the cognitive process of reconfiguration and reframing of present conditions, is a social activity that involves sharing, collaborating, interacting, interpreting and reconfiguring [Schön, 1983, Boud, 2006, Macchia et al., 2015a].

DIT in museum influences visitors involvement in terms of reflective experience. For instance, mobile-technologies provide on demand material and additional information for expanding potentials of tours of exhibitions [Stogner, 2009]. Moreover, visitors share their experience in the museum through the use of new mobile applications and platforms for sharing images, text and audio. The sharing opportunity has the relevant role to bring to the surface different elements of the exhibition from each person's point of view [Proctor, 2010]. Therefore, introducing DITs influences and revolutionizes museums expanding improving tightening relationships and the role of the agents, the values and the norms. This change of museum provides new opportunities to interpret and to design *for* museum encouraging collaboration and participation [Stuedahl and Lowe, 2015, Culén et al., 2015]. Still the structural evolution of museums together with the influence of new DIT in museum interpretation and design display the complex em-

bedded structure of museum institutions in the social context that includes written and non-written norms conventionally recognized by the community [Hess and Ostrom, 2007]. Thus, analyzing an Infrastructure deals with understanding of the role of the institution and the evolving/designing process of the institution itself. The evolving/design process of an institution depends on *"collective actions and self-governing behaviors; trust and reciprocity; and the continual design and/or evolution of appropriate rules"* [Hess and Ostrom, 2007]. Moreover, the collective participation of people facilitates the sustainability and the reproduction of the institution. In this respect, the collective and relational configurations of museums can be explained in terms of CI stressing mechanisms and object and subjects and norms in the range of cultural prompt and maintenance. The sustainability of CI is related to the participatory and collective activities around the cultural context. The success of CI depends on the infrastructuring process that makes possible the connection between the different components of the Cultural Infrastructure (see Figure 2.1 Page 29): (a) people participation; (b) museum artifacts; (c) common recognition of the institution; (d) set of practices; (e) introduction of ICT; (f) stimulation of knowledge. Thus, people, as citizens without differentiation between groups of people such as museum staff, visitors, exhibition designers, who participate and mutually understand norms preserve and maintain museum institution.

The term *people* - as citizens, emphasizes the collective participation of each person and of each different role to the reproduction of the CI. However, the term *people* recalls the current adoption of the term *public* for discussing infrastructure and infrastructuring suggests the term public [Ehn, 2008, Le Dantec and DiSalvo, 2013]. While the concept of *public* addresses participants struggling for a better future, the adoption of the term *people* aims to underlines shared identities together with the concept community and of common needs (see Section 2.1.2 Page 20).

People's participation to the maintenance of the infrastructure is an ongoing process for sustaining, maintaining, and improving CI through sharing information and re-interpretation and re-construction of the context. This paragraph discusses and describes this ongoing process as the process of Infrastructuring Knowledge (IK): a shared activity for creating knowledge between people and through the infrastructure.

2.2.2 Infrastructuring Knowledge in Cultural Infrastructure

This paragraph discusses and describes this ongoing process as the process of Infrastructuring Knowledge (IK): a shared activity for creating knowledge between people and through the infrastructure. As discussed in the previous Section the concept of infrastructure includes multiple features and aspects of a social phenomenon and is about a pulsating system of people, artifacts, materials and contexts that causes novelty in the environment of discussion [Edwards et al., 2007]. Thus, the infrastructure helps ready-to-hand and contextual needs to *communicate, move or inform* [Macchia, 2015]. Reframing museum as infrastructure I aim to emphasize the cultural role of museums, for endorsing those features that belong to museums.

The notion of *culture* refers to what we know, or perceive, and believe to know, to effectively relate with other members of the society [Ingold, 2010]. Moreover, cultural institutions negotiate the cultural process across formal or informal rules. On this topic, Bennett [1995] describes the role of museum institutions for preserving, bestowing and stimulating tangible and intangible cultural heritage, and to support and stimulate knowledge and social identity. The adoption of the CI concept stresses on the cultural and dynamic character of this institution, and implicitly recognizes practices, languages and signals commonly assumed and kept by a community.

The dynamic condition and the on-going process for maintaining and as well stimulating the improvement of Infrastructures emphasizes the role of the context [Binder et al., 2011]. In fact, Infrastructures cannot be *de-contextualized* and condensed into a simple platform, because they exist because of practices and relationships between the structural elements.

In respect to CIs, practices and relationships aim to transmit cultural property, and *"express and preserve visual and concrete representations of culture"* [Macchia et al., 2014]. Therefore, as Diaz, D'Andrea and I wrote [Macchia et al., 2014], museums practices configure and design the museum context as a space for interactions. In this respect Infrastructuring distresses and constantly associates people, objects, practices and activities.

Thus, Infrastructuring is a collective process in which people dynami-

cally participate through the environment to configure and re-configure CIs [Macchia et al., 2015b]. People contribute in *"designing a future, in preparing the ground for a collective and democratic participation"* [Macchia et al., 2015b]. Still, *Infrastructuring* describes participatory experiences between people, who implicitly adjust power relationships in respect to the context and following recognized practices.

In the context of museum people contribute and participate with the purpose to create knowledge, they share ideas, opinion and experiences in the context of museum. Hence, IK is a participatory process that occurs in the frame of a CI. As my colleagues and I underlined [Macchia et al., 2015b], the Infrastructuring in CI process implies democratic and commons value, and shared responsibility in respect to the production of knowledge .

Processes and dynamics involved in and through museum institutions offer the opportunity through space and technology to share knowledge between people. The sharing experience rooted in museums bonds within the literature on infrastructure embedding the visiting experience as a *dynamic* ongoing process even though *asynchronous* and *associated to the circumstances* process. This is the infrastructuring process that highlights the interactive nature of museum institutions. Therefore, infrastructuring is a process designed to create and appropriate the space through interacting, doing, making, using objects and technology. In the setting of museum the process of infrastructuring is very often about touching and experimenting scientific objects or natural phenomenon representations that combine and enrich previous knowledge with new information (See Chapter 6). In this perspective, infrastructuring is an intellectual tool for understanding the dynamics of the museum experience.

The different descriptions listed above (see Bowker and Star [2002], Karasti and Syrjänen [2004], Binder et al. [2011], Marttila et al. [2013]) concur to describe Infrastructuring as an ongoing, asynchronous and relational involvement of people. Infrastructuring is the process of adapting and adjusting existing states for making more efficient and adapted systems. This interpretation of infrastructuring includes processes of *"interpreting and modifying an exhibition with and for its visitors"* [Macchia, 2015] (see Chapter 5). Thus, the concept of infrastructuring suggests valuable strategies and parameters for understanding practices of museums.

The practicality of Infrastructuring involves actions; relationships and dialogues in museums that are meaningful through the use (and non use) of technology in a specific space. However, the process of IK embeds a complex combination of approaches and theoretical perspectives that while helping to underline specific issues and to highlight particular features, combine shades and details..

2.3   Summing up the Infrastructuring process

In order to help the understanding of the combined conceptual and theoretical details provide in these pages, this Section provides an outline of the core points discussed over the Chapter. This Chapter includes two main perspectives for dealing with design for museum: feminism in HCI and Infrastructuring. Building this work on reflections for designing DITs for museums, I found easy to loose the direction of what *designing* DIT implies and where the responsibility of design lays. Thus, I wrote this Chapter with the intention to organize thoughts and theoretical hints for understanding implications and the meanings of designing for people to share and create knowledge together; and providing the guidelines of my research.

The discussion related to the feminist approach helps to frame the relevance of dealing with context where people who have different needs and perception of society connect together. Moreover, adopting a feminist approach to the design process helps to offer a design solution for an actual change in terms of inclusiveness, equality and identity as well. Indeed, the feminist approach helps me at first place to highlights and stresses on divergent and/or complementary dynamics among people from different groups. Are there any differences among groups? How the relation between Pilots (see Page) and visitors can be fruitful in terms of creating knowledge? And how, in this frame, DITs can help the creation of knowledge. The feminist approach lets researchers and designers to see beyond the end of their nose, supporting and stimulating alternative interpretations of phenomena. In this context, the adoption of such approach helps to openly interpret dynamics that characterize the creation of knowledge.

The process of creation knowledge occurs through activities in which people reconfigure contextual conditions and envision alternative possibilities for the context itself. Thus, the participatory experience of creating knowledge in a museum is a *"design process [that] arises by the sharing practice"* [Macchia et al., 2015b].

The participation of people to the process of creating knowledge lays on combined perspectives and factors contributing to the interpretation of this process in relation to the concept of *infrastructuring*. The concept of infrastructuring indeed emphasizes the participatory and equal contribution of people's activities and interaction in creating knowledge. However, discussing participation and equality between people in the area of designing is a tough challenge. Designing DITs has to take into account the embodiment of the interactive processes, simultaneously highlighting similarities and differences between people. In this respect, designing DIT embeds and inscribes relational-actions impacting the process of creating knowledge in the context of museum. The way through which DIT re-shapes the context changes the ecology and the perception of the space requiring distribution of power in the relationship between technology and people. In this direction, the need for unpacking the relationships and the values that connect technology, people and the environment is growing in the HCI community. The increasing interest of the HCI community on relationships and values of people, technology and space is to learn critiques of design and promoting social changes and inclusions.

To clarify how new DIT impacts museums, the following Chapter 3 takes into account the role of Human-Computer and interaction design to such cultural institutions.

Chapter 3

HCI and Museums

> [...] The borderline work of
> culture demands an encounter
> with "newness" that is not part
> of the continuum of past and
> present. It creates a sense of the
> new as an insurgent act of
> cultural translation. [...]
>
> Homi K. Bhabha - *The Location
> of Culture*

This Chapter investigates and discusses the implications of Digital Interactive Technology (DIT) in the field of Human Computer Interaction (HCI) in relation to museum. It first disentangles and explains what the evolution of the HCI community is coping with, focusing in the so called *Third Paradigm*. In doing so, the Chapter provides the frame for understanding the current interpretation of the interaction between human and technology. The *Third Paradigm* of HCI helps to deal with the evolution of museum dynamics since the introduction of DITs. Thus, beginning with a focus on the evolution of HCI, the chapter concludes with an overview of museum changes.

3.1 The evolution of HCI and implications for museums

The evolution of Human-Computer Interaction includes different levels of the discipline: frameworks, models, theories, and paradigms [Rogers et al., 2011]. Frameworks describe *"the questions intended to inform specific domain areas"*, while models are simplified representations of an area for helping explanation and evaluation [Rogers et al., 2011]. Theories aim to explain phenomena, and paradigms aim to provide guidelines for a research community to approach and deal with their own field [Khun, 1962, Rogers et al., 2011].

The HCI community is increasingly recognizing the value of socio-technical systems and of implications of technology for the society. For instance, Dourish and Bell [2011] describe computing technology as processes rather than objects. The authors unfold technology in respect to cultural practices and environment. This re-interpretation of technology as actively embedded and performing in the social context, reframes the field of HCI, re-viewing the HCI paradigm. The latest *3rd Paradigm of HCI* provides a set of theoretical and methodological tools for dealing with interactive technology [Harrison et al., 2007, 2011]. At the top of this shared understanding of HCI is the meaning of interaction

> *"not as a form of information processing but as a form of meaning making in which the artifact and its context at all levels are mutually defining and subject to multiple interpretations"*. [Harrison et al., 2007]

While the **1st** and the **2nd** Paradigm of HCI built on the metaphor of mind as a computer, and related human and computer in terms of rationalities and processing activities, the **3rd** Paradigm emphasizes the engagement of people in using technology [Dourish, 2004, Dourish and Bell, 2011, Bell et al., 2003, Harrison and Dourish, 1996]. The shift of the paradigm implies change of research questions and methods through which we find answers [Harrison et al., 2011]. Because of the unstructured evaluation approach that multiple interpretation, voices and understanding requires, the HCI community is adopting and integrating research methods that allow re-

Paradigms in HCI

	1st Paradigm	2nd Paradigm	3rd Paradigm
Metaphor of Interaction	Human and machine couple	"Interaction as information communication"	"Interaction as phenomenological situated"
Scope of the Interaction	"Optimizing fit between man and machine"	"Optimizing accuracy and efficiency of information transfer"	Supporting situated action
Typical research questions	How to fix interactive problems and issues?	How to model and improve communication?	How can we support interaction without constraining it too strongly by what a computer can do or understand?
Related disciplines	"Engineering and programming and ergonomics"	"Laboratory and theoretical behavioral science"	"Ethnography, action research, practice based research, interaction analysis"

Table 3.1: Guidelines for understanding main differences between the HCI paradigms [Harrison et al., 2007]

searchers to develop a multifaceted understating of technological phenomena. Current perception on technology focuses on context and researchers reconfigure disciplines such as design, art and ethnography (see Chapter 4). Hence, the emphasis of HCI refers to *"situated action"* [Suchman, 1987]. Henceforward, contextualized extension of HCI reframe the role of tasks. As Harrison et al. [2011] write, the application of usability tests and studies happen to be difficult in relation to ambient interfaces since standard evaluation techniques have imprecise and fuzzy results. This HCI perspective recognizes the potential of multiple understanding of technology and of the environment in which the technology performs [vom Lehn

Designing and evaluating interactive systems

Thinking through doing mind and action are deeply integrated and co-participate in learning and reasoning;

Performance peoples body is capable of a wide range and sophisticated actions *"faster and more nuanced than symbolic cognition"*;

Visibility artefacts foster collaboration and cooperation;

Risk uncertain consequences of actions shapes people and computer interactions;

Thickness of practice developing technology frames on work practices thus digital practices are rather more complicated than they could seem.

Table 3.2: Description of themes of interactive design [Klemmer et al., 2006]

et al., 2001]. Big question marks refer to the evaluation of technology in respect to multiple perspectives that, nevertheless, refer to the social potential of computing technology [Sengers and Gaver, 2006]. DIT has the value of allowing people to get together, building on the occasion to re-interpret the technology itself, enhancing value and cultural implications. The situated action approach and the collective reinterpretation of technology reframe the cognitive emotional model HCI tradition (that refers to the 2nd Paradigm): reject the *cause-effect* information-emotion in favor to a collective and contextualized construction of emotions.

The 3rd Paradigm of HCI stresses the embodiment of the interaction into phenomena, into the context, the relationships and the technology, and re-inform the interaction design process. Klemmer et al. [2006] describe five noticeable themes for designing and evaluating interactive systems summarized in Table 3.2 Page 40. The 3rd Paradigm of HCI follows an uneasy ontological position focusing on questions about knowledge creation *in* and *through* context and technology. In this frame, the HCI community deconstructs the rhetoric of unique interpretation, opening the discussion to multiple voices and to the contextualized production of knowledge (see Chapter 2). To understand the implications of creating knowledge, researchers are called to apply to the traditional design domain cultural considerations, and political and power dynamics. Discussing about this reframing of de-

signing HCI, *"Postcolonial computing* invites to investigate how designing technology encounters diverse knowledge and practices [Irani et al., 2010]. Great interest is reserved to interaction in public space. In this direction, museum and exhibition spaces offer interesting occasions for studying interaction distresses through people and DIT. Moreover, museum spaces provide examples of meaning making arising [vom Lehn et al., 2001]. Meaning making is about constructing understanding of the world around us through interaction and relationships through and with the objects [Dourish, 2004]. As Dourish [2004] points out meaning depends on the way people interact and perceive the world. Additionally, the understanding of world evolves and changes through the way people share the meaning of their experiences. Interactions and spaces provide people with a common and shared background of information fundamental for interpreting and understanding mutual negotiations. In this respect, the purpose of an interactive system is to provide occasions to communicate between people and through the system [Dourish, 2004].

A further aspect that helps the understanding of meaning is the concept of *intentionality* that *"distinguishes conscious thoughts from the merely physical or mechanical operation of the world"* [Dourish, 2004]. In respect to computational systems, the effect of interaction in the context depends on the way we interact through the computational system. Together with the intentionality of the interaction, concerns in HCI domain refer to enduring the interactive relationship through embodying interaction into systems.

As Dourish [2004] specifies, the exploration of meaning in relation to interactive systems helps the theory for designing interactive systems. The purposes of this investigation interweave the 3rd *Paradigm* of HCI (see Table 3.1 Page 39) joining theory and practices in connection to the multidisciplinary perspective of HCI and Computer Supported Cooperative Work (CSCW). Investigation about meaning intersects methods of analysis that require *"different sort of sensibilities"*. This sensitivity refers to the ability to capture the environment and to the tension of translating the understanding from the field for the purpose of actual projects for stimulating interaction [Blomberg and Karasti, 2013, Dourish, 2004, Woodruff et al., 2001]. Interactive technologies endorse and stimulate in different ways a face-to-face (or as we will discuss on Chapter 6, a hand-to-hand)

interaction [Woodruff et al., 2001]. In this direction, museums introduce interactive technologies as engaging tools for sustaining visitors' interactions during their visiting experience [Woodruff et al., 2001]. For instance, Hindmarsh et al. [2002] describe their Ghost Ship experience on visitors' behavior in relation to DIT in terms of opportunity for enhancing visitors' geniality and cordiality. As the author explain, visitors approach and engage together simultaneously across the interactive technology. Moreover, interactive technologies attract people, and stimulate interactions and engagement. Furthermore, connecting with the concept of intermediary object [Boujut and Blanco, 2003][1]
, interactive technologies guide and trigger cooperation through people stimulating new practices and activities.

In this discussion of interaction experience, negotiation and conciliation take a core position on the process of creating knowledge. Moreover, as the discussion around the 3rd *Paradigm* of HCI underlines, the environment and the DIT blur together providing opportunities to people to communicate and share knowledge. For providing a clear picture of museum as an opportunity for creating knowledge the following Section 3.2 focuses on museum changes and on the intervention of DIT to this change.

3.2 Museums changes and DIT

This Section discusses changes of museum due to social and historical evolution, with a specific focus on the introduction of Digital Interactive Technology (DIT) in the context of museum. After having introduced the evolution of the *idea* of museum, the Section focuses on the relationships between visitors and curators, a relationship stressed and changed by and through the introduction of technology in museums.

As introduced in Section 2.2.1 Page 31, museum institutions changed over the last centuries. Particularly, museums turned into a public instrument for *"collective good"* instead of being a private symbol of political and economic power [Bennett, 2013]. Museums, as we know them today, are the

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[1]The concept intermediary object has been introduced by Boujut and Blanco [2003] for remarking the difference between an object for collaboration and a boundary object [Star, 1988] that serves to find the link between two different perspectives.

outcome of egalitarian and inclusive principles of the modern society. Cultural and ethical changes toward an inclusive idea of society contributed to a new interpretation of the role of museum as an amusing and educative opportunity for citizens. In fact, Bennett [2005] describes museums as instruments and occasions for developing new environments, and stimulating inclusive and participative social and civic agendas. In this direction, Hooper-Greenhill [1992] describes the changes of museum as linked to the modern interpretation of knowledge that is a combination of factors and connections. Knowledge is what the author describes a *"holistic experience which is defined through its relationship to people."* Moreover, Hooper-Greenhill [1992] describes the process of creating knowledge as

> *"shaped through a mix of experience, activity, and pleasure, in an environment where both the "learning" subjects and the "teaching" subject have equal power."*

Given by social and political implications, museums have multiple aims: collecting, preserving, and exhibiting objects for the pleasure of visitors, and building relation between past, present, and future generations [Crane, 2006]. Such complex tasks, of linking past, present and future, stimulate and challenge imagination and conversation [Carr, 2011] impacting people's knowledge through the introduction of new kind of artifacts and the adoption of new media [Stogner, 2009].

Together with the evolved interpretative framework of knowledge, museums faced a new wave of changes in terms of *amusement* and *eduction* because of the current introduction of Information Communication Technology (ICT) [Hooper-Greenhill, 1992]. Research related to the introduction of ICTs in museum field highlights visitors as the core subjects and as the beneficiary of a greater part of ICTs projects about museums [Ciolfi, 2013, Simon, 2010, Nuno Correia et al., 2010, Kaptelinin, 2011, Hooper-Greenhill, 2013, Diaz and Macchia, (Forthcoming]. While the role of curators and of exhibition designers is on the background Ciolfi [2013], while these professional figures are implicitly recognized and discussed among the museum community experts [Macdonald, 2006]. In fact, this subject has been discussed during a conference organized, in the end of 2009, by the Arken Museum

of Modern Art[2], the Louisiana Museum of Modern Art[3], and the Copenhagen Doctoral School of Cultural Studies in the Department of Arts and Cultural Studies[4]. The conference entitled "Event Culture: The Museum and Its Staging of Contemporary Art"[5] discussed the changed role of museum and about the figure of the curator and the curatorial activity, which concluded with the fact that temporary exhibitions are generally preferred than permanent collections. The un-permanent profile of curators activity is influencing the role of institution as a whole. Finally, the conference focused on the introduction of new technologies and on the influence they have in designing exhibitions. Since the conference took place in 2009, some steps have been taken to consider both roles, the one of curator and that of visitor. While discussion on new technologies for museum improvement, Kaptelinin [2011] emphasize the complexity of museum activity and of the circumstances where museum artifacts and technologies are taking place among visitors and museum staff. Museum staff and visitors are the core of museum experience and engaging visitors museum experience [Kaptelinin, 2011] overall through the adoption of new technologies. Besides, the introduction of technologies engages visitors and contributes to make concrete decisions regarding design and deployment of technologies in museums [Kaptelinin, 2011]. In addition, the use of social networking tools and to the introduction of interactive technologies dynamically changed and enhanced the visitors' perception of museums and the profession of curator as well [Stuedahl, 2015a, Kaptelinin, 2011, Proctor, 2010, Hall and Bannon, 2005].

However, the increasing introduction of technology in the museum environment opened to few critiques: while technology extend museum perimeters, technology is *de-naturalizing* museums, re-formalizing them into themeparks, creating a "generic space of edutainment" [Griffiths, 1999]. Some researches investigate the combination between amusing and educative purposes, which blurs into the museum visit as a unique experience Ellenbogen [2002], Ash [2003]. ICTs allow visitors to access the museum through dif-

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[2]Look at arken.dk - last visited 16th November 2015

[3]Look at louisiana.dk - last visited 16th November 2015

[4]Look at Department of Arts and Cultural Studies, University of Copenhagen: artsandculturalstudies.ku.dk - last visited 16th November 2015

[5]Look at eventculture.ikk.ku.dk - last visit 10 November 2015

ferent ways and positions, the enhancement of the visiting experience by introducing new practices and rules for sharing the experience between (and within) groups of people Hooper-Greenhill [2013]. DIT and smart devices stimulate, enhance and increase the sharing potential of visitors during the visiting experience [Weilenmann et al., 2013]. As Weilenmann et al. [2013] underline, the sharing activity can be considered in respect to two narrative forms, on the one hand it has the aim to remind an event, while on the other hand, the *sharing* moment emphasizes the communication and the description of the experience. Thus *sharing* is not only a *communication of experience*, in fact, as already mentioned above, it is a way to organize preferences and "curate" a personal collection with the use of content coming from a direct experience and from the museum web site, as well [Stogner, 2009]. However, communication of the experience is not only mediated by technology and outside museum walls. As the following Chapters describe, visitors communicate their experience by acting together and interacting through the space.

Chapter 4

Research method: Techniques to go through TEE

This magnificent irradiation must have been produced by an agent of great shining power. The luminous part traced on the sea an immense oval, much elongated, the centre of which condensed a burning heat, whose overpowering brilliancy died out by successive gradations.

Jules Verne - *Twenty Thousand Leagues under the Sea*

The previous chapters deal with the application of Social Informatics paradigm to the design of Digital Interactive Technology (DIT) and interactive systems that aim to support the creation of knowledge in the context of museums. The previous Chapter 2 and Chapter 3 introduce theory and methodology for dealing with design of DIT. I draw theoretical guidelines for questioning social consequences of the introduction of DIT into public spaces that, indeed, impacts on social policies and human/technology/environment relationships. Following the trajectory drew by the previous Chapters, this Chapter describes the used methods for collecting data for illustrating an image of people's activities and perceptions on using (or not) DIT. Thus, focusing on sharing knowledge between people in museum TEE, into HCI domains, I take into account two permanent

museum areas of the Museum of Science (MUSE) of Trento - Italy. The two areas where I conducted the ethnography for collecting the data are positively different - even opposite: the Maxi Ooh, a children area that provides visitors with high-tech interactive performances (see Figure 4.2 Page 56), and the Discovery, an other children area where children-like environment provides visitors with information about alpine forests (see Figure 4.3 Page 58).

Methods for accounting design DIT that actually helps people to create knowledge, include ethnographic and design measures, interweaving two research traditions: on one hand the STS tradition highlights and extricates relationships between objects, subjects and environment; and on the other hand the HCI tradition that aims to construct and change the context as it is.

For seeds to grow and be fruitful, we need to nourish the ground and preparing it. In order to prepare the ground for designing for public spaces, supporting and encouraging people to share their understanding on subjects proposed by museum exhibitions, there is the need to understand which dynamics, elements, factors, subjects and contexts invite and encourage creation of knowledge. For disentangling the complexity and articulation of the phenomenon of socially creating knowledge, I adopt ethnographic method, which aims to highlight and unscramble the relationship among connections and influences between people, DIT and space, in order to participate within the design process. Ethnographic methods, which traditionally belong to anthropologist rather than interactive designers, helps to underline details of interactions and implication of DIT to the interaction. Details on interactions and implication of DIT to the interaction, underlined by ethnographic methods, are related to social understanding rather than on technical understanding [Dourish, 2004]. Hence, going out from safe and *pure* laboratories and using anthropological methods instead of controlled and privileged experiment, provides guidelines for understanding people's actual interpretation and use of DIT rather than how people might interpret the technology [Dourish, 2004].

This Chapter is divided into two sections: first, the Chapter provides an

overview of ethnography as a method and, second, it describes how I used ethnography to identify guideline for designing context and DIT.

4.1 Ethnography and museums

We are social being and because of this our nature is to communicate; additionally, we make things and are ingenious [Fry, 2012a]. As the author underlines, for us *making* is a combination of *"active construction of experimental life and implicated in ideas, meaning, symbolic forms, objects, structures and thus material and immaterial relations"* [Norman, 1988]. As observed during the field study at the MUSE, museums provide the occasions for going through the features of human being, features that lead to the creation of knowledge through the interaction with DIT. A combination - human being and DIT - *"that creates super-powerful beings"*. Museums, as cultural institutions, are multifaceted social systems that reproduce culture through rules and norms, aims to stimulate people's knowledge [Giddens, 2013]. For instance, Miller [2009] describes cultural institutions, such as universities and museums, having the explicit aim to disseminate knowledge and to reproduce and progress their culture. Additionally cultural institutions provide occasions for people to socialize and share experiences (see Chapter 3). In this direction, the fieldwork at the MUSE highlighted the dynamics concerning people, DIT, and creation of knowledge. Ethnography differs from other research approaches and methods that involve structured and in-office activities, such as surveys and statistical analysis. Ethnography is definitely in contrast with social experiments, and controlled and artificial interventions meant to prove and demonstrate research ideas and theory. Rather, ethnography brings researchers into a practical level that exposes them to applied and down-to-earth form of understanding [Macaulay et al., 2000]. Doing ethnography is about looking at social phenomena and organizations *"from the inside"* and from an in-action point of view [Button and Dourish, 1996]. Moreover, as Button and Dourish [1996] recall, doing fieldwork from an ethnomethodological perspective is about narrating and analytically picturing *the* story, rather than providing a bunch of sketches from the field. Thus the ethnogra-

pher is someone different than a person who enters the field, takes some notes and says *"Goodbye and thank you"*. For grasping intentions, meaning, and perceptions [Hakken, 1999], the ethnographer, even when we talk about *quick-and-dirty* [Nyce and Löwgren, 1995] and/or *rapid* ethnography [Millen, 2000], has to engage with people and empathically build a relationship with them. Thus, the ethnographer is in the position to translate cultural dynamics that arise from observations and makes these dynamics accessible for designers. Ethnographers depict in-context dynamics providing stories and narrations for letting others to understand - rather, represent - how actual dynamics are.

The lexicon of ethnographic studies origins in anthropological research and *"places an emphasis on the detailed understanding of culture, through intensive, long-term involvement and* [. . .] *thick description"* [Dourish, 2004]. For instance, traditional ethnography, such as those portrayed by Mead [1928] about the Samoan teenagers or by Malinowski [1922] on his detailed analysis of the Trobrian population, takes into account details with the instance to understand different cultures. The traditional ethnography is worth for providing detailed descriptions of cultures and meanings behind these culture features. However, the current use and interpretation of ethnography brings researchers and ethnographers to a new stage of using ethnographic methods. For instance HCI researchers with time constrains and technological renovation requirements[1], adopt and shape ethnographic methods with the specific intention to operationalize the understandings of the fieldwork and apply this understanding into the creation of new objects and/or services.

Adopting ethnography as research method for exploring the creation of knowledge provides understandings about the actual impact of people's participation and interaction with and through DITs [Macaulay et al., 2000]. Hence, ethnographic observations and analysis uncover needs for interaction design unveiling the practices rather than the processes of action [Dourish, 2004]. While the *process* describes norms and formal regulation, practices refer to the everyday capacity of people to make sense of the processes into everyday life conditions. The observation of practices aims

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[1]I consider the trend to continuously produce new technology as *technological rush*, a concept connected with the un-sustainability of technology (see Chapter 5 and Tomlinson et al. [2013])

to understand **how** people are *getting the things done*, how they actually interact with each other and within a context, and provides insight for understanding patterns of use and of action. Focusing on practices rather than on processes that are useful in order to enter in the field, helps research on people's activities and interactions [vom Lehn et al., 2001]. Thus, ethnographic observations in museums and galleries provide information on the features of materiality, and on social interactions and experiences [Falk and Dierking, 2000]. I dare say that ethnography helps researchers to take distances from implicit assumptions about the visiting activity and helps to understand how *"the visitors learn what the project team intended"* [Falk and Dierking, 2000]. Besides, looking at practices and interactions, ethnography follows and informs on everyday changes and accommodations to the evolving circumstances [Dourish, 2004]. The feature to keep on the flow and the rhythm of changes in ordinary spaces give the opportunity to grasp the essence of actual needs letting the researcher to empathize with the people around. There are not clear instructions for dealing with ethnographic methods; still, the researcher has to encounter the world first-hand (to paraphrase Blomberg and Karasti [2013]) and looking at it from different angles and perspectives to make of practices visible [Star and Strauss, 1999]. As Star and Strauss [1999] underline, there are circumstances in which people are quite visible while the practices are rather invisible and referred to the background, and the role of researcher is to make the invisible visible. Thus, an ethnographic study helps to understand social practices and possibly inform the researcher for improving social interaction and modifying former conditions (see Section 4.1.1 Page 53). Hence, ethnography is not a mere instrument for informing design, it is rather an open ended and interpretative investigation that goes together with design [Blomberg and Karasti, 2013] looking at future potential for instance in terms of design challenge. In fact, Bell et al. [2003] invite to discuss and *"develop innovative approaches to design through deeper understandings of the social and cultural meanings of domestic technologies"*.

4.1.1 About doing ethnography

Doing ethnography seems to me well suited method for dealing with the current complexity of public spaces amazed and extended and stretch by the increasing use of interactive and interconnecting systems that drip working context and pervade in wide measure different areas of private and social life [Hughes et al., 1994]. Ethnography is useful in complex contexts - such as cultural institutions - that involve differentiated agents with multiple needs, highly differentiated set of objects and services. In these kind of contexts, ethnography highlights everyday or routinized aspects and interactions that other in-office methods can't perceive. However, ethnography needs time and effort for grasping details of contexts and the HCI domain of research can hardly count on these features. For instance, in HCI research priorities are mainly related to rapid and continuous changes of technology, and delivery deadlines or founds restrictions affect the way to conduct ethnography. Ethnography in HCI recalls specific, perhaps rigid, schemes for in-office and planned research requirements. This use of ethnography limits the study to a plain functional and circumscribed experience for serving a specific project, rather than providing an independent and flexible set of information about the field of study [Hughes et al., 1994]. Thus, I embraced the opportunity of the doctoral research to enter the field of the museum to focus on general understanding of museum dynamics. However, ethnographic outcomes slide toward the context of reference and inform on potentially similar context.

For this study, entering the field has been an experience itself that introduced me to the MUSE. Entering the field is relevant to have a first perception about the institution. Doing ethnography could be woolly. I can empathize with visitors and connecting with them and be part of the scene with them, while I still have the opportunity to take a step back and change perspective each time there is something new that comes up and is worth to be investigated.

Doing ethnography in the museum has to do with the spare time of people, with their intimate moments within family and friends, and within themselves. Additionally, ethnography in this specific context has to deal with working time of museum staff. Thus, doing ethnography in museums

is rather about balancing the personal experience between two different groups of people, which happen to be more interrelated than it seems at first glance. The interconnection between visitors and museum staff challenges the delicate conditions when visitors and museum personnel negotiate their relationship. Because of the gracefulness of this relationship, the role of the ethnographer is rather complicated and knotty: I had to measure myself with and within this relationship. I had to balance and to position my role among different situations in order to grasp details. The ethnographer might enter tiptoes in the museum, trying to catch traces and feelings of people and asking the permission for observing.

Every day is different, each time the ethnographer accedes the museum there are new people to talk with and to observe, there are different visitors and the museum staff is (luckily) not always the same and every note and pencilled out memo has different taste and a different meaning. Thus, personally entering the Museum of Science in Trento (MUSE) itself has been a quite intriguing experience that offered valuable material for understanding further observation details.

The following section describes the ethnographic experience at the MUSE, focusing on personal understanding of how museum works, on the ethnographic methods adopted and on the way the ethnographic material has been used and organized for this thesis.

4.2 Ethnography at the MUSE

Ethnographical investigations has been over criticized for the uniqueness of and for the specificity of the contextual conditions that reduce comparative opportunities [Blomberg and Karasti, 2013].

When I considered the MUSE as my fieldwork, it was an odd while happy situation for the institution. The former Museum of Science of the city of Trento was going to be moved from the hearth of the city to be re-opened in a building in the new neighborhood *LeAlbere*. I negotiated my research at MUSE together the head of the Department of External Relationships and the head of Department of Public Programs[2] I begun my observations

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[2]During a seminar in Venice, I met Antonia Caola, responsible for external relationships and introduced me to Samuela Caliari head of Public Programs at the MUSE and her collaborator Rosaria Viola. With

during the first birthday of the new museum the 19th of July 2014 doing observations in the new area for children, the *Maxi Ooh.* After having spend three months in the Maxi Ooh, with the museum management we agreed to start a new slot of observation in an other children area, the *Discovery.* The two areas are different as the following paragraphs describe.

Figure 4.1: Non-interactive area and the entrance in the Tactile room of the Maxi Ooh

The Maxi Ooh

The Maxi Ooh is a special exhibition for children from zero to five and for those adults who come along with them. The exhibition is protected by glass-walls and marginally impacts the colorful and exuberant permanent exhibition about physics laws of ground floor (see Figure 4.1 Page 54).

Antonia we met a second time and agreed that the coming opening - 27th July 2013 - was favorable and advantageous for starting an investigation. Even though the opportunity to start the observations was forthcoming, organizing and arranging the procedure to officially enter in the museum was rather longer than we expected.

The Maxi Ooh is a peaceful area, so calm that Pilots[3] make jokes saying *"a shift in the Maxi Ooh is a company bonus"*. To enter in this peaceful area of the museum, visitors are asked to take off their shoes , feeling free to be involved in the environment without getting formal information or suggestion from the museum staff, but enjoy the experience. Taking off the shoes and feeling free to move in the space without following a specific visiting strategy or path provides visitors with a first opportunity to find themselves in a sympathetic and peaceful mindset. Also, the glass-walls around the Maxi Ooh help to create a comforting space where visitors cane move across the three rounded rooms in the area. Each room has a different sensorial theme: Relaxation, Tactile, and Sound (See Figure 4.2 Page 56) where there are interactive installations for providing sensorial feedbacks. The Relaxing room is a half-light relaxing bathroom with sensors that detect human presence and let waters and bubbles flash out. Differently, the Tactile room is a fairly large round room where pillows spread all over the floor and cloves of different material invite visitors to enjoy and experiment their tactile skills. The white walls are enriched by the projection of fairylike forest or see-world landscape (see Figure 4.2a Page 56). The Sound Room is a smaller rounded space where a vibrating chaise-long with earphones for listening classical music, a huge cushion and two screen-installations with two microphones at the corners fulfill the area. The two screens are supported by white totem: people can talk at the microphones and either small forms and symbols pop up in the screen or the draw moves following peoples sounds (see Figure 4.2c Page 56). Additionally, a projection displays the visitors' figures, which are perceived by sensors in the room: when the represented people talk, bubbles appear and move on the wall (see Figure 4.2d Page 56). The bubbles have different colors and size depending on the tone and the frequency of visitors' voice.

The design of the space and the used material are in harmony with the objective of the area to stimulate people to enjoy and interpret the exhibition following their inclinations, there is nothing wrong or right. Visitors interact interpreting the space as if it was a blank paper and they could

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[3]Pilots are as professional natural scientists, usually provide visitors with additional information about the natural world.

(a) Child walk on the light creek of the forest like landscape in the Tactile Room.

(b) Children look for music instruments in the non-interactive space in the Maxi Ooh

(c) An installation reacts to visitors' blow in the Sound room
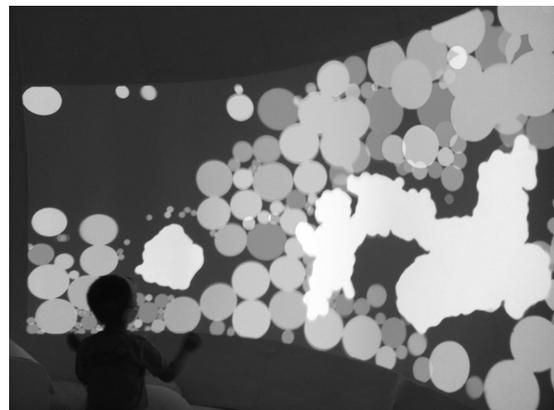
(d) Bubbles represent voices in the Sound room

Figure 4.2: Installations in the area of Maxi Ooh

draw on it: everything is white and the around objects are ready to be re-defined and used according to new (some time unexpected) purposes. Through, interactive sensors the environment changes and activates if and when visitors move and talk: virtual and interactive environments turn on because of visitors actions. Between the rounded rooms, an area for relaxing and enjoying each other company has been arranged with sofas, armchairs, wooden toys and books (See Figure 4.2b Page 56).

The first time I entered in the area, I was surprised: everything was almost set for welcoming visitors for the first time during the celebration of the first year of successes of the MUSE. The museum staff planned to let in the Maxi Ooh eight slots of fifty visitors. During each slot of twenty minutes

visitors were mingling around experimenting the area. During this packed event nobody realized I was there, it was like being transparent, I took notes from the corners of the spaces. During each slot of time I took notes from a different area of the Maxi. During this day of I took notes of the *quick-and-dirty* visiting experience of four hundred people. This experience was quite different than the those had during everyday ethnography. After the overwhelming and opening event, I spent three days per week for two month in the Maxi Ooh. I have been provided with an *official* t-shirt of the museum and a badge saying my name. I wore the t-shirt since one day I forgot to wear it. I have no idea if it was because my own perception and attitude were different, but without wearing the official museum t-shirt visitors seemed more open and eager for talking.

Pilots introduced me to visitors and I used to present myself and my role there, asking the permission to follow the visiting experience and to take notes. It is indeed unluckily that someone would have not allowing me to take written notes. However, it was evident that some visitors my presence in the room was quite too much. Whenever I could perceived tension from visitors with having me around, I left the room and spent sometime with the Pilot. However, spending time with Pilots it has always been valuable since provided unexpected information around the museum environment.

Doing ethnography at the Maxi Ooh was interesting for the unusual design of the area. Differently from other museum spaces, this one was inviting visitors to *do-it-by-themselves* and to feel the environment without the support of the museum staff; to learn and experience the exhibition through the senses. The Discovery area is fairly different, the museum staff is directly involved to the visiting experience and the environment is calling for energetic and lively interactions.

The Discovery

The Discovery is an other children area at the MUSE, it is colorful and gripping. Opposing to the Maxi Ooh, the Discovery invites for chats and conversations between visitors and with Pilots. In fact, while doing ethnography in this area, empty time was filled by discussions and anecdotes about the museum experience; everyday-chats were far more useful than

Figure 4.3: People in the Discovery

formal or planned interviews, as I could realized attempting an interview
with notes and recording device with one of the Pilot. The first (and only)
attempt for formal interviews was an actual failure. I wished to investigate
relationships between visitors and Pilots, from Pilots' side. I decided for
this (set, as I was planning) interview since informal talks revealed some
techniques Pilots use to get closer to visitors and build on a relationship,
like telling personal adventures in the wood. The attempted-interview gave
fewer information than five minutes *chit-chat*, since the answers were look-
ing too *perfect*. However, in the Discovery there were many occasions to
talk with Pilot and to look at them at their very best in their relation with
visitors.

The Discovery is a kind of playground setting at the third floor (see Figure
4.3 Page 58). The area provides three different kind of installations: chest
drawers with natural items; discovering non-digital games; and a multi
touch interactive tabletop with a game (see Figure 4.4b Page 59).

The chest drawers withhold mainly original forest items such as feathers,
skulls, feces, nuts, leaves, and other natural and animal article to let vis-

(a) The bush of smell lets people to explore and guess some forest smells.

(b) The interactive tabletop game ALP is an occasion for feeding animals.

(c) The view from the third floor.

Figure 4.4: Elements of the Discovery

itors understanding some special *treasures* of alpine forest. At the same pace as the chest drawers, the discovering installations hide forest object in holes where visitors can put their hands for guessing or conceal forest smell unlucky to understand at first glance (see Figure 4.4a Page 59). Differently from Maxi Ooh, which is protected by glass-walls, the Discovery is open and embedded in the surrounding environment that displays forest items and explains forest-life through panels, videos and showcases.

When I started the observation activities at the Discovery, I planned to follow the same direction adopted for the Maxi Ooh. However, I realized very soon that differently from the Maxi Ooh, an intensive program of observations would have been required because, even though the space is definitely smaller, it is open to everyone and visitors move quick between the exhibitions and across the installations. I opted for intermittent observations to cover multiple conditions and keeping the level of enthusiasm and the freshness that observations and taking notes require. In fact, for my understanding of what *doing ethnography* needs, time for *resting* mind and making sense of the observations is of a major key for grasping information and details. Thus, I planned visit the museum all the days during the week for one month, alternating the schedule between morning and afternoon. It was around Christmas time, thus some days were pretty boring and empty while some others, mainly during the weekend, were packed as I never thought it could have been. During empty time I took the occasion to talk with Pilots to learn about their job, their opinion about the museum and to learn about alpine forest (very nice side effect!).

Altogether I spent three months in the field observing, taking notes, having informal discussions and taking few pictures[4] of interesting episodes, give the research material to work on. I mainly preferred to stay aside the situation, trying to do not invade people's free time unless a built relationship would have emerge by sharing experience or asking about my research (see Table 4.1 61). Because of the attempt to not interfere with peoples visiting experience as much as possible, but without being invisible, I used unobtrusive while visible technique: pen and a red notebook, rather than video recording or compulsive picturing (see Figure 4.5 Page 60). For

Figure 4.5: A picture while I was searching for a note in one of the diary. This specific picture shows how people move in the Discovery: the draw in the center represent a magnifier glass over an insect in a case.

instance, the issue of video recording is that researchers may need multiple cameras to have a fair idea of the circumstances. Moreover, in addition

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[4]I decided to take really few pictures in order to disturb the visit as less I could. When there was an instant, I showed the visitors the pictures I took while they were interacting or observing something, and asked if they wanted me to share the file with them and if I could use them for my works without showing the face. Moreover, I am not showing the identity of visitors I pictured, also because I did not want to ask for sign any agreement. Not asking for signing agreement is a deliberate choice: asking for signing papers is building a formal relationship, which could have affect the connection I built with visitors.

Field	Maxi Ooh	Discovery
Period	July-September (2014) three times a week	Mid November-December (2014) every day
Techniques	field notes, informal chatting, few picture	
Main feature	Protected area, three interactive enhanced rooms, common area without interactive technology, fixed maximum number of people	Open area related to the extended exhibition in the same floor, mainly analogue installations, the interactive game ALP
Ethnographic extracts	Maxi Ooh extracts • Moving for Inviting, Page 73 • Discussing positions, Page 73 • How to make a tree, Page 76 • Coming through the interaction, Page 82 • How the slap works, Page 84 • Testing voice and sound during the break, Page 91 • Making bubbles by chances, Page 103 • Stopping the lights, Page 114 • Stopping the lights, Page 114 • Making shapes together, Page 131	Discovery extracts • Which animal-avatar to choose, Page 78 • Moving the discussion from the Discovery to the floor exhibit, Page 90 • Making connection with the others, Page 105 • It is from bat, Page 107 • Footprints in the forest, Page 112 • Evolution of feeding system in the Alps, Page 107 • Sprint up to the stairs looking forward to play, Page 138 • Dear deer breaks the game, Page 138 • Moving calmly through the installations, Page 140

Table 4.1: Summary of the ethnography conducted at the MUSE with the list of the ethnographic extract describes in the further Chapters.

to the researcher subjective *filter* there is the filter of the camera with a restricted view-angle. Furthermore, visitors' reaction to camera is unlikely predictable [vom Lehn et al., 2001].

While talking with visitors about their experience I asked for their e-mail address for contacting them and eventually get interviews about their perception on the experience of sharing knowledge. However, after the episode I'm going to describe in the following lines, I decided to not follow the observations with interviews. In this episode a family from an other Italian region agreed for an in-time interview and we met at the bar of the museum when they ended the visit. Interviewing family members all together is quite tough. When we got together, I offered coffee to the parents and an ice cream to the child, I felt as though neither of them was feeling comfortable and pleased as they were while we had talked at the Maxi Ooh. Perhaps because the long tour at the museum tired them (when they left the Maxi Ooh they had a tour of almost one hour and half) or because talk with stranger is not that easy if the circumstances change. However, while asking for their perception on the Maxi Ooh and what they were bringing home, the kind of answer I received overlapped previous talk. Thus, I used the interview to get practical information. Both parents are musicians and one of them manages a music-therapy association, the child herself is participating to preparatory music sections. Their professional background and passions stimulated the three of them to share their understanding mainly about the Sound Room. The interview was quite short and ended with questions about how many times they visit museums and if they actually interact artifacts offered for providing additional information and if it so, if they do talk about what they learnt. They use to travel a lot and visit museums very often and try the different installation museums propose. However, they usually keep this as a family experience.

As consequence of this episode, which was actually interesting and pleasant, I decided to get further information during the visiting experience and not in a second time. Even if I opted for this choice, I asked visitors for their contact for thanking them for their time and if needed for further meetings [5].

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[5]This is a short anecdote: I was in a train and a man seated close to me looked familiar, apparently I was looking familiar too, at one point I realized he was the father of a very nice child who visited the

The data collected during the ethnography touches different aspects of museum experiences and the understanding of the context is a progressive experience. Moreover, the collection and the analysis of the data grows together through four activities [Silverman, 2000]:

Data reduction Raw data are selected, simplified and organized;

Data display The data are assembled for identifying relationships and drawing the direction of the analysis;

Conclusion drawing Data get to have regularities, *causal flows"* and explanatory patterns;

Verification Draft conclusion are tested in terms of plausibility.

While taking notes and transcribing them, different categories of actions and interactions pop-up on the surface and illuminate the data. Clustering actions under categories of data helps the organization and the analysis of the ethnographic extracts. As well, using the contents of categories as descriptions provide a grid for interpreting and understanding actions and activities.

My analysis of raw data highlighted two main interpretative lines of activities: individual and collaborative. I decided to cluster the individual activities under a *theme* that I decided to titled *Method*. I clustered collaborative activities a under different themes that describe reiterated actions and interactions in relation to the creation of knowledge. The different activities that characterize the themes are clustered in respect to similar actions and interactions. I adopt NVivo, a computer-assisted system for qualitative analysis, helped to organize clusters of collaborative actions[6] (see Table 4.2 Page 66). The relationships among nodes build the body of this research and are discussed in the following Chapters. I built the relationships according with the personal interpretation of the nodes and of how the nodes connect with each other. However the support of the program for qualitative analysis helps to visualize the data and and to find

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Maxi Ooh. When we both recognized each other he was interested on the research and asked for further results. These are aspects of doing research field I like more, the contact with people.

[6]I describe clusters as *themes* according with the lexicon of the program Nvivo.
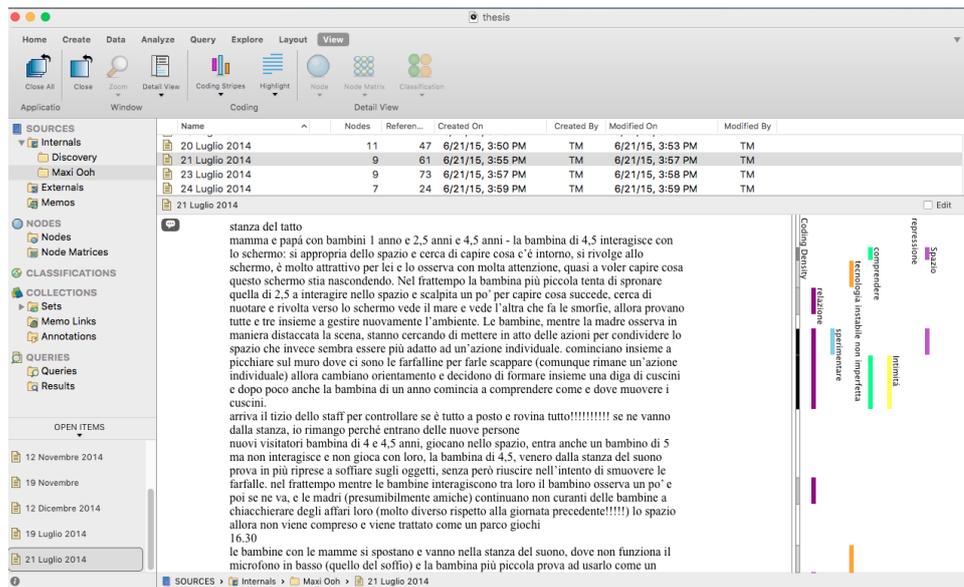
Figure 4.6: Visualization of nodes in an ethnographic extract. Visualizing how the nodes relate together helps to analyze the interactions and to understand how the activities and the actions happen.

proximity between extract. The relationships identified by the program are an interesting starting point to go through the analysis of the data.

The following Chapters tackle the organization and the analysis of the data using extracts of people's actions and interactions at the museum. The analysis and the discussion of the ethnographic extracts provide the conditions for constructing a codify understanding of relevant conditions, actions, and interactions for people to create knowledge.

The following section describes the themes nodes identified during the analytical process.

4.3 Research Material: transcribing, storing, analyzing

Making sense of qualitative data collected during the ethnography and developing understanding around them is rather a fascinating experience that highlights the complexity of social life, relations and correlations among behaviors, actions and words that, otherwise, might flew away. With the research question in mind on *how to design DIT for people to create knowl-*

edge, I transcribed and coded the ethnographic notes into NVivo. I highlighted sentences, paragraphs and aspects of the transcribed notes related to *sharing information* and *creating knowledge* coding in respect to the action, the outcome, the context creating nodes and themes for clustering conditions that stimulate/generate knowledge.

NVivo, a software for computing-assisted analysis for qualitative data, can store internal and external file, which is a quite interesting feature that lets flexible rooms for researchers to analyze different kind of documents. Even though this feature might be quite of interest when using multiple techniques such as interviews or conversation analysis, in this specific case I personally preferred to analyze internal documents, because of the cleanness of storing the material.

Transcribing notes and making comments into NVivo display recurrent conditions and interaction that can be coded as nodes. The process of coding the text is supported quite well by the system: while writing sources, it is possible to underline text and associate it to an existing or a new node. Nodes can be clustered in themes for providing a first sight understanding of the commonalities between the nodes.

The analysis of the data highlighted fourteen nodes that I grouped into four main themes: learning, sociality, technology and methods (see Table 4.2 Page 66). These themes and the related nodes provide integrated information for getting information for designing DIT for museums that are going to be explained in the following Chapters. However, the following Chapters take into account nodes that support heavy relationships, while set aside five *spare* nodes having light relationship (see Table 4.3 Page 67). I sorted the density of the relationships running a universal query on NVivo and categorized as heavy relationships with a relational weight higher than #3 points of weight out of #11 (see Figure 4.7 Page 68). However, because of the intrinsic bias of the universal matrix the range of points considered is between #3 and #7. The nodes with lighter relationships than weight #3 are interesting as well for the understanding of human/technology connection.

Themes and Nodes

Learning : This theme refers to learning as a social process that occurs through collective participation to activities. Thus, this interpretation of learning implies the influential role of the context in making the learning process happening [Lave and Wenger, 1991]. This theme is about the conjunction of four nodes:

Understanding (see Table 6.2, Page 102)

Puzzling (see Table 4.3, Page 67)

Discovering (see Table 6.1, Page 100)

Experimenting (see Table 6.1, Page 100)

Sociality : This group of nodes aims to underline a relational experience in the process of visiting the museum. As matter of fact, this group of nodes includes:

Intimacy (see Table 4.3, Page 67)

Relationship (see Table 5.1 Page 73)

Restraint (see Table 4.3, Page 67)

Space (see Table 5.2, Page 81)

Technology : With this theme I underline the actual intervention of technology in the process of creating knowledge. This theme mainly refers to the kind of relationship that human develop in respect to technology, space and people. Thus the nodes touch on:

In and out (see Table 5.3, Page 96)

Reinterpretation (see Table 7.2, Page 132)

Sustainability (see Table 7.2, Page 132)

Space (see Table 5.2, Page 81)

Instability vs Imperfection (see Table 4.3, Page 67)

Method : While the themes described above allude to the interaction between people and technology and space, this specific theme refers to the ethnographic method and provides insights on the ethnographic understanding through the following nodes:

Ethnographer (see Table 4.3, Page 67)

Narration (see Table 4.3, Page 67)

Table 4.2: Themes and Nodes

Nodes and Themes for understanding human/technology relationship
The nodes related to the theme *Method* are interesting for developing further understanding on the implication of ethnography for ICT research, add fuzziness to the context of this research. The node *Ethnographer* is mainly related to doing ethnography, and the node *Narration* is related to episodes of visitors' story telling.

The nodes following describes are mainly related to individual experiences, and I'm positive I will unpack these nodes in an other context.

[**Puzzling**] This node describes episodes and anecdotes similar to those of *Experimenting* ((see Table 6.1, Page 100)). However, the node *Puzzling* concerns individual experiences.

> "She is looking around perplex, and runs her foot over the pillow-stone."

[**Instability vs imperfection**] This is a node that describes situation in which a technology is not perfect, but is not affecting visitors' experience.

> "The child talks close to the microphone while the mother stand and makes movements for the sensors perceive her."

[**Intimacy**] The moment of understanding how to use a technology is related to individual experience and feeling that are personal. That personal to require to switch language.

> "She understands how the object works and she starts to speak Spanish - before they were talking Italian - bringing the son closer and they start play."

[**Restraint**] Interacting with technology appears as a social activity that has to be shared by participants. Some times visitors restrict others in their interaction for joining a common activity.

> "The child accept the condition posed by the grandmother and stopped the interaction."

Table 4.3: *"Spare"* nodes and themes not directly involved in this work

	A : calma	B : compr...	C : etnografa	D : in and...	E : Intimità	F : narrazi...	G : puzzle	H : reinter...	I : relazione	J : repress...	K : scoprire	L : sosteni...	M : Spazio	N : sperim...	O : tecnol...	P : telefono
1 : calma	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 : comprendere	0	5	0	0	3	0	0	0	3	0	0	0	2	2	0	0
3 : etnografa	0	0	9	6	0	2	0	6	8	0	6	4	4	6	0	0
4 : in and out	0	0	6	7	0	0	0	6	7	0	6	0	3	6	0	0
5 : Intimità	0	3	0	0	4	0	0	0	3	0	0	0	0	2	0	0
6 : narrazione	0	0	2	0	0	4	0	2	0	0	2	0	0	0	0	0
7 : puzzle	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0
8 : reinterpretare...	0	0	6	6	0	2	0	8	6	0	6	0	2	6	0	0
9 : relazione	0	3	8	7	3	0	0	6	11	0	6	4	6	7	2	0
10 : repressione	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
11 : scoprire	0	0	6	6	0	2	0	6	6	0	7	0	0	6	0	0
12 : sostenibilità	0	0	4	0	0	0	0	0	4	0	0	4	4	0	0	0
13 : Spazio	0	2	4	3	0	0	0	2	6	0	0	4	8	3	0	0
14 : sperimentare	0	2	6	6	2	0	2	6	7	0	6	0	3	10	0	0
15 : tecnologia i...	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0
16 : telefono	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Figure 4.7: This matrix represents the weight of relationships among nodes. Weight 0 indicates no relationships automatically identified between nodes, while #11 indicates the stronger relationship identified. However, this compilation include the relationship with the node itself as weight #1. Thus, the stronger relationship between different nodes is weight #7 (without considering weight #8, which is connected with the personal experience and perspective of being an ethnographer. For instance, nodes relationship with weight #7 are *In and Out* and *Relationship* disentangled in the following Chapter 5) in connection with the node *space*.

4.3.1 The fuzziness of *universal matrix* of relationships

As mentioning in the previous subsection, developing knowledge from qualitative data is far to be immediate while bring to the surface unexpected and fascinating interpretation of what the world is offering us everyday. Thus, the analysis of data provides suggestions for shaping answers to research questions. *Objectivity* is fairly impossible and inappropriate to discuss here, the analysis of qualitative data can and has to be explained and shared following the unexpected. However, as previously introduced the analysis of ethnography is quite articulated and fare to be easygoing. For instance, to get to know what the node *In and Out* highlights I adopted first the universal matrix displayed in Figure 4.7 Page 68 for spotting the more relevant relationships with other nodes (see Figure 5.6 Page 89). However, the node *In and Out*, Figure 5.6 describes, is connected with all the nodes and is through the analysis of the transcription that the relevant information of the node and its relationships can be highlighted. For instance, the connection with the node *Relationship* is relevant for weight of the relationship between the nodes, which is #7, and also because it connect also with the node *Reinterpretation*: both nodes have wight of relationship of #6. The node *In and Out* has a strong connection with the other nodes under the theme of *Technology* that is further discussed in
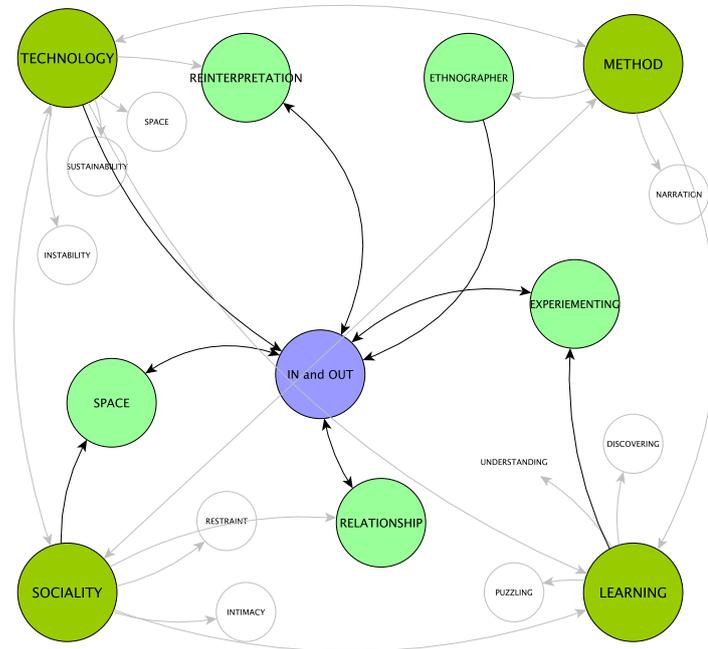
Figure 4.8: Relations and connections between nodes focusing on *In and Out*

Section 5.2 Page <u>87</u>). Grouping the notes related to the *In and Out* node under the theme of *Technology* had been quite stressing since this node also helps to describe conditions and interaction through which people socially create knowledge. The *In and Out* node mainly links with nodes that concern people's relationships in the space. Additionally, this node frequently links with two nodes of the *Learning* theme: *Discovering* and *Experimenting* (see Figure 5.6 Page <u>89</u>). As can be observed in Figure 4.9 Page <u>70</u>, both nodes of *Discovering* and *Experimenting* have a quite similar overlapping of link, with differnces on the intensity of the relationships. In fact, while the node *Experimenting* is strongly related with the node *Relationship*, the node *Discovering* is mostly related to the node *Relationship*. Analyzing the relationships between the nodes and focusing on the meaning of them, and relating the analysis with the understanding of creating knowledge in TEE, I focus on dynamics of relationships between people and technologies.

Following this main line, the forthcoming Chapters discuss how people dialogue together towards installations and museum trajectory recall an organic interpretation of the space (see Chapter 5); how people participate
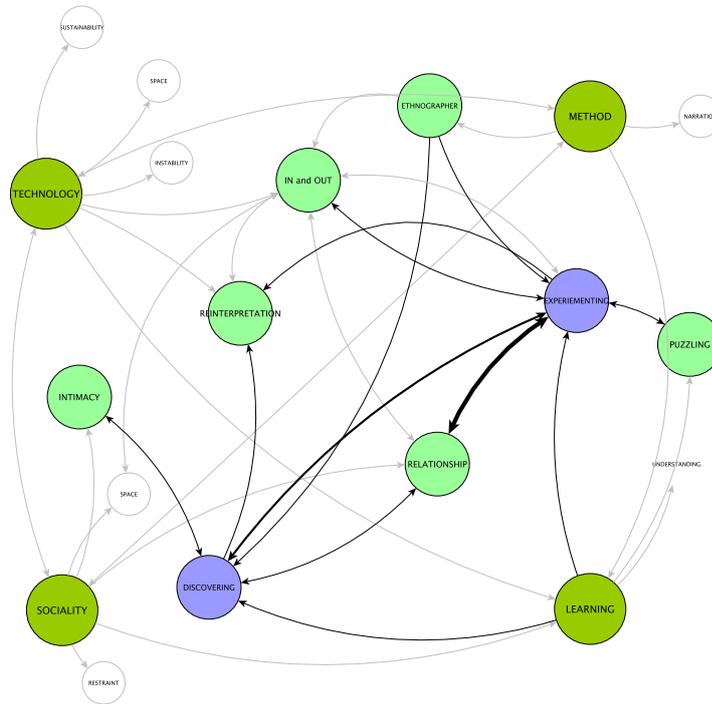
Figure 4.9: Relations and connections between nodes focusing on *Discovering* and *Experimenting*

on make sense of knowledge (see Chapter 6) and make sense of technology (see Chapter 7).

Chapter 5

Opening a Dialogue through Inter/Action

New technologies and media
must be more than add-ons to
existing practices. New
technologies and learning
theories must together serve as
catalysts for fundamentally
rethinking what learning,
working, and collaborating can
be and should be in the next
century.

Fischer and Scharff [1998]

By moving through the ethnographic experience, this Chapter and the
following Chapters 6 and 7 discuss the creation of knowledge in museums through different angles. While the next two Chapters stress on the
reinterpretation and use of Digital Interactive Technology (DIT) in museum spaces, the present Chapter depicts the experience at museum in
terms of collaboration and participation, which are activities embedded
into the node *Relationship* (see Table 4.2). This chapter provides a first
step for understanding Human Computer Interaction (HCI) through the
metaphor of Infrastructuring Knowledge: in terms of social participation
of creating, maintaining and stimulating new meaning and interpretation
of environment. In fact, sharing knowledge in museum institutions links to
relationships between components, features and the context of museum.
The chapter takes into account the actions in relation to DITs and how

people act in the space: first, describes conditions and dialogues that help people to make sense of interactions and expand the potential use of them; second, focuses on how people move in the space. While the first section of the chapter provides information on how people use and make sense of DITs; the second section of the chapter describes people's movements, preparing the basis for the discussion on Chapter 7.

5.1   Crafting Dialogues

The theme *Sociality* (see Table 4.2) identifies and includes mechanisms of connection on group dimension. Going through the ethnographic notes and the extracts of nodes related to the theme *Sociality*, the analysis of activities and experiences includes individual and social behaviors, which imply sharing perception of self and others.The theme *Sociality* emphasizes associating patterns in museum environment through which people push each other to a constructive relationship. The constructive relationship grows through graceful experiences that embrace other people and the way to interact with objects. In this direction, the node *Relationship* describes the everyday museum experience as a connecting activity between people for fulfilling and enhancing the museum experience.

Fulfilling and enhancing the museum experience is a social experience that grows through dialogues. Nodes like *Relationship* look at the connection amonf people, objects and space, synchronizing multiple activities and pursue a shared perception of the experience. In this respect, the Universal query run in NVivo highlights a strong association between the nodes *Relationship*, *In and out*, *Discovering*, and *Reinterpretation* (see Figure 4.7 Page 68). However, the weight of the node *Relationship* is higher than the others. Thus, the relationships between people participating to the museum experience together with the presence of DITs are disclosed as core attribution for stimulating understanding on the surrounding environment. The interpretation of the exhibition evolves and changes throughout the narration people make of it. The primary concerns of understanding the information and the meanings of the exhibition, and sharing this understanding, is at the base of social museum experience. The relationship

Node Relationship

The node of *Relationship* is embedded in the theme defined *Sociality* that aims to underline relational experience in the process of visiting museum.

The *Relationship* node describes activities and situations in which visitors and visitors or visitors and Pilots or Pilots and Pilots interact and act creating a new condition and a reinterpretation of the environment and influence each other behavior and experience.

Example of ethnographic extracts for the node of *Relationship*:

> "The child stands up holding the microphone of the sound installation - the one with the symbols popping up - looking at the screen and talking, he has the body twist towards the other child and time to time he looks at him. The second child takes this situation as an invitation to try the installation. They do voice experiment together doing funny noises."
> [**Moving for inviting - MaxiOoh**]

> "I can can see that it is a collective discover: they are balancing their relationships between the adults and the children. The adults at first were keeping the situation but now the situation is changed because they all together are experimenting new ways to get the result. They are discussing about their position and about who has to do what. They are negotiating the relationships between them and with installation."
> [**Discussing positions - MaxiOoh**]

Both the note extracts reported here underline the relevance of relationship between people in the context of museum. While the first extract describes a situation in which there is a request of connection, the second extract describe a condition through which participants to the interaction smoothly rebalance their relationship, reconfiguring their investigative role. The discussion around the relationship between people helps to clarify how people can arrive together to make sense of the interaction and how they build the interaction together. The lonely use of DIT is very unlikely, in fact when visitors interact alone with a DIT often behave and move welcoming other people either visitors or museum staff. Situation as the one described first in which the child twist looking the other child are quite often, for instance in the Discovery where people are more free to arrive and leave, visitors wait for others to join the interaction and discuss about it.

Table 5.1: Node Relationship

between people at the *Maxi Ooh* and at the *Discovery* happens in two different moments: first, during the process of figuring out the activities; second, when the primary museum message has been understood equally by the participants. The relational experience and the exchange of in-

Figure 5.1: The *magic* Tree projeted in the *Tactile* Room

formation is differently stimulated in the two museum-area: while in the *Discovery* the non-digital objects and the exposed items stimulate visitors' storytelling [Macchia, 2015], in the Maxi Ooh the digital interactive installations trigger visitors imagination in order to collaborative experiment different ways to get understanding reasons of the outcomes of the interaction. For example, the interaction with the digital interactive installations serves people to develop methods for producing an outcomes it does not matter if the starting point the outcomes are always the same, the most interesting thing is to build multiple ways to connect input and output. Thus, if the generation of the magic tree in the *Tactile room* depends on visitors' position and on the time they spend standing in front of the wall, when visitors understand the process they create other ways to reach the goal.

The process of understanding *how* to create the tree is a challenge and a *tough job* (see Figure 5.1) because it appears after around ten or fifteen seconds people stand in front of the wall, and without Pilot's suggestion, visitors unlikely stand quiet for such long time without moving (see Figure 5.1). Creating a tree seems a lucky faith. Discovering the existence of this specific interaction is matter of circumstances: either you discover it casually standing in front of the wall, or you see someone who did it, already.

> The game is to touch as much lightning butterfly as possible: the child is jumping here and there following the butterfly while the father has to stand and, because he is taller than her, he can just move the arms. While standing in the same spot the father stop and look straight in front of him understanding that something in the light is changing and exclaim "ah look! what's happening?". The child stops and looks towards the same direction her father is looking at. She gets closer a little bit puzzled. And eventually an orange tree with hexagonal fluorescent flowers pops up. The child is surprised and didn't expect this to appear. They both wait to understand what happens. As far as it disappear after few seconds they look with a questioning expression. Since I am not allowed to say anything I tell them about the life of trees, that you need time for the seeds to grow. Both father and child continue my narration and make a history of it." [continue...]
> [**How to make a tree - MaxiOoh**]

The daughter and the father were building and triggering mutual and participative narration. The developing of a narrative experience, inventing a game, telling about imperceptible changes, looking at each other wandering what is happening and following small hints to develop hypothetical actions for making things happening, are all together narrative experiences. The dialogue is unstructured and jump from an understanding through an other: the verbal communication stops when the tree pops up and disappears. However, the dialogue between participants continues switching from the game of touching lightening butterfly to *plant* and arising a tree. The dialogue, during the verbal break, continues by sharing movements: a process that actually makes the technology works. Through the construction of a narration, people build the understanding of the process to create the *Tree*. The narration grows together with participants interaction: they discuss *how* to stand and they provoke each other for investigating.

> [... continue] "The child asks how the wall perceive her presence. The father looks at me - I pretend to be really focused on what I am writing - and says that probably there are sensors for perceiving people's presence.
> Still standing, he looks at the Kinect on the other installation and asks the child to help looking around to find an other Kinect like that. Even though the second Kinect is difficult to find, because is hanging from the ceiling and it is white as everything else and the half-light does not help either, the child finds it and this seems to make the two more familiar with the installation. In fact they vigorously turn to the wall waiting for the tree to come up. [continue ...]"
> [**How to make a tree - MaxiOoh**]

The two visitors especially open up a dialogue for understanding how the *Tree* arises. Both of them are coming through each other interpretation of the activity. It is possible to perceive the thinking process, the attempt to catch small details to understand how things work - the fact to look at the Kinect, or comparing what the other is thinking. The dialogue happens as a set of conjuncted parts connected by the technology, by the perception of the interactive potential. For instance the fact that they immediately turn to look at the wall when they perceived the presence of the Kinect, suggests that the interactive process builds on main understanding and thought on how things may interact.

Because of the waiting time for the tree to appear they have rooms to share their understanding and interpretation on the situation. In fact father and child exchange their impression questioning and negotiating what they see:

> [continue ...] "There is something happening dad!? Don't you think?" The child can see that the light in front of her is changing, there is a sort of fog arising exactly in front her. She is quite happy and surprised so she moved and every thing fell apart, but the father could see the fog. So they both agreed that was the first clue of the tree."
> [**How to make a tree - MaxiOoh**]

The mutual understanding of this first idea of the tree appearance encourages both of them to keep on the experimentation. In fact they discussed how they were standing in front of the wall, and the child had the arms raised as if the were branches of a tree.

Because they discussed about their position and how they had to be perceived by the Kinect, that they could see at one point, each of them creates

a tree in those five seconds required by the system. Thus, the opportunity to talk and share what they can perceive make sense of the waiting time in which they can open a dialogue.

Equally, the interactive digital tabletop in the Discovery area provides people with a space for discussing their experience (see Figure 4.4b). The waiting time for the game to open very often they start to discuss about what they did in the area. As vom Lehn et al. [2001] discuss in respect to video artifacts, this multitouch interactive tabletop give visitors the occasion to communicate. Moreover, the digital artifacts are communication

(a) Visitors play with Acchiappa la Pappa (ALP) in the Discovey.

(b) Hands are dropping the animal-avatars on the screen of ALP.

Figure 5.2: Visitors play with Acchiappa la Pappa (ALP) in the Discovey

tools in respect to the environment they are part of. For instance, a father with two children of eleven and eight sat at the interactive tabletop to play *Acchiappa La Pappa* (ALP) (see Figure 5.2) made connection on what was around for discussing the game after the first match.

> "The first game has been quite difficult for the younger boy. The fact is he chose as his avatar the squirrel, this animals has less opportunity to win than the owl or the fox because while the other two animals have a wider diet the squirrel is eating few things. The father understands the reason for the boy to loos and encourage him to pick an other animal, suggesting to prefer one with a broader diet. The two boys and the father start a discussion over the things they learnt about nature from the *Discovery* area and as well from the labyrinth forest. The discussion that is referring to the exposed animals in the labyrinth, switches to the avatars of the game and they keep the discussion

around the potential option for winning. At the end the younger brother decides for the fox because eats everything but bugs and the elder brother picks the hawk. The fathers decides for the squirrel."
[**Which animal-avatar to choose - Discovery**]

Figure 5.3: The Labyrinth in the third floor displays information and characteristics of alpine forests using pictures, animals, and diagrams.

The discussion describes the connection the visitors made between the game and what they saw in the labyrinth (see Figure 5.3 Page 78). Per se, the labyrinth is a permanent exposition of animals and images from the alpine forest that shows the differences of the alpine fauna. The role of the technology, as well as it happened between the father and the daughter while creating the tree is about providing new space opportunity. Moreover, on one hand, the use of DIT in museum is about providing information, on the other hand DIT helps people in the process to understand and make sense of what happens. The outcome of DIT is more than winning a game and making a tree appearing. In this context, when people have the occasion for discussing and opening a dialogue on what they are doing, DIT supports people in the process of meaning making and of creation of knowledge.

In this way, people marvelously use the technology, finding unexpected room for elaborating *ad hoc* dialogues and uses, and for developing momentary interpretation of space.

5.1.1 Making use of a space through DIT

The value of *space* is increasingly recognized in the field HCI by a number of scholars, who discuss the topic from different perspectives [Akama, 2015, 2014, Kaptelinin and Bannon, 2012, Dourish, 2006, Heath et al., 2002, Nardi and O'Day, 1999, Harrison and Dourish, 1996].

The concept of space in the field of HCI integrates an understanding of technology *"as part of an ecology"* [Nardi and O'Day, 1999]. Considering technology as a part of an ecology emphasize the interconnection and the network of relationships stimulated by the human's interpretation and interaction in the environment. However, the more the technology pervades the space, the more understanding the concept of space is relevant for the HCI researchers. This is particularly relevant considering the trend of describing technology as a thing, rather than as a part of a whole. For instance, Nardi and O'Day [1999] describe how the attention generally drives to

> *"computers, networking, application, handheld information gadgets, instruments, monitors, widgets ad infinitum".*

Moreover, Nardi and O'Day [1999] stress on the role covered by *"color, texture and functions of the technologies"* and the usability. In this case, the set of feature of the space invites people to

> *"move from place to place, talk, carry pieces of paper, type, play messages, pick up the telephone, send faxes, have meetings, and go for lunch"* [Nardi and O'Day, 1999]

Additionally, we can consider the space as an opportunity to see new things and, concentrating on the *space*, we can *"switch the perception of looking at objects"* [Akama, 2014]. Thus, following Akama [2014, 2015], the space can be the chance to develop a meaning between things or events. The potentiality of the space carries both objective and subjective meaning of technology. We can objectively describe the space between objects, and we can

subjectively describe the relational distance between people/things/events. Moreover, the space between things and events is something worth thinking about since designing DITs affects space, and people's emotion, interaction and participation.

Developing and constructing meaning is a matter of reconfiguring the *space* as a *place* [Dourish, 2006, Harrison and Dourish, 1996]. Hence, Dourish [2006] and Harrison and Dourish [1996] describe **space** as the "structure of the world", and the **place** as the assumed, accepted and enduring "social meaning in the course of interaction".

> *"Space is the opportunity; place is the (understood) reality."* [Harrison and Dourish, 1996]

Of course as the two authors discuss, the relationship between space and place is quite ambiguous because the place is in some respect about enhancing the space through the integration of "social meaning, convention, cultural understandings about role, function and nature and so on" [Harrison and Dourish, 1996]. Thus a place is a space with added values. Constructing understanding on the value of space stresses on environmental conditions and highlights connections for helping consciousness on people's needs. For instance, the visiting experience improves when visitors have the chance to move through the space and adopt diverse areas to make sense of their understanding about the surrounding environment. The fact that visitors in the Maxi Ooh strictly divide between a space for investigating and explore and an area to relax happens to be crucial for them to understand and share their interpretation of the space.

The ethnographic notes highlight the crucial role of the space, becoming a place overall in respect to the process of making knowledge (see for a better understanding Harrison and Dourish [1996] in Section 1.3.1 Page 10). At the same time, there is not unique way to describe the place: it is complex and differently adopted in relation to the condition and the needs. Place can be described as tangible or virtual. While the tangible place regards the *In and out* node and the physical movements that connect a space with an other (see Table 5.3 Page 96); the virtual place is

Node Space

When I labeled the node *Space* I wanted to emphasize areas available for acting. Spaces are zones in museum where people can act create relationships and connecting with the environment. With this description of *Space* in mind the references mainly connect with extension of the space with actions, thus the space is about opportunities for acting through the digitalized artifacts.

Example of ethnographic extracts for the node of *Space*:

> "The teenagers are discussing together about the feeing habits of the animals represented in the game of the interactive tabletop (see Figure 5.2). The Pilot helps them giving information about the anatomy of the animals and their habitats. In this way, they spend their time playing with the tabletop and deconstructing potential habits of the animal avatars. They realize they did not actually visit the exhibition when they get out the area. Nevertheless one of the boys exclaims "what about the rest?" But they did not have time for visiting the remaining installation of the discovery and the Pilot told what they are missing. One of the girls reply they will come back again." [Focusing on the ALP game - Discovery]

This extract is one of my favorites because of the density of the *relationship* and the connection between people: in this extract the role of the Pilot is rather significant for coming along with the teenagers in the construction of the understanding of the wildlife; in the meanwhile the Pilot provides a connection between the game an the surrounding environment, while the interactive tabletop offers additional space to the Discovery area, a virtual space that has the value to reframe the dialogue between the visitors and the Pilot. The means of this node is to connect together situations in which the space has been extended or stretched by objects or actions, by the fantasy and the need of people. Thus, while this specific extract underlines the configuration of a verbal space that extend the game so much that people even forgot the remain of the exhibition, other examples of this node deal informal and unexpected extension of space through tangible experience.

Table 5.2: Node Space

differently characterized by interweaving digital spaces and physical spaces and is sorted in the node *Space* (see Table 5.2 Page 81). The references of the node *Space* indeed refers to the peculiar connection between virtual and physical space that build a sort of extended place.

> "The three of them are playing within the forest-like installation. The mother moves outwards from the installation perimeter to take a picture of her children. Doing so the Kinect perceives her presence thus her image appears on the wall and the younger child points at it shouting an happy "look!!!". The mother and the elder child turn to look at the wall and the all of them get closer to take a picture on the sea-like environment. The younger child leaves the tactile room and comes back with the ball and two music instruments. She gives one instrument to her mother and one to her sister. The way to use the instruments does not really matter for the child, the mean for her was about having a non-virtual connection with the projected image. She grabs the ball and rises it in front of her, telling to the sister to do the same with her instrument. The mother looking at the projected image starts to play her instrument, the elder child does the same, and the younger sister shake the ball. After few seconds the younger child moves toward the light crook and uses the ball to see if the water stops. "Look if I through the ball it changes!""
> [**Coming through the interaction - Maxi Ooh**]

This vignette happens to be interesting for the use of the instruments and the ball the two children and the mother did. In fact, they do not use the object for doing something specific, they rather used them for making a connection between themselves and the projected figures. Rising the hand and shaking the object create a relationship between the digitally interactive context and the non-digital interactive context, bringing the interaction onto two levels of interactivity.

In the *Tactil* room the interaction happens through movements rather than dialogues, and at the same time an dialogue made out of gestures seems to pervade the room and to get extended by the use of the digitalized performances. The performance of the elder child can be structured in five main actions:

1. experiencing the interaction with the Kinect;

2. getting out of the room;

3. coming back with objects for each of the interacting participants;

4. shaking and ask to shake the objects in front of the camera;

5. checking the movements of the objects in their hands and on the wall.

This performance uncovers peculiarity of digitalized installations and environment by which the interaction is performed. An Interactive Digitalized object or installation is an artifact that is meant to engage visitors and/or provides additional information, and this specific installation in the *tactile* give opportunities to the visitors to gather together in a spot making of the situation a relational situation. Thus, the interaction between visitors might be limited to the comments on their on projection in the projection sea-like landscape and on the virtual bubbles popping up from their own reflections (see Figure 5.5 85). Although the kind of digitalized interaction is limited to fun engaging experience, visitors take such interactive opportunity as a chance to extend the space adding interactions that re-frame the installation.

Reframing the installation and enhancing the interaction configure the interaction in a different space. Indeed, the introduction of the ball and music instruments move the interaction from the solely projection, to the object *and* to the projection.

This added passage is crucial for performing the interaction and adding meaning to it. The engaging action happens without the additional objects, however, the introduction of object establishes an opportunity for dialoguing trough actions. An opportunity that requires, together with the objects, additional sense of space since interactions happen in spaces. Essentially, the mother and the children in the last vignette performed an extension of space through the use of the objects. For instance, when the child came back with the objects, she integrated the interaction with a new level of actions. Thus, while the plain interaction runs back and forth: people move in front of the Kinect and react to the images; the introduction of objects reframe the interaction adding an interactive level ahead the interaction with the Kinect. The additional interactive level helps people to cross the digital bounder, providing a sort of conversion channel between the non-digital interactive space and the digital interactive one. Similar occasions can be observed in relation to the fairy-like forest in the tactile room (see Figure 5.4 Page 84). The transitional channel for crossing the

Figure 5.4: The *fairy-like forest* interactive projected environment in the *Tactile* Room

digital edge serves to understand how the interaction occurs and for making sense of it. For instance, during the opening day of the Maxi Ooh, when time was limited and was not efficient to exit the room and coming back, a couple of times people used their own bodies to perform and investigate the interaction. While it seemed quite obvious for visitors to use the palms for exploding projected butterflies in the fairylike wall, it is not obvious how the interaction happens, in fact:

> [...] one of the children while playing to explode butterflies by slapping his hand on the wall just stops to look at the palm of his hand and re-does the movement he already did few times. Slapping an other time his hand on the wall he follows the movement to (it seems) catch the moment of the explosion and how the interaction happens.
> [**How the slap works - Maxi Ooh**]

While smashing the hand on the wall, the child was actually using his hand as an extension of his thoughts and of himself, as well. As a tool. He tightly looked at the palm as he turned to understand were possible sensors were arranged.

Moreover, the examination of the interaction provides rooms for the person to perform the action adding meaning to the object, adding space between her/himself, the object, and the digital interactive installation. Going through the ethnographic notes I uncovered several examples of visitors getting closer to the Kinect for the detection-projection of visitors (see Figure 5.5 Page 85), who were trying to find the linking space between themselves and the projection. For instance, a girl who saw herself projected in the sea-like environment got closer and closer still looking at the projection until she perfectly identified the source of the interaction. When standing in front of the Kinect the girl grabbed both side of the artifact and moved it slowly until she could see her face again.

Then, after having re-positioned the Kinect, she walked back again still
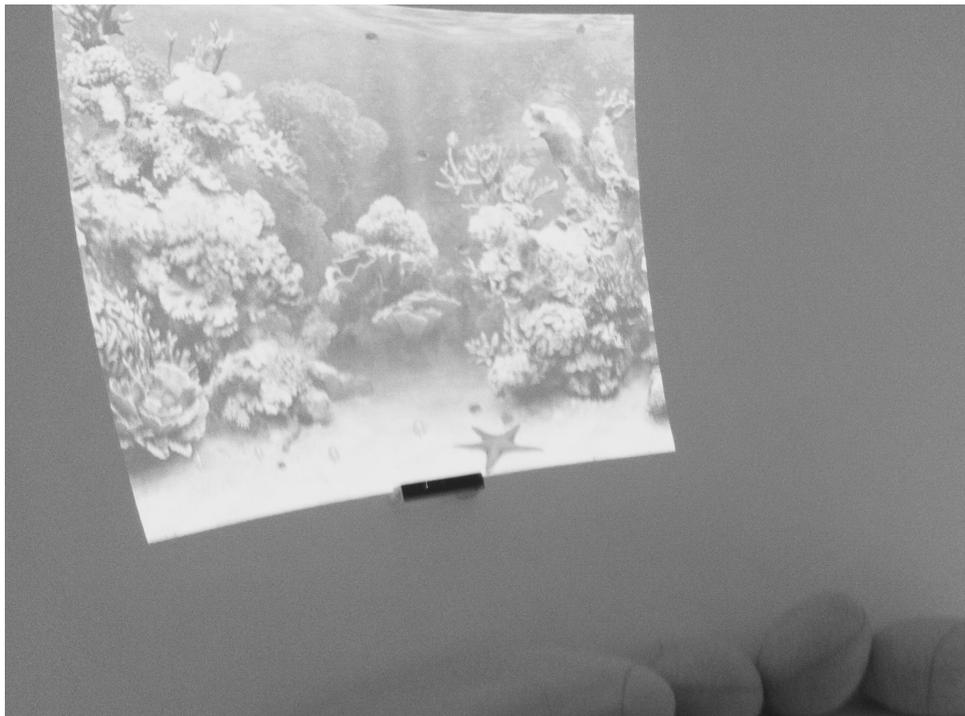
Figure 5.5: The Kinect under the projected sea-like environment detects people displaying them in sea-like scene. Small bubbles pop-up from the figures of projected people.

monitoring the projected image. She walked back and she turned a couple of time checking for the distance for, eventually, figuring the extension of the space. So far, the distance between the Kinect and the spot where people still detect their complete figure does not change. However, after

dealing and fixing with the Kinect, people turn to check distances.The actions of holding, moving and fixing the Kinect to find how the interaction occurs, bound together the physical and the perceived space. Similarly, the use of pillows (see Figure 4.2a Page 56) as supporting objects for changing the interactive outcomes, creates layers of interactive possibilities that helps people to find the meaning of the interaction.

Adding space between the action, the interaction and the DIT builds the occasion for people to add meaning to the space and the interaction. The objects and the observation of the body parts as they serve to interact with the installation contribute to develop meaning for understanding the space and making sense of it, making of it a place. The arrangement of objects and bodies in different occasions and conditions indicates the need for people to picture a space for investigating the value of the interaction and what is more of the DIT. Interacting with an artifact that it is fun as it is, indeed hardly engages visitors and hardly brings them to further level of meaning-development; differently, a reconfiguration of the interaction through the adoption of *extra* elements for increasing and enhancing the space provides people with new opportunities for engaging with the DITs. Extra elements, like music instruments and the pillows support the people's interaction. Even though these kind of objects do not have planned purposes in the context, they soon become tools for supporting further interactive experience and for re-shaping the space. Moreover, extra tools stimulates people's re-interpretation of their bodies. Bodies become themselves instruments for interacting and for reconfiguring the interacting experience.

Although fantasy and people's creativity influence and determine the interaction, the role of extra elements goes beyond the mere fun as it seems. As a matter of fact, extra elements provide visitors with additional opportunities for making connections and for evaluating the interactive potentials of an installation.

Achieving the extension of the space for interacting, as described above, can be handled through the objects embedded in the DIT, as it is the case of managing the Kinect; through the reconfiguration of self-body; through, physically close objects to the installation or physically unrelated to it - as the music instruments and the ball are.

The extra elements add some specific features to the interactive process empowering people on the appropriation of the space. Moving and introducing objects from one space to another softens up, reduces and even removes limits and borders of spaces. In the case of the child who brings the objects inside the room even though she can use the pillows, which are already there, or to look at her hands as the boy did, suggests to investigate on how external objects make sense of DIT without people being aware of the reason of it. This investigation brings together objects, environment and movements that in a sort of symbolic way make sense of people construction of relationship.

The following section disentangles the peculiar reconfiguration and use of objects for making of a space a place - adapting Dourish [2006] and Harrison and Dourish [1996] - focusing on the confident and cool combination of environmental factors and people's way to move in the space. The extension of the space results through the involvement between digital and non-digital components of the exhibition. This convergence allows visitors to be part of a performance, a sort of role game focuses on the elaboration of the understood and experimented dynamics of the exhibit because of the reconfiguration also of the space.

5.2 Organic Installation and Collaborative trajectory

The previous section brought to the surface the role of the dialogue between people for making sense of Interactive digitalized artifact. The dialogue helps visitors to investigate and compare expectations, opinions and mechanisms for making sense of the interaction. As discussed through ethnographic extracts, the interaction by itself is not permanently engaging visitors, differently the prospect to understand the mechanisms that activate the interaction or the mechanisms to make the interaction to come through - see ethnographic notes Page 76 [How to make a tree - MaxiOoh] and Page 78 [Which animal-avatar to choose - Discovery] - stimulate people's interest on the DIT as a *space* to experiment and to test.

The concept of *space* has been discusses in the subsection 5.1.1. In this subsection I proposed an interpretation of interaction as a potential ex-

tension of the space. Some ethnographical observations demonstrate how some people need more space for interacting (see Page 82 [Coming through the interaction - Maxi Ooh] or Page 84 [How the slap works - Maxi Ooh]): a space that can be added trough the introduction of new objects or through the expansion of the body as an interactive tool.

I emphasized this relation-space aspect of the interaction since the ethnography displays a recurrent adoption and interaction with objects and elements and discussions to add information and contents to proposed and structured interactions. Analyzing the notes the space and the influences that the space has on the interaction with and through the Interactive Digitalized Artifacts, I noticed that people move quite often between Interactive Digitalized areas and non-digitalized ones. In order to describe this behavior I adopted the label *In and Out* for the node (see Table 5.3 Page 96).

The main interest in relation to the *In and Out* node in this section is related to the ecological experience of visiting a museum. Even though, this discussion is not directly related to the use of DIT, it helps to have a deeper understanding on the dynamics that bring to the surface people's expectations and needs. The practical relevance of this discussion nourish understanding on designing for stimulating the creation of knowledge in public space. Thus, in this section I disentangle the relations that occurs in the Theme of *Sociality* in respect to the nodes *Space* and *In and Out* through the filter of the ethnographic interpretation of the nodes.

Combining together the previously discussed node of *Space* and the one of *In and Out* serves to identify the environmental condition for supporting mechanisms to endorse and stimulate a re-interpretation of interactions. Hence, activities and interactions happen through conditions and objects that, as discussed in the first section of the chapter, stimulate and encourage dialogues and comparisons over and across subjects.

The way we know and make sense of our experience is far to be a solely and isolated fact. It is unlikely to be the bright outcome of a *non-place*, of a transitory and tricky place [Augé, 1995].

Thus, the way we move, use and interact in the space influences and stimulates the way we can know. The node *In and Out* as introduced is related to two main line of experiencing the museum environment: on one side,
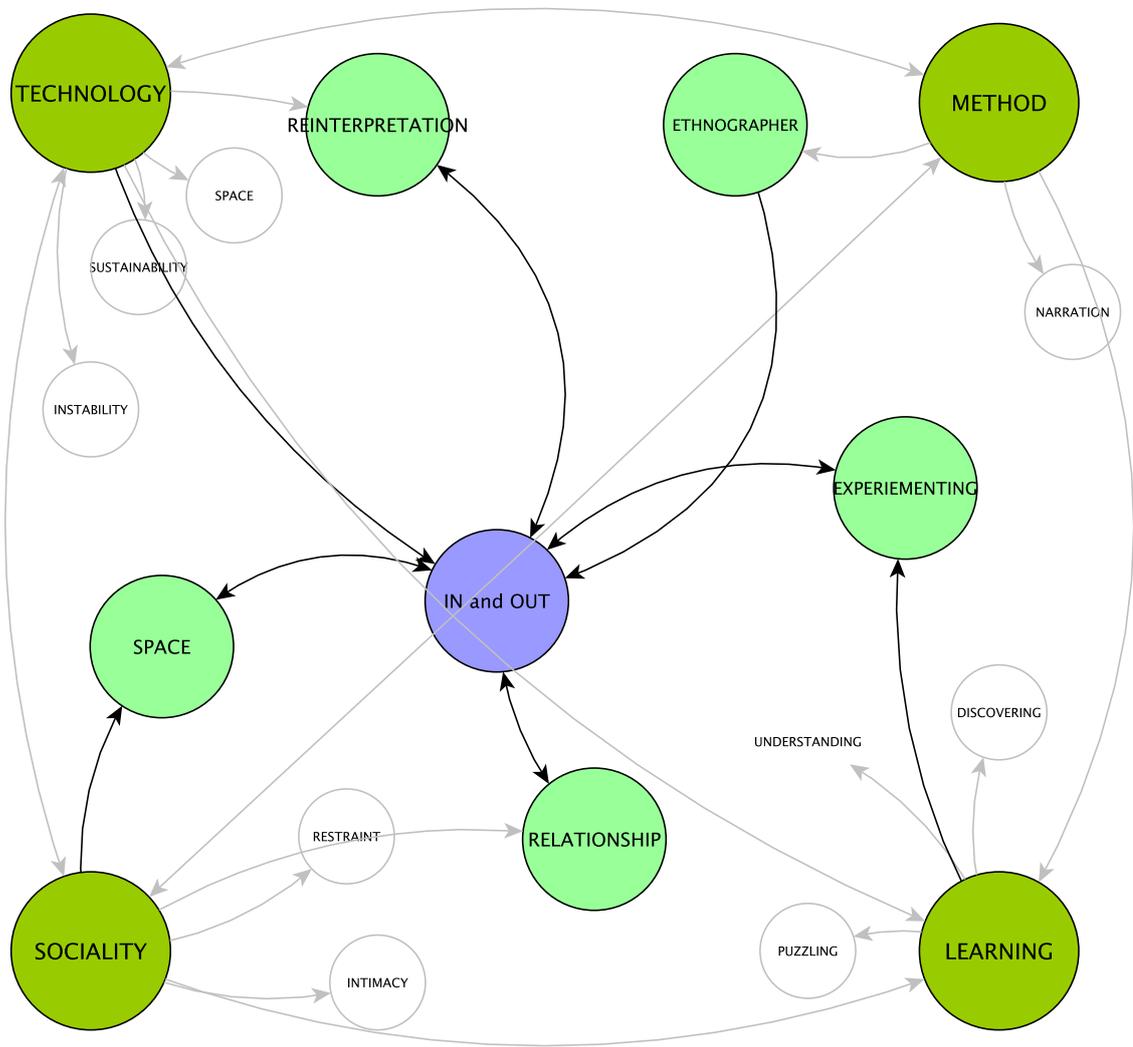
Figure 5.6: Relations and connections between nodes focusing on *In and Out*

using it for making physical connections, on the other side to directly interact with technologies. Still, the node refers to the importance of moving in the environment. To move and experience the environment is the entryway for elaborating the information and creating knowledge. For instance, for understanding better the information in the Discovery, people often get out the area for getting additional details about the animals from the labyrinth forest area (see Figure 5.3, page 78) or look at the hanging animals floating in the air (see Figure 4.4c, page 59).

"Holding the paw of the owls and focusing on the talon, the Pilot is telling to the parents and the child about the hunting techniques of this rapacious bird. For explaining how the strength wings plays a fundamental role on the hunting activity the Pilot is miming the wingspan and to make sure they both understand the dynamics of the owls actions they all move outside the area and continue the discussion standing right under the hanging stuffed owl. Funny enough, as they approach the corner with the owl, the child for the first time realizes that owls have large wings and the representations in books of owls with close wings are just partly true."
[**Moving the discussion from the Discovery to the floor exhibit**]

The reason for the small group to move from the Discovery is to find evidences about what the Pilot was explaining. The movement traces a discussing trajectory that connect together the museum space and allow people to improve their discussion and their understanding over the topic. The position where the owl hangs represents the average flight altitude of the animal, an information that invite parents and the child to question about the food habits "what are they eating in there?". Hence, this discussion prepares the ground for going back again to the Discovery with enough information to interpret and understand the exposed objects and the interactive game ALP with new eyes.

The main effect of moving "in and out" through the museum spaces, is that the environment shapes, changes, and redefines in respect to people's interpretation of the environment. The way through which visitors, together with the support of the Pilot, reconfigure the environment draws the lines for the interaction and for sharing the understanding around the subject of the exhibition. Thus, the physical characteristics of the environment smoothly make sense for each different situation. Moreover, moving through the environment and making sense of it making of the space a place, is about appropriating it.

In line with the Science and Technology Studies (STS) tradition, the concept of appropriation is about to reframe and reconfigure the space in relation to respective conditions. Thus, visitors and Pilot re-interpret the space through experiencing it [Silverstone et al., 1992]. People appropriate the space in the moment in which they perceive themselves as independent users of the environment or members of the community that owns the space. Moreover, the process of appropriation is embedded into a specific

circumstance and is related to people and object in use [MacKenzie, 1996]. In the context of museum, moving through the space and identifying new sources for getting information and connecting details between subject is an opportunity for people to enhance the experience and to open to knowledge. In this regard, *appropriation* implies to feel free to move between a space or another and to redefine practices of visiting. For instance, referring to the notes [Coming through the interaction - Maxi Ooh] (Page 82), when the child left the room and came back with the ball and the music instruments, she demonstrated to feel autonomous and independent in the museum space. This feeling is not only desirable but fundamental for stimulating new practices and adapting this behavior to specific needs. Through the investigation of people's activities, it is possible to unveil features of museum for stimulating and letting people to share their understanding about the presented subject and elaborate information to create knowledge. First the independent and autonomous feeling of connecting the areas: the gestures to take off the shoes in the Discovery (see the ethnographic extract [Taking off the shoes. Learning from somewhere else - Discovery and Maxi Ooh] Page 96, in Table 5.3) displays the side of museum of change practices of visiting. The child in this extract shows invisible links between different areas. Similarly, the practice of blurring spaces in museums and change the visiting experience refers to moments of transition.

The second aspect that stimulates people to create knowledge is about changing the frame of reference.

> "[...] Some visitors are having the morning-break at the Maxi Ooh. They are three couple of one adult and a child and they don't know each other. They are having tea and biscuits, and discuss about their experience in the *Sound room*. This time I am cheating a bit, I'm staying quite distant, so I can only listen at them. Still, they are talking about the bubbles they previously did. They are trying to reproduce the sounds they made when the only two yellow bubbles appeared on the wall. The discussion is continuing between laugh and voice experimentations. They end up again in the sound room testing the experimentation voice did during the break."
> [**Testing voice and sound during the break - Maxi Ooh**]

The visitors described in this last extract moved from the inside sound

room to the outside break area, still inside the Maxi Ooh. Moving from a room for experimenting their voice to a space for relaxing, change the way they interacted. Mingling in the relaxing area while discussing on voice experiments, let visitors to reframe the discussion, to reflect on it and to take some distance from it. In this way, visitors can make sense on what they are learning and create something new. Reframing a subject and taking distances from it, has been discussed and is a fundamental aspect of the creative process [May, 1975]. The creative process is about becoming aware of existing condition and improving current conditions. However to talk about novelty, people have also to improvise, interpret and reflect while experimenting [Ingold, 2010, Schön, 1983]. Thus, moving from a space to another stimulate visitors' creative abilities providing elements for *relating to* and for *experimenting with.* Getting out from one space and moving to an other and then coming back, as it has been described in the note [Moving the discussion from the Discovery to the floor exhibit], Page 90, is a trajectory activity that serves visitors and museum staff to reframe the situation and find new connection and interpretation for the surrounding exhibition.

Discussing about the museum environment is including multiple aspect of the process of creating knowledge in the context of Technologically Enhanced Environment and in relation to DITs. The following section summarize this discussion and proposes a few guidelines for facing this kind of environment.

5.3 Guidelines for designing DIT for public spaces: setting the stage

This section explores how the analysis of the ethnography provides insight for designing Digital Interactive Technology (DIT). The extracts wrote over the chapter highlight the conditions for supporting and adding value the face-to-face interaction and relationship [Klemmer et al., 2006]. The value related to DIT is of interest for different reasons in the HCI and CSCW community and together with the improvement of quality of the face-to-face interaction, DIT allows mixed interactions: both physical and digi-

tal, making of a constructed space a valuable place [Harrison and Dourish, 1996, Dourish, 2004, 2006]. Potentially, DIT occupies a core position in enhancing face-to-face relationships in public spaces with the aim to support and stimulate sharing conditions and situation. Following this potential implication of DIT in public spaces, this Chapter takes into account relationships between visitors and the role of the Technologically Enhanced Environment (TEE) as a medium for crafting a dialogue through DITs. However, the environment has a double interpretative perspective: on one side the discussion refers to space as the occasion to make sense of the interaction through the use of objects; on the other side the environment relates to the way people move in and out, reframing the perimeter and the context in respect to their investigation needs.

Thus, the Chapter focuses on three issues that are salient for making of a TEE an opportunity for creating knowledge:

- the first issue for creating knowledge is the possibility of *Crafting Dialogue* for making sense of DIT;

- the second issue is strongly embedded into *making use of the space.* In fact, interactions and dialogues get more value in respect to possibility to move in/through the space;

- the third issue is related to the capacity to extend the space through the introduction of unexpected actions or objects.

Performing and acting for extending the space usually individually engage visitor while stimulating the connection *between* visitors. The environment is a blank canvas that can be drawn through people trajectory *in and out* the spaces. Visitor and museums staff, find hints, suggestions and inputs for framing their understanding on many different subjects in different areas of museum through objects and DITs. Some time visitors intentionally move from a space to another for finding new information and discovering hints to create connection among the subjects of the exhibitions; in other cases, changes just happen and the value of the information in the museum acquires value because people interiorized and appropriated museum practices.

This Chapter discusses the value of DIT regarding the support of potential face-to-face relationships for stimulating knowledge. In this frame, DIT helps people to communicate, and share their information and their understanding on the exhibition, bearing on visitors' relationships and crafting dialogue. The mediating position of DIT in museums environment is the first step for understanding the accomplishment of the artifact in stimulating people's cooperation for creating knowledge. Designing DIT is worth for first engaging visitors and amusing them. Thus, it is possible to describe the success of a DIT in term of the length of the interaction and investigation people perform with it. The success of DIT depends in the first place on the pattern of interactions in relation to the place: is there space and time enough for moving? Are there evidences for supporting the interaction? [. . .]

Figure 5.7: Installation for drawing with the voice in the Sound Room in the Maxi Ooh. Visitors can talk (very often they sing) on the two microphones and can create draws and pictures through their voices. In respect to what a person says and if each microphone is taken, the picture is different.

You may have noticed that I little mentioned the installation that works with the breath (see Figure 4.2c Page 56). This is because, this installa-

tion is positioned in a tricky spot: small children can only use the lower microphone because standing on a pillow as everybody would and try to do is not really safe since the pillow can not be screwed in the middle of other objects and rolls away. Differently, an other installation is behind the chaise-long (see Figure 5.7), which serves as support for fixing the pillow and using it as lift. Making sense of the "interaction through the use of objects" and "reframing the perimeter" moving in and out from the space are necessary conditions for DIT success but not enough.

The space and the collocation of interactive installations can be re arranged by people. This specific aspect of people arranging the space and configuring it in respect to their needs is following the basic requirement of people to find room to communicate and interact.

The need of communicating and interacting for constructing values in the museum and for building meaning on the gathered information is one of the core aspects that rises by the analysis of the ethnographic node. The following Chapter 6 differently takes into account the relationships between the nodes of *Discovering* and *Experimenting* (see Figure 4.9 Page 70). These two nodes are embedded into the theme of *Learning* and are strongly related with the node of *Relationship* that, as explained earlier in this chapter strongly connect with the way people interact through the DIT.

Node In and Out

While I was going through the field notes I realized that the relationship between inside and outside an area is relevant for the way people can interact with Interactive Digitalized Objects. To emphasize this peculiar aspect of the visiting process I organized the references related to it under the node of *In and Out.* I particularly like this node and the connection it develops through the other nodes identified. Moreover, it is specifically interesting in the frame of this context because highlights two main aspects related to the use of Digital Interactive Technology in public spaces. First, this node describes how visitors need to find their own path of visiting in order to answer to their needs.

> "When they enter they take off their shoes and the way they move and interact with us is similar to the one adopted at the Maxi Ooh. The way they move in the area is smooth, they are not talking laud and go through the installation as if they know exactly what they are looking for. I ask to the child if they have been at the Maxi Ooh, and the mother answered smiling "we liked to take off the shoes; I know we don't have to, here, but you know it is like feeling home.""
> [Taking off the shoes. Learning from somewhere else - Discovery and Maxi Ooh]

Moreover the connection between *In and Out* put the emphasis on the time for going through and decompressing the input of Digital Interactive Technology.

> "Even though the child of four exclaims "there are no touchscreen!" they are really enthusiastic over the exhibit. They are tremendously lively and they tried everything in few minutes. They cross the interactive rooms and touched all the object they could in the less time ever. They are not really keen on the Interactive Digitalized Technology, they do not find any interest in the digitalized interaction. They are not using any of the interactive installation with the intention to use it. The frenetic interaction ends when the child of four glimpses the books in the area with the sofas. All of them sit and flip the pages of the books. They are calming down. After some minutes they all enter the Tactile room." [Getting off the room and take a breath - Maxi Ooh]

The two extracts serve to exemplify the evidences that moving *In and out* between the digitally enhanced and non-enhanced areas is relevant to understand in order to identify accordances between DIT and creation of knowledge. In Section 5.2 the node is discussed in terms of relationships in and between the installations; while the Chapter 7 looks at the node *In and Out* in relation to the nodes *Reinterpretation*, *Experiementing*, *Understanding* and *Sustainability* as an opportunity for detaching from excessive input.

Table 5.3: Node In and Out

Chapter 6

Infrastructuring Knowledge: a participatory experience

> When you sing with a group of people, you learn how to subsume yourself into a group consciousness because a capella singing is all about the immersion of the self into the community. That's one of the great feelings - to stop being me for a little while and to become us. That way lies empathy, the great social virtue.
>
> Brian Eno - *Singing: The Key To A Long Life*

Following the previous discussion on opening a dialogue toward the space, this Chapter includes *participation* as a core experience for Infrastructuring Knowledge (IK). In this direction, the inclusion of the participatory experience is relevant for understanding the nodes of *Discovering* and *Experimenting*, both strongly related with the node *Relationship* (see Table 6.1 Page <u>100</u>). Even though the two nodes of *Discovering* and *Experimenting* pervade the scene, the node *Understanding* triggers the other two (see Table 6.2 Page <u>102</u>) in respect to the creation of knowledge. In this frame, I daresay that the process of IK is complex because of the involvement of many different stages of the museum visiting experience, which includes the dialogical process and the movements through the spaces described in

the previous Chapter 5, and the relationships that grow through the interaction and reinterpretation of DITs. Therefore, the focus of this Chapter is about unpacking and disentangling the process of IK in respect to the participatory interaction with Digital Interactive Technology (DIT).

This Chapter discusses the potentiality of IK embedded in the DIT, necessary for it to stimulate thoughts, and to encourage the sharing of information and knowledge.

6.1   Looking at Knowledge creation

The evidences collected through the observations at the museum allow me to describe the museum experience in terms of the relationships and the interactions that arise during the visit. By analyzing the theme Learning in Table 4.2 Page 66, what comes at the surface at first glance is the way through which people act and perform in the process of creating knowledge through the use of DIT and across body experience. As introduced in the previous Chapter 5, DIT stimulates social experiences instead of individual ones, challenging interaction designers and researchers in respect to the understanding of the interplay between technologies and social practices. Creating knowledge in museums, deals with sociomaterial tradition that interlaces people, materials, and practices. Sociomaterial considerations are embedded into the design discours through the topics of knowledge, creation, and sharing [Bjørn and Osterlund, 2014, Pipek and Wulf, 2009]. Thus, interaction design research includes the crossing locus between materiality (objects) and society (individuals). Besides, sociomaterial discussions embed the subject of *practices*: regular and mutual renowned human activities, which by separating formal prescriptions and procedures, combine social participation, negotiations, and handling technologies [Dourish, 2006]. The link between sociomateriality and design processes redefines collaborative explorations in respect to the adoption and adaptation of technologies. Such interpretation and extension of the notion of sociomateriality inscribes Infrastructuring in the everyday context and in the co-creation and interpretation of technologies involved in co-working and cooperative systems (see Chapter 2).

Combining together the nodes in the theme of Learning stimulates the discussion for a new description of design challenges for education and recreation, providing new understanding on what interacting with DIT means for people. This exploration of the nodes (see Table 6.1 Page <u>100</u>) draws considerations on how IK occurs as a participatory process nourished by human and technological relationships and by the exploration of the environment [Macchia et al., 2015b]. Thus, taking into account the concept of IK opens to designs aimed at matching individuals with different habits and idiosyncrasies, and converging and stimulating common practices.

Designing DIT for public spaces is in the tough position of designing for both individual and collective interests and needs. Moreover, designing DIT has the intention to influence and impact people's interaction for making of a *space* a *place*. As a matter of fact a space becomes a place through people's actions and interpretations. In this respect DIT endorses and stimulates face-to-face interaction, links people and space, enhances visitors' sociability and cordiality. As Hindmarsh et al. [2002] highlight, visitors approach and engage simultaneously across interactive technologies, stimulating interactions and engagement. Moreover, connecting with the concept of intermediary object [Boujut and Blanco, 2003], interactive technologies lead and produce cooperation through people stimulating new practices and activities. The concept of intermediary object has been adopted by Boujut and Blanco for remarking the difference between an object for collaboration and a boundary object that is necessary to find the link between different perspectives. Hence, interactive technology offers additional information and methods for getting information [Heath and vom Lehn, 2008]. In this respect, Heath and vom Lehn [2008] depict the power of interactive technologies to inspire and re-shape the exhibition environment encouraging informal and social communication.

6.2 Bodily Knowledge Creation

While the previous section and the previous Chapter 5 describe the role of connecting with the environment and with other visitors through the dialogue, great difference in Infrastructuring Knowledge (IK) is made by

Nodes related to experiencing museum

Museum experiences and knowledge processes are connected mainly to the *Themes* concerning the museum experience as an activity rather then a methodological experience as highlighted in Table 4.2 (Page 66) and Figure 4.9 (Page 70). The interconnection between *Experimentation*, *Relationship*, and *Discovering* highlights evidences that describe the museum experience as a set of activities that have a lot to do with the intention to learn something new and share what has been learnt. In fact, ethnographic notes that refer to the analysis of connection between nodes point out the social experiences of interpreting and sharing:

Experimenting this node refers to those ethnographic descriptions of investigative actions and behaviors such as:

> "[...] the two men enter into the Discovery and pushing the red-dotted mushrooms on the plastic bush they look around to see what happens."
> [Wrong push - Discovery]

Relationship this label group ethnographic notes related to moments in which visitors create some new relationships that serve them to understand the surrounding environment:

> "[...] they build the game on a new interpretation of it, while one is describing what is feeling with the hand the others have to guess the object. While doing so they tell about their experience at the museum mentioning what they remember from other places pointing at things or asking things related to objects around"
> [Guess what - Discovery]

Discovering this node includes ethnographic notes about processes though which visitors discover how an installation works or how to change the actions of the installation:

> "The mother has an epiphany while watching the children moving and slapping the wall and she says "it is like a ballet!" implying that more delicate gestures works better than quick and energetic movements"
> [Moving slowly - Tactile room]

Table 6.1: Relationships between nodes: *Experimentation*, *Relationship*, *Discovering*

physical, tactile and sensorial experiences. The process of sharing and creating knowledge in the context of museum is a fairly fascinating set of actions that deal with the combination of self and collective activities.

Moreover, the combination of *body and mind* experience is extremely fascinating. The fact of moving and touching and looking and interacting is inspiring and stimulating knowledge involving social practices that are unlikely common in other circumstances of social life.

The analysis of ethnographic notes highlights a certain set of steps related to the learning process:

$$Discovering \implies Experiementing \implies Understanding.$$

This description of learning process invites for reflections on how the process interweaves within the TEE. For instance, the analysis of Discovering and Experimenting highlights the combination between creative and stable socialization with interactions not exclusively related to DIT. Moreover, *sharing together* triggers and stimulates a specific way to use installations and interact with DIT.

As of interest for the process of IK, the following subsection focuses on the creative interpretation and on temporary-stable socializing process, which is directly connected with the previous Chapter 5; then, the section continues disentangling the dynamics of sharing experience. As mentioned earlier, *sharing* includes actions that trigger and stimulate a specific way to interact with DIT. Following this line, the Chapter continues describing features of *creative interpretation* and *stable socialization*, to explaining the meaning of *sharing together*.

6.2.1 Creative Interpretation: socializing and participating together

The environment makes the difference in stimulating a creative process. The creative process is about generating ideas, problem solving or design products that are novel and valuable [Singer, 1996]. Furthermore, creativity is a collective and social process inscribed in *"joint thinking, passionate conversations, and shared struggles among different people"* [Giaccardi et al., 2013]. Like Fischer et al. [2006] underline, objects come in support of the creative process and constitute links for mutual interpretation of the environment as a communicative channel. In this respect, the immersive condition into the Maxi Ooh or in the Discovery is the first step for stimulating among visitors mutual interpretation of the environment among

Node Understanding

By definition, the term *Understanding* implies that a person fruitfully grasp the meaning or the intentionality of something or of the belief of someone, and *it* is related to a subject/matter. In respect, to the ethnographic notes that *define* the meaning of understanding the main feature relates to specific insights that let people use and interpret the purpose of objects and installations. For instance, while visiting the Discovery it is quite unlikely that people immediately understand what is the purpose of a plastic bush with holes topped with glasses, which happens to be a magnifier.

> "The beauty of this place is the fact that through objects and technology people are actually having *aha* moments. The lens is not having any purpose until the visitor is not opening the drawer with that small small insects."
> [Understanding the magnifier - Discovery]

However, *Understanding* is not only related to *aha* moments - even though these moments are those I prefer. *Understanding* is also the result of discussions and investigation:

> "They take out the skulls from the drawers and lean them against the top of the reproduced trunk of chest drawers (see Figure 6.1). While discussing the boy disposed the skulls following what he defines an evolutionary order."
> [Understanding the magnifier - Discovery]

Table 6.2: Node Understanding

visitors. Thus, visitors perform and reconfigure the space and translate the meaning of the environment from an educational exposition to an educational engagement.

The environment as an open and informal space invites visitors to have fun and share investigations with each other. Children as well as adults, deal with tangible and material environment learning from active participation, accommodation and assimilation. The immersive condition soon becomes a discovering opportunity where moving and doing things trigger multiple effects. Moreover, *discovering* means find out new things, places and facts:

Figure 6.1: Skulls displayed in the chest of drawers in the Discovery.

> " . . . the three of them are chatting in the sound-room. They are not forward enough for the sensors perceive their presence and projecting their body-shapes on the wall. But they are forward enough for the microphones to detect their voices, thus they feel the echo in the rounded room. The girl steps inside a little more still talking, and eventually her figure is projected on the curvy wall with colored bubbles spurting from the head of the figure. They all look quiet at the figure thus the bubbles do not appear any longer. The boy stepping on, exclaims "do the bubble again!" and his figure and the bubbles over his head appear on the wall too."
> [**Making bubbles by chances - Maxi Ooh**]

Because of this interaction, the three of them discovered the installation as well how to make it work. However, this is rather different than experimenting the installation and its different potentials. Very often people carry on their investigation after having understood how something works, testing different inputs and position for figuring out how the outcomes are regulated. *Discovering* and *experimenting* blurs together when the action is collective. Stimulated by the involving environment people reconsider the situation in terms of a role-playing-game that sees visitors investigating what is represented through shared collaboration. Moreover, as introduced

in Chapter 5 the interpretative and investigative process stimulates social and interactive behavior among people, challenging visitors to support and stimulate each other's experience.

> " . . . The child sees his figure projected directly into the sea. Surprised by this he turns to the mother exclaiming "look!". Moving fast the Kinect (see Figure 5.5 Page 85) a lot of bubbles move with him. Looking at the scene the mother points out the fact of producing bubbles. Getting closer to her son for being detected by the Kinect she observes the movements of the bubbles do and asks the son to do some movements with the hands to understand if the bubbles are coming out from everything is moving and she says "look, they just come out from the mouth!""
> [**Bubbles in the sea-world - Maxi Ooh**]

Experiencing the museum environment is about exploring and experimenting following each other movements and grasping details from the other's actions. In fact, for getting information and for making sense of the experience, visitors share their understanding of what the space offers to them, imitating and improving each others' actions. Visitors genuinely take example from each other, causing independent and imitative actions that inspire a kind of stable relation between visitors.

Both areas are, in different level, protected spaces where glass-walls and short fences of artificial and flat bushes separate visitors from the *rest* and because of this they build on a sort of relationship that is unlikely to happen in other areas. In this respect, people have the opportunity to directly connect with the others in a rather easy way. For instance, in one of my favorite episodes for describing this connective phenomenon a child connects with another building, for the time of the visit, a very strong relationship.

> " It is a very busy day today, there are all together fourteen people! Around midday a father with the daughter approached inside the discovery very quietly. The child gets closer to the father as she looks around for picturing what is this childhood area is for. She is looking at everything, like scanning every object and every person while focusing on people's interactions. After having almost stared at everything, she concentrates on a child of the same age who was interacting with the tactile bush (see Figure 6.2 Page 106). Still holding her father's hand, she gets closer to the child. They two of them communicate without words, but just through their eyes. Since the child begins to interact

> with the other child through questioning expressions, the father goes back to his daughter inviting her to try the installation inserting her hand in one of the holes. For some reasons the child moved away, for going back to the child at the tactile bush with whom she already developed a relationship"
> [**Making connection with the others - Discovery**]

The episode describes a representative way to investigate and examine how the area is; moreover, this first step allows new visitors to connect with other experienced visitors. Still, contacts and networking between visitors happen when they perceive and feel each other's familiarity with the area. For instance, if a visitor or a group of visitors is about to exit the exhibition they will be unlikely to connect with other visitors because the time for building on a relationship is insufficient for perceiving the other and understanding the others' movements. In this respect, moving, holding, showing and touching non-digital interactive technology seems to help visitors in the process of connecting together. Rather, visitors interested in the information provided by the exhibition, prefer to start their investigation discovering and touching the forest materials, such as woods and representations of natural elements, instead of using and playing with the interactive game. Hence, the interactive game seems to be a validation for the information acquired in the surroundings and a way for sharing and creating knowledge with the other visitors, more than a source of information. Sharing the visiting experience with others is result of combined factors like constructing dialogues and connecting to each other through bodily and physical contacts. Moreover, visitors share similar educational needs fulfilled and encourage through and by an informal performances and collaborations among visitors discovering how the interactive installations work in the Maxi Ooh, and what the objects in holes and in drawers represent and which kind of fragrances the plastic flowers release.

Visiting the exhibition, communicating and interacting together, people at the museum are momentarily part of a group involvement with similar behaviors, and shared needs and meanings. Literature may describe arrangements of people with common practice and shared identity as Communities of Practice [Shove et al., 2014, Wenger, 1998]: informal grouping of engaged and active involved into common activities. Meanwhile, building a community of practice is a dynamic process that needs long-term

Figure 6.2: In the Discovery, this bush hides objects in holes in which visitors can put their hands to guess what the object is.

participation and common memories. Hence, a transitory shared museum visiting experience is not about talking of community of practice per-se, but might be described as *practicing-community*. However, in this context the notion of *community* is symbolically adopted for underlining a shared and involving interests of a group of people. Thus, In this perspective, the common and short-term experience is about participating to the creation to the sense of community, which by nature is called to extinguish right at the end of the interacting experience that occurs through the connection with DIT and through the constructing of relationships between people. For instance a shared investigation and discovery of the museum space is an informal involvement between people and DITs.

For instance, informal involvement and shared investigation in the museum are stimulated by the understanding of the dynamics behind the bubble in the Maxi Ooh, or because of the items in the drawers in the Discovery, which provide intuitions for causing new understanding.

"It is a quiet morning and a lady approached the Discovery with her daughter after having mingled around, and watching and touching things the girl opens the drawer with faces inside; each small plastic case contains examples of animals that live in the forest. The lady is commenting with the girl the different examples trying to recognize the animals. The game is quite fun, they are truly engaged, even more when the girl comments about the content of one of the small cube cases saying *"is this the same of the one we found in front of the house on the mountain?"* An engaging discussion between the two of them arises and when it seems to reach an en-passe and the Pilot is going toward them while asking what they found. They begin telling him they found some similar faces close to their house in the mountain and they were wondering if it was a mouse. Since I am interested in the discussion *"whatever, I am learning a lot of stuff here!"* I just enjoy the discussion and we tell each other about similar encounter. The stories and the episodes of life about such kind of encounters and further explanations suggested to the Pilot that the faces found by the two visitors were from a bat."
[**It is from bat - Discovery**]

The point of this episode is about finding ways to understand and to create a common ground to communicate. The role of the person does not matter - for instance, is she/he a visitor rather than a Pilot? - the point is to find connections between personal understanding and knowledge, and between ours and those of others. Identifying common background or similarities allows strangers to link together for balancing their position in the discourse and in the space simultaneously interacting with different elements. A similar episode happened at the Discovery and underlines the dynamics of the connection between people. For instance the following episode describes how people at the museum starts to share their experiences connecting through the installations:

"an old lady is describing to the Pilot some footprints she saw near her house close to the forest. Mother and child advance towards the trunk and, hearing the discussion, the child interferes with the conversation asking details about the footprints. As the episode ends the child tells her story, happened when she was hiking in the forest with her parents."
[**Footprints in the forest - Discovery**]

This episode concludes with the understanding about the rarity of foxes and of how *lucky* we are if we see one of these animals in the Alps. In this frame, sharing life experiences while interacting with the other installation

highlights the need for visitors to set relationships for building a common area of discussion, a space in which to move and for identifying the other as part of the community. Then, interacting with DITs occurs in terms of socializing and communicating. This stage of interaction happens to be fundamental in respect to creating the potentiality for creating knowledge. In respect to the node Discovering the connecting stage is essential for making possible the interaction or at least for making int valuable. Nevertheless, connecting with other and creating a common language and background is not what emerges from the creation of knowledge, which in the contest of museum is rather physical and tangible. As the following section discusses, Infrastructuring Knowledge in Cultural Infrastructure deals also with the tangibility and the physicality of the interaction. For instance, with socializing and collective participation, the emphasis of IK is on discovering together more than on discovering per se, and on the involvement of senses like touch and aural support and to help the connection between visitors.

6.3   Infrastructuring knowledge through senses

As introduced in the previous section, the use of artifacts serves people to get together and share their knowledge and the information they collected. In this respect, an interesting role is played by the interactive game in the Discovery (see Figure 5.2 Page 77). This interactive technology is more likely to be constructive for visitors when participants have already shared the experience together in the space. Moreover, the game happens to be an occasion for discussing *Experimenting* the *understanding* for kind of proving the *understanding*. Thus, the process described in Page 101 continues and reshape as this:

$$Discovering \implies Experiementing \implies Understanding \implies Experiementing$$

Through the use of the ALP, visitors build a shared sense of the space and turn it into a meaningful place. For instance, the switch of the game from a futile game into a meaningful interactive experience for stimulating a shared understanding and creation of meaning occurs very frequently. This re-interpretation of the game establishes and inspires visitors to adopt

an integrated and participative playacting instead of an impersonal one. Moreover, a combined and shared visiting experience contributes to the re-configuration of the exhibition shifting and enhancing the meaning of interactions.

As outcome of the creative interpretation of the space and making of it a place, the museum interactive areas of Discovery and Maxi Ooh stimulates a construction of an experience that fully involves people. Experiencing the exhibitions together is about movements and sensorial involvement that helps, first, the identification of opportunities to discover new information; second, the construction of sense about the information through discussions. In this frame of movements and collective experience, DITs play a central role in supporting visitors to relate with each other and sharing information and creating knowledge as it emerges from different angles of reading data. On one hand, as the previous chapter introduces, DITs help to construct the dialogue, and on the other hand DITs keep and bear the formation of relationships between people, providing opportunities for constructing informational and knowledge outcomes.

Providing opportunity for constructing knowledge outcomes is becoming a key design challenge in museum context and for stimulating people to reinterpret designed services and products in situ. Furthermore, informative and amusing systems are far more successful when based onto situated practices. Therefore, the interactive game contributes to describe space in terms of sharing interactions and engagement embodied by the game itself.

6.3.1   Narrating through DITs: the case of

As introduced previously in Page 105, visitors use and interact with the interactive game ALP in the Discovery at the end of their visit, after having experimented the other installations. ALP is a multi-player tabletop game, which the goal is to feed animal avatars. The game helps visitors to share their knowledge and competences about habits of the alpine fauna. As a matter of fact, an interactive tabletop is about sharing and the ALP is about sharing experience: visitors sit around the interactive table with the intention of having a fun and pleasant time. They laugh and chat.

I detected a trend in using the ALP:

the first match serves to understand how the game works;

after the first match visitors discuss about the avatar they selected and examine favorable selections;

during the discussion the multi-touch tabletop turns to a place for sharing, a sort of round table, instead of the interactive screen for the game;

the conversation continues and provides an occasion for visitors to adapt the game in respect to their needs;

the matches continues in respect of the relationship settled with participants ether they can develop a competitive game (using all the same avatar) or a cooperative game (selecting a different avatar each).

Similarly, the selection of the avatars follows a quite regular path:

for the first match participants select different avatars taking the decision by heart;

the following selections of the avatars depend on the kind of game participants seek to play:

> **selecting different avatars** reduces the level of competition and increases the level of cooperation because different animals eat different kinds of food and there is enough food for each of the animal avatars;

> **the opposite situation** occurs when participants select the same avatars.

If visitors constructed a relationship during while visiting the area, they are inclined to first select the same avatar for two matches in order to get to know well the game. Once participants are familiars with the rules of the game the competitive nature of people makes a *click* and the game shifts toward a cooperative experience. The competitive game does not last very long and, as introduced, visitors who do not know each other are mainly competing and even the interfere with each other dropping wrong animals to reduce points of other; differently a competitive game serves people who

know each other by the visiting experience for experimenting the game and develop understanding. When familiar participants understand rules and techniques they switch to a cooperative game. During cooperative games, interactions are bold and fast: the volume of participants' voices rises and visitors advise each other about which animals to pick up if, they do not directly help each other dropping animals for feeding the others avatars; hands (or better, fingers) move faster. Still, participants look at the whole situation; they are not only concentrating on their own avatar but also on the others and look at the score reached. Rather, sharing becomes more relevant than *winning for winning* and the objective of the game is that all win. For instance, during a match three children decided to share the success and they helped each other to win: as a result the three of them won because they shared the meaning of the game.

> *"In nature"* one of explained me understanding I was a little bit puzzled, *"if the herbivorous dies starving, then the carnivorous dies since there are no herbivorous to consume anymore.*

Since they were sharing enthusiasm, space and actions, and knowledge. However, sharing enthusiasm is at the base of museum success.

> *"The goal of rising enthusiasm and opening the door to a new interest is justification for supporting art gallery"* . . . *"so why not a modern centre for science events?* [Norman, 1993]

In his famous book *Things that make us smart*, Norman [1993] refers to a conversation related to museum experiences and the goal for funding interactive science. Sharing Norman's description of enthusiasm as crucial but insufficient for making of a museum a good museum, it is worth to recall the essentiality of enthusiasm for engaging visitors.

Still recalling the fact that visitors play with ALP during at the end of the visit, this interactive game turns on and re-enlightens the enthusiasm about the exhibition, providing the opportunity to recall and remember and discuss the experience had. For instance the ALP serves as a narration of the experience

> There are two couples of lady-and-child, who arrived with some minutes of difference] [. . .] while the Pilot is explaining the evolution of jaws of deers the visitors are asking questions about the surrounding elements for investigating the area of the museum as a whole. Thus, the Pilot himself reconsiders the way to tell information about the animals and move the explanation towards the feeding system in the Alps, showing the berries and inviting the visitors to touch the teeth in the skulls. [. . .] The visitors are now playing together with the ALP. Because it requires some instants for to load the game the visitors are discussing together about the evolution of the feeding systems - that is related to the name of the game *"Catch the food".* They concentrate on the match and still while looking at each other game I can hear suggestions coming from what they just learnt.
> [**Evolution of feeding system in the Alps - Discovery**]

This specific episode was quite peculiar in describing the mechanism of sharing a topic and collaborating because of it - even though they selected different avatars!

The game becomes a *space* for narrating and practicing the information acquired during the visit. Moreover, enthusiastic visitors are looking forward to be involved in participative activities such as playing games and reconstruct the space and making of it a narrative experience. The enthusiasm allows visitors to interact with DIT for sharing and collaborating instead of developing competitive, antagonist and individual experiences that reduce the potential for gathering new information and limit the capacity of Infrastructuring Knowledge. Thus, interpreting and reconfiguring the DIT as an occasion for reproducing the experience and for narrating it by thinking and plan how to play, is an example of social and mutual learning behavior that is possible when visitors feel and develop a common topic of discussion.

6.3.2   Sharing space and actions for developing a common meaning

As the previous section discusses, sharing enthusiasm is part of the success of the game in the Discovery, and explicit manifestations of enthusiasm has been observed for the installations in the Maxi Ooh. In this respect, a bunch of exclamations that precede investigations and experimentation in the two areas can be listed from the simple enthusiastic *"look!!!"* - that has

been used quite often in both Discovery and Maxi Ooh - to the poetic *"it is like a ballet"* - used mainly in the tactile room, and revised in the sound room - and quite ironic expressions like *"is like taking LSD!"*. However, enthusiasm is more than an exclamation, it is about engagement and interest. Expressions of enthusiasm are by definition examples of excitement for something new and are examples of perseveration in discovering as well. Perseveration in discovering relates to the participative and involving experience people engage through the space. As part of the experience of Infrastructuring Knowledge a core position is played by the occupation of the space, of moving through the digital table top of the ALP and moving across the room in the Maxi Ooh. As previously introduced the discussion about space and place is in previous sections, the discourse around space and place is particularly related to the creation of a common meaning. Constructing a place from a space, so building meaning out of (arid) DIT and TEE is for visitors building the arena for acting, interacting, discussing and Infrastructuring Knowledge. In this respect, the narrative experience while using the ALP (see Page 112) and the experimenting interaction while moving in the Maxi Ooh (see Page 103) frame the basis for Infrastructuring Knowledge. Nevertheless, narrating and understanding and experimenting are necessaries and not sufficient condition for people to build on a constructive experience. Because of the possibility for people to feel the space in the museum and to move and to touch things, DITs ultimately convert onto something that has a new and shared meaning among people who participate to the creation of the construction of the experience.

Interacting with DIT is about understanding the other participants' needs and creating an ecological understanding of it. For instance, the fairy-like forest (see Figure 5.4 in Page 84) can become an occasion for experimenting skills of *civil engineering*

> Three stranger children are playing in the tactile room build a barrier to change the flow of the light (see Figure 5.4 in Page 84). They are discussing how they want the flow to change, for exemplifying what he is thinking he seat on the floor. The result is not the one the child would and together with the other who agree with the plan of the one who sat, they debate for finding possible solutions. [. . .]

> In their experimenting and discussing and moving the three children adopt a *"three passages of stop and doing"* for re-designing and interpreting the environment. They improvise a participative process merging each other ideas and *whishes* for stopping the light flow. First, they use their feet and hands. Unhappy, they struggle lying down together. Third, while collecting only negative results, they begin a new brainstorming on how to positioning themselves. The participative design process continues by re-setting individual ideas and put them together, and focusing on the stream of light; thus they lay one by the other. Again, this solution is not satisfying the three young *engineers*: still some rays are crossing them. Thus, standing aside the light, they discuss a third time how to position their own bodies to block all the rays. During the creative process, one of the children brings a pillow for using it as a seat and sits on the perimeter of the light flow and another child observes a wide curve of the light provoked by the pillow. Because of this discovery the children begin to reconsider the space and the objects available and bring and set of different pillows. [. . .]
> Two lines of pillows at twenty centimeters from each other stop the flow of light and the room is a little bit darker, as one of the child observe.
> **Stopping the lights - Maxi ooh**

Thus, in this case the kind of acknowledgment acquired through the interaction with the fairy-like installation in the Maxi Ooh is related to the process of learning dynamics for interventions: sharing the understanding of the outcomes and grasping details for changing and re-configuring the environment.

Infrastructuring Knowledge is a composite process that interweaves person-to-person dialogue, people direct interaction with DITs and the experience embedded to the environment. The connection through DITs and the sensibility of figuring out the outcomes of the interaction becomes relevant in respect to both the natural dynamics moving in the space and in respect to the understanding of cooperative and participative behavior.

The cooperative and participative experience seems to be at the base for elaborating acquired information; either we talk about grasping details from the environment or we reframe the information collected from the exhibition for playing a game. *Understanding* and *Experimenting* ground in the context and are activities that allow people to find meanings for interactions and enhance the meaning of the space because of building common goals and a common *place*. Building common goals and places serves people to move and make actions for interpreting information and Infrastructuring

Knowledge. In this respect, the interactive game in the Discovery provides an contextual occasion for constructing meanings on the experience had in the area; the ALP invites visitors to share the understanding on the natural items exposed in the Discovery, combining physical with intellectual involvement. For instance, playing with DITs leaves space to people for combining and coordinating actions for shaping space and time meant for discussing and comparing the understandings of the actions and of the exhibit. Hence, the amusing and engaging contribution of DITs reframes in terms of education following to two aspects: on one hand DIT provides insights informing people on some specific area of knowledge; on the other side DIT provides an occasion for sharing knowledge and supporting the network for Infrastructuring Knowledge. The occasion for pausing and for discussing that occurs while interacting with DIT is crucial for adding value to the interaction. For instance, the interactive installation with the bubbles projected on the wall in the Maxi Ooh (see Figure 4.2d Page 56) shows information about visitors' voice and allows them to open on discussions that, otherwise, would be unlucky to come up with. Moreover, the time visitors spend on moving and balancing the activities together is an occasion and a condition, as well, for summarizing the experience and sharing it.

DITs are sources for gathering and sharing information, for discussing this information and blooming knowledge. Visitors, who join in the interactive experience, are amused by what they see in the area and elaborate their experience.

6.4 Guidelines for Designing DIT for Public Space: the Interaction and the Space

Designing DIT interweaves social, academic, commercial, human aspects. Moreover, designing DIT can enhance public spaces, such as museums. Section 5.3 Page 92 in Chapter 5 describes a first step for designing DIT that includes a three-points outcome:

- crafting dialogue;

- making use of the space;

- drawing trajectory.

Similarly, this Chapter provides a second step for designing DIT for public space. The observations refer to the dynamics through which visitors share information and add value to this information. Mainly the point touched in this chapter focuses on the participatory reconfiguration of the environment while interacting with DITs.

The analysis of the visiting experience outlines the need for people to be **actively involved** within the interaction for engaging in new connections. This requirement relates with the opportunity to **bodily engage** with the context, and interweaves the previous step: moving across the environment and touching things for changing the set of the context help people to find the adapt frame for constructing knowledge. However the environment is more than the physical space of the exhibition, the environment is the opportunity for interacting. The opportunity for interacting includes the possibility to reconfigure the environment. Reconfiguring the environment is about looking at it from a different point of view and re-interpreting the frame of it - see the ethnographic note *"Stopping the lights"* (Page <u>114</u>). Moreover, reconfiguring the environment can be as well related to the re-interpretation of the interaction - like the ethnographic note *"Evolution of the feeding system in he Alps"* describes (Page <u>112</u>). Furthermore, the re-configuration of the environment happens when people construct a shared and a common background through crafting dialogue and using the space and making trajectory. For instance, the game ALP becomes an opportunity for sharing the understanding and for making sense of the visit at the Discovery. Playing with the game is a social experience that allows visitors to find a place for refining their visiting experience constructing a common point of view and interpretation on the information got from the environment. The game draws an opportunity for visitors in the Discovery for interacting, something that the all exhibition is blindly stimulating. Similarly, the installations in the Maxi Ooh offer visitors with the opportunity for interacting and talking with each other, promoting the re-definition of individual and collective understanding of the outcomes of the installation. Going back to the ALP in the discovery, the main feature of the game is the one of **bringing visitors together** and **providing the occasion** for

communicating and interacting. Sitting together, moving fingers on the touch-screen for dropping the figures and waiting for the game to load, allow visitors to exchange their interpretation on the visiting experience. DIT has to provide the occasion for connecting together and collaborating for creating a common meaning over the information provided by the exhibit. Besides, engaging with DIT depends on the *stress* of interacting: the less new information the DIT the more it stimulates people to experiment. The *Experimenting* process serves for refining details of previous *Understanding*, thus the interaction with DIT focuses on sharing and elaborating previous information and grounding the situated knowledge acquired during the experience. Moreover, DIT embodies the potential for interacting with strangers who have in common the visiting experience, and encourages their mutual interpretation of the exhibition.

Hence, the interaction with DIT recalls the connections visitors had while visiting the exhibition and offer the occasion for establishing the connection and building a relationship for the time of sharing the interactive space. The interaction with DIT is about **practicing community**: visitors relate with each other sharing space and meaning and manners through which to interact and communicate together. Also, visitors are more likely to share their experience when they can find similarities with the others. Thus DIT, more than providing further information, is about shaping the place for stimulating person-to-person interaction and comparison, and providing a place for Infrastructuring Knowledge.

Interacting with DIT provides occasions for connecting with strangers by listening to descriptions from the museum staff; By looking at the same installation at the same time as the others do, by sharing the space and developing a common understanding on the outcomes of the interactions with DIT. Hence, DIT engages through physical involvement, either moving the body or using the other senses. Thus, DITs happen to be tools for loading practices of sharing knowledge and for sharing in-action.

Visitors share their experience and create knowledge together through multiple ways. However, the interaction with the interactive game provides a good occasion for them to ground and elaborate information acquired during the visit. Thus, visitors interpret and re-configure the DIT as a space

for *processing* the information. Moreover, DIT helps visitors to recall initial enthusiasm when it is installed in non-digitalized context such the Discovery is (see Chapter 7), which is vital for sharing the experience and for keeping the relationship. Still, *"keeping the relationships"* is possible because of the social experience stimulated by the environment and because of the fact that the game itself encourages visitors to connect and to find a common discussion theme. While visitors interact with the game they share their enthusiasm in a common space and through actions that let them share their knowledge.

Thus, the design of a DIT should take into account the latent potential of these technologies to connect visitors and to provide them with the possibility of a pause in the information flow, allowing them to create knowledge. The waiting time for the technology to complete their task happens to be stimulating instead of annoying. In these intervals of time, people establish connections and share experiences.

The following Chapter has roots on the pauses, information flows and connection, providing a critical interpretation of what designing DIT implies for the quality of the museum experience.

Chapter 7

People's interventions: design as rethinking interaction

> [...] cannot exist without
> constantly revolutionizing the
> instruments of production, and
> thereby the relations of
> production, and with them the
> whole relations of society.
>
> Karl Marx and Friedrich Engels
> - *The Communist Manifesto*

With the intention to describe limits and potentials of Digital Interactive Technologies (DITs) for people's creation of knowledge, this Chapter takes in exam processes embedded in the dichotomy *technology and non-technology*. The reflections in this concluding chapter of the data-body of the thesis build on relationships of the *In and out* node with nodes that imply the creation of knowledge. These reflections direct the attention on dynamics of approach and use DITs.

Museums are complex and young institutions that, paradoxically enough, are stable as they explore and display established features and parameters of our society and natural world, while they are unstable in respect to the promotion and stimulation of cultural evolution and changes. Because of the paradoxical nature of museums, these institutions are, more than others, theatre of cultural and technological changes, and experimentation [Macchia and Salgado, 2014]. The concept of *Infrastructuring Knowledge* (IK) helps the understanding of these changes. This concept emphasizes

the process for maintaining while changing and improving the museum ecology of people, technology, relationships and actions for making the museum a sustainable - as permanent - institution.

While investigating the dynamics that occur in museums in relation to the introduction of Information Communication Technology (ICT) and DIT, I observed some interesting recurrent behaviors among visitors. Indeed, the time visitors spend interacting with DIT has a sort of sinusoidal pace. This recurrent way to interact with technology invites me to reflect on what designing DIT implies for the sustainability of the Technologically Enhanced Environment (TEE), that is the consistency and permanent success of the exhibition environment itself. The discussion on sustainability I suggest in this chapter aims to understand how a DIT actually acknowledges and balance people's interaction and DITs integrating museums dynamics. Although the concept of sustainability mainly refers to environmental and natural resources, the approach adopted to understand the way DIT is used moves towards the intrinsic features of technology and focus on the *futuring* [Fry, 1999, 2009, 2012a] potential of DIT and using DIT (see Table 7.1 Page <u>121</u>). Thus, I aim to uncover and discuss in which terms DIT for a TEE can be considered as sustainable.

Because of the complexity and multi-usage of the concept of sustainability, the following section describes how this concept is discussed in the field of Human Computer Interaction (HCI) and Computer Supported Cooperative Work (CSCW). Then, the Chapter continues framing the theme of sustainability in respect to people's interaction and experience of the space. Hence, the aim of discussing DIT through the lens of sustainability is for raising debates on directions and lines that might be useful when designing for long-term TEE.

7.1 Sustainability, HCI and CSCW

There is a reasonably growing body of research that refers to the relationship between the concept of *sustainability* and ICT among HCI and CSCW researchers. CHI and CSCW communities walk on to discover technological

Futuring vs De-futuring
With the term *futuring*, Fry [1999, 2012a] imply the descriptions of design practices in terms of decisions for the future. *Futuring* means designing having in mind the finite time of human existence and for maintaining high-level conditions of human being and quality of life. While the term de-futuring implies the negation of future, that is about setting practices that go against time and *"rapidly negate our future"* [Fry, 2012a] that is about damaging the planet as well as anthropocentrically out-disruptive. Technological research and evolution is intrinsic to humanity as well as the *futuring* research, the creation for practices and technologies that lead to the future.

Table 7.1: Design is about *futuring*

alternatives and solutions for facing issues related to environment, energy consumption and waste production through the design and introduction of computerized artifacts and systems that look at a sustainable future. DiSalvo et al. [2010] and Knowles et al. [2013] summarize the main tracks of this researching area focusing on different needs and designing strategies. While Knowles et al. [2013] discuss *sustainability* in respect to economical, social and environmental needs; DiSalvo et al. [2010] describe strategies for informing *users* about the *"environmental impact of their actions"* and strategies for improving the level of sustainability through designing technologies, and changing designing parameters, criticizing and rethinking the current state of things.

Hence, a main and relevant aspect that connects these research directions is the interest on the impact that technology has in *"different forms of social life"* [Wulf et al., 2011]. In this frame, the impact of technology is understood as a transformative and innovative opportunity to click within certain needs and practices that do not compromise future generations to respond to their needs [Wulf et al., 2011]. Still, discussing about sustainability either refers to the environmental sense, or to the development of disadvantaged areas. Furthermore, discussions about sustainability are meant to avoid *"a future of scarcity"* [Tomlinson et al., 2013].

Thus, the concept of sustainability mainly refers to desired and desirable futures that is informed by a comprehensive overview of collective and integrative actions, rather economical, social, technological and ecologi-

cal Robinson:2006. In such terms, sustainability is strongly related with the idea of development and, in the beginning of the 1980s, recalled and emphasized the

> "environmental concerns about the increasingly evident ecological consequences of human activities and sociopolitical concerns about human development issues" [Robinson, 2004].

Sustainability concerns the need to incorporate and embed new forms of resources and knowledge frames, for contributing to the general wellbeing, affecting future changes. In this respect, sustainability refers to multiple aspects of everyday life and social changes, including economical or environmental changes, or else technological or educational [Reed, 1996, Sellen et al., 2009, DiSalvo et al., 2010, Knowles et al., 2013]. However, nowadays the globalized society has to deal with the limitation of natural and social resources, which leads the society to a potential future of scarcity.

Tomlinson et al. [2013] argue about the possibilities of design for changing practices, shifting culture and driving people (designers and non-designers) towards a re-interpretation of resources and social/political/institutional life. As the researchers underline, there is potential for new strategies for facing and preventing "a future of scarcity". Thus, HCI researchers are called to design and develop long-term technologies [Kaptelinin and Nardi, 2006]. Additionally, crossing disciplines and engaging people with different interests, HCI scholars are in the position to stimulate actionable knowledge for developing interactive systems for the better. Engaging the collectivity for promoting a sustainable perception of social life and stimulating practices directed to sustainable values, aims to configure the role of technology in the discussion of *futuring*. This interpretation of technology draws practices and engages people in activities for stimulating relationships and collaborations. In this perspective, designing technology for public spaces provides a useful starting point to stimulate people's critical views and understanding of potential risks for future society.

DiSalvo et al. [2010] unfold the growing discussions on sustainability among researchers outlining principles of sustainability and emphasizing on the potential of the concept of *sustainability* as a tool for rethinking implications of design and other research clusters; for instance their review of the con-

cept of sustainability identifies a cluster that sets methods and approaches applied to interaction design. Following this trend, the concept of sustainability moves steps further from the mere idea of recycling, promoting a cultural change, rising new issues and awareness among researchers that open up questions related to new design oportunities [Sellen et al., 2009]. For instance, Sellen et al. [2009] highlight the need to make explicit the *"complexity of new ecosystems of technologies"* that impact people's interactive activity. Moreover, the authors underline that people are becoming dependent on their relationships with technology.

People's dependence on technology stimulates a more broad investigation around the changing society and the impact of technology to the future. Thus, according with Sellen et al. [2009], the HCI disciplines open up to the need for rising awareness on supporting, augmenting, or constraining (sustainable) human value.

Since new questions trigger the need for new practices and approaches in the field of HCI, the following section introduces the discourse on the revaluation of *design* as a critical opportunity for looking and improving the society.

7.1.1   Interaction Design and the silence of DIT

As described earlier, the concept of sustainability is broadly used in HCI and CSCW for accounting different aspects related to new technologies. In terms of designing DIT, the adoption of a research frame related to sustainability mainly refers, and my concern is, about rising practices and values that encourage long-term and valuable interactive experience between people and across DIT. Namely, my concern is on implications of DIT in public spaces for promoting shared and collective perceptions and knowledge. By reflecting upon how DIT engages people in museum and how peoples' interaction is related to DIT, I aim to promote awareness on the potential responsibility of interaction designer in terms of social changes. The discussion on interaction design responsibility interweaves the previous discussion on sustainability and is framed across concepts such as *critical design, un-design* and *non design* - discussed in the following section.

Interaction design and its responsibilities

Interaction design is about *"shaping digital artifacts - products, services, and spaces - with particular attention paid to the qualities of the user experience"* [Fallman, 2008] and has the aim to develop something new. Moreover, interaction design is very often about changing perspective and developing new interpretative frames. However, changes and new interpretative frames affect understanding of contexts and people interaction.

Changes and new perspectives embed and interweave the concept of *"good"* that emphasize the social nature of quality [Fallman, 2011]. Moreover, following the tradition of Participatory Design, interaction design and other interpretations of design processes focus on social, political and relational challenges. Thus, rather than focusing on the merely interactive activity, questions are directed also to *"social, cultural, ethical, and moral issues, with a bearing on new themes in HCI, such as sustainable interaction"* [Fallman, 2011]. New questions floating in the air open to the need for questioning and clarifying the kind of values that stimulate changes for a desirable future, as design is about [Ackoff, 1979, Schön, 1983]. According with Bardzell and Bardzell [2013] the HCI researchers care about the concept of desirable future and privileges technologies that

> *"serve but also marginalize, that aesthetically please but also isolate, that stimulate economic growth but also threaten the earth."*
> [Bardzell and Bardzell, 2013]

As matter of fact, designing DIT is about maintaining while improving *status quo* in respect to *"cultural, social, technical, and economic expectation"* providing *"alternative social, cultural, technical, or economic values"* [Bardzell and Bardzell, 2013]. In this frame, interaction design blurs the concept of sustainability provoking and stimulating values that stimulate alternative interpretations of technology.

Even though the broad description of sustainability proposed by Blevis [2007]

> *"disposal, salvage, recycling, remanufacturing for reuse, reuse as is, achieving longevity of use, sharing for maximal use, achieving*

heirloom status, finding wholesome alternatives to use, and active repair of misuse"

still has echoes among researchers and designers in HCI and CSCW communities, increasing interest links to a broader reading of interaction design as tool for promoting collective responsibility for the future.

Interaction designers together with people they design with and for, have the opportunity to impact the future changing everyday practice [Tomlinson et al., 2013]. In the same pace, Bardzell et al. [2012] face our responsibility for a future

"in which technologies play positive social and cultural roles. This critical reasoning can support new ways of framing the practices, methods, and design spaces of HCI. Such re-visioning benefits both commercial innovation and responsible design."

Hence, DIT shapes and provides conditions for a sustainable culture of technological usage [Blevis, 2007, Choi and Blevis, 2011]. Following Blevis [2007], designing interaction embeds sociocultural and ecological impacts of technologies that come together with the critical attitude to consider and design technology. Thus critical design intervenes with the interpretation of the present, and encourages actions that lead to a sustainable future [Blevis, 2007]. Increasingly, the role of sustainable interaction design deals with ubiquitous computing and the extension of computing artifacts in public spaces that let users to interact within technologically enhanced environments. Often, integrated DITs in public spaces aim to improve people collaboration, interactive learning and amusement [Luff et al., 2003, Hall and Bannon, 2005, Kaptelinin and Nardi, 2012]. Interaction design and DIT stimulate and enhance social and contextual factors [Ciolfi and Bannon, 2005] supporting the process of making of a space a place [Dourish, 2006].

Distinguishing physical spaces and meaningful places helps interaction designers to adopt (or not? - Baumer and Silberman [2011]) interactive technologies to stimulate a place or an other.

In this direction, discussions on *not design* and *un-design* are growing [Pierce, 2014, Baumer and Silberman, 2011]. This trend associates with

the fact that unsustainable future links to the complexity of relationships that technology brings to multiple aspects of social life [Baumer and Silberman, 2011]. New design opportunities include the inhibition and displacing of technologies in order to think about the plain and the empty: what the emptiness rather the plain offers to interaction? [Pierce, 2014, 2012, Akama, 2014]. While this discussion grows from the instance that technology has negative and risky impacts on society [Pierce, 2012], the following subsection provides a frame in which technology can have an actually decisive role for wealth of knowledge when there are ways out.

7.2 The experience of interacting

The previous section explores how HCI and CSCW deal with the concept of sustainability, emphasizing the responsibility of interaction design from the peculiar perspectives that see design as an opportunity for being critical and for thinking about what we (as designers and researchers) are doing. In his very interesting works, Fry [1999, 2009, 2012a,b] takes an even a more drastic position to confront the implication of designing things. For instance, the author argues about human's inclination of being *technology beings* saying

> *"[. . .] when our numbers were few and our technology basic, our impacts were low and able to be accommodated by natural systems. But now the global population is so large, and still growing, and our mental and material attainments creating impacts so vast that, as already said, our very future is uncertain."* [Fry, 2012b]

Thus, Fry [1999, 2009, 2012a] concern is for the impacts of technology within the natural system. Design is about drawing a new world rather than merely producing new things [Erling et al., 2012, Fry, 2012a]. In this respect, ethnographic observations recalled earlier (see Chapters 5 and 6) highlight the social potential embedded in Digital Interactive Technology (DIT) and expressed by human beings.

Hence, DIT offers occasions for socializing contributing to the future of culture. This (sometime) hidden potential comes together with the possibility for people to pause from the direct inputs of DIT (see Figure 7.2

Page 134). The node *In and Out* described in Table 5.3 (Page 96) describes the museum visit as an *organic* experience between insightful conditions and activities and breathing time: *"insightful condition"* means actions and activities with a lot of inputs and *"breathing time"* means period in which visitors can reframe and reconsider inputs they had from *"insightful conditions"*.

The circular process of constructing meaningful understanding of the exhibition recurs through all the ethnographic notes. For instance the episode [Getting off the room] (Table 5.3 Page 96) provides an insight about what *breathing time* means and provides evidences about the importance of the in-out sequence for information or activities to be get and understood by someone. Moreover, the *in and out* process of visiting museum is connected with nodes that relate to the creation of knowledge. In fact, Figure 5.6, Page 89, highlights strong relationships among various nodes: *Space* (see Table 5.2), *Experimenting*, *Discovering* and *Relationship* (see 6.1). These nodes are tight together by inter-related activities that have to do with *the process for* understanding and learning rather than *with* understanding and learning, with strong emphasis on links between the nodes *Experimenting*, *Discovering* and *Relationship*. While analyzing the nodes and their relationships I understood that these activities, while are well self defined by specific actions and verbs such as

EXPERIMENTING : EXPECTING, TRYING, DOING
DISCOVERING : EXCLAMATIONS, DISCUSSING, CHANGING ACTION
RELATIONSHIP : GETTING CLOSER, LOOK AT THE OTHER, ASKING

are not self-contained and exhaustive for framing the process of creating knowledge, even less self-sufficient when including DIT. The actions and the situations described by the nodes are tight knotted and blurred together in the process of making sense of the interaction and supporting visitors with the elaboration of the information acquired by acting in terms of *discovering*, *experimenting* and *relating with others*. Moreover, the complexity is linked with the ability to reinterpret the technology and to swift actions (see Table 7.2 Page 132). The interconnection among all this nodes helps to understand the complexity of moving and interpreting a TEE with the support of the context itself.

For instance, interacting together with other people is helping one to cap-

ture relevant inputs from the interaction, elaborate information and to share the elaboration with others is stimulating the knowledge process while changing and reconfiguring established actions. This integrative process occurs explicitly when DIT is involved in the Maxi Ooh and in the relation to the tabletop in the Discovery.

> "[...] A group of children and adults is interacting together with the bubble installation in the sound room [see Figure 4.2d Page 56], a child exclaims "Now there are all the colors!" to an other child and the dad of her, while two other children scream alternately. It is becoming a collective moment of discovery: they start to construct some sort of balancing relationship. The three adults are bringing into the game discussions and movements to understand how things work and interact with everyone in the room to understand how things are. The game at some point is no longer the one of discovery *per se* but it is about experimenting ways to cover the wall making more or bigger bubbles. While, the group is interacting some of the components in turn move outside the room or interact with the other two installation for few moments. They follow together this activity to the moment they fulfill of big bubble the all projection. The relationship established through the interaction continue further and activating new practices that I didn't see very often: the group looks tight to the enthusiastic flow and bringing back the wooden objects (it is unlikely that the wooden toys are put in their box after being used). Outside the room even though additional experimentations are not taking place: from the room and reframing actions after the apex of the interaction."
> [**Experiencing the interaction - Maxi Ooh**]

This episode [Experiencing the interaction] in the Music room clarifies how the interaction happens to be meaningful for one who participates with others:

It is becoming a collective moment of discovery: for activating a collective interaction that, as it can be observed from the vignette, helps visitors understanding end experimenting of the installation, people need to recognize a common and shared input for establishing a new outcome. A new outcome is mainly a way to personalize and reframe the possible results of the interaction. Thus, it is not by nature that the experience is shared among the member of a group of people; a collaborative and shared experience occurs when participants by chance some variables manifest together. The observations at the museum

highlight common aspects that stimulate people to aggregate like (1) *free space* available for people to move, (2) triggering events, for instance someone pointing to a specific outcome of interaction, (3) the occasion to take a step back.

experimenting ways to cover the wall: elaborating information and inputs gained while interacting together with other people, observing them, talking with them, and experiencing with them happens when people together reframe the rules of the game and re-fix them in respect to new scopes and purposes. While the aim of the bubble interactive installation is about inviting visitors to experiment with their voices, the group of people in the last vignette has the shared scope of filling the wall with colored bubbles. By experience I can say that this is a quite easy task. Differently, it is not an easy task to figure out how to produce all the different colors of the bubble. Each color and size indicates different tones and pitches. And the higher the combination between the tone and the pitch the smaller the bubble and the faster it disappears from the wall. Thus finding the best combination of sound is an intense exercise that needs time and energy to be build.

move outside the room or interact with the other two installations: this aspect has been introduced earlier in Chapter 5 Page 90 in respect to the connection between a space and an other. Similarly, in the process of understanding the interaction and creating knowledge through it, people demonstrate a common time rhythm of interaction that can be connected to the creative process [Macchia et al., 2015a]. Nevertheless, interacting with people and DIT and creating knowledge out of this is a creative process that includes four stages "*preparation, incubation, aha moment, verification*" and the second stage is about developing understandings on received information. The second stage, a first step of the elaboration of new understanding about the inputs in museum also affects how people move away and recommit themselves to the source of information and with the interacting group.

the interaction continues further with new practices: interacting for constructing a new frame of museum experience with other people -

who can be strangers - establishing a sort of permanent link that outsiders do not understand. The established link among participants of the interactive activity develops signals and behaviors mutually recognized by the members of the group. Because the interaction with DIT has often unexpected outcomes the established connections and relationships last for the time of the interaction and on through manifestation of new practices. For instance, as the vignette describes, the interaction develops practices that are unlikely to manifest otherwise, like reordering wooden toys. Moreover, developed practices mainly relate to the concept of sharing and common good (see Chapter 1), and finally, also with the concept of *futuring.*

The interacting experience in the context of museum TEE is a dialogue between people, DIT and environment as well. As described in Chapter 5 the museum experience is based on dialogues usually embedded on the flow of actions and rather invisible because it occurs as a accepted and natural social practice. The social value of the experience depends on the intrinsic relational potential of the DIT. In fact the more people a DIT gathers together, the more the interaction is valuable in terms of social practices of sharing understanding for the creation of meaning. Thus, *meaningful* interactions in museums refers to the participatory construction of shared process or thing or interactions or purpose. For instance, the following ethnographic extraction describes a sequence of actions that lay on the fulfillment of expectation through changing and combining two main factors: engaging with others and altering the environment.

> "[. . .] The child is not satisfied by the results of his voice in the screen. He realizes that his position is not comfortable and decides to bring some pillows as a sort of stool. The child experiments the installation from a different point of view and looks quite satisfies by the result of his voice on the popping up figures in the screen. Anyway a younger (and shorter) child enter in the sound room and stares at the screen. The first child invites the other to join the activity saying "try!" while pointing at the second microphone. The younger child looks a little bit puzzled and still not really convinced about how the installation works. Meanwhile a child is blowing on one of the microphones of the other installation inviting from time to time his family to play with him. This installation is attracting him more than others, in fact he is changing

> position every now and then in order to see if the image changes and if the
> blow gets stronger. He calls a girl to blow on the spare microphone. She joins
> the child and they blow together as much as they can moving the shapes in
> the screen really fast. Satisfied, they lough."
> [**Making shapes together - Maxi Ooh**]

While the second vignette highlights the value of engaging people and altering the environment for realizing goals, the first vignette shows the worth of synchronous activities for the establishment of relationships and interactions. In fact, although the totem installation is designed for two, the projection of the bubbles reacts to sounds coming from an indistinct number of people who are in the room. Both vignettes emphasize the role of sharing the experience with another, and feeling and appropriating the space with the central difference that feeling and appropriating the environment within a larger group of people has a double side: on one side of altering the space through the introduction of physical elements (see for instance vignette [Stopping the lights] Page 114), on the other side the appropriation of the environment depends on the occasion to move from a space to an other as described above in Page 129.

This section points out ways of people to interact in TEE in terms of social practices. However, a main understanding about a macro-level of interactions in TEE acknowledges the role of DIT as spur for stimulating social practices for the good of a group of people. Moreover, the observations wrote in this section stress the role of the environment and the way people move on it. Thus the following subsections explore the appropriation of the environment in terms of moving through the space for making sense of the acquired information and established relationships.

7.3 Appropriating the environment: moving in the space

As introduced above, the ways people interact with DIT and across the space in the museum are of great deal in inspiring social and sustainable practices and building relationships among people. Analyzing the observations done, a rhythmic path of movements can be spotted: in the Maxi Ooh can be observed a rhythmic performance of behaving inside and out-

Nodes related to experiencing Technology
Museum experiences and knowledge processes are connected to the themes mainly related to the museum experience as an activity rather then to museum as a methodological experience as highlighted in Table 4.2 (Page 66) and Figure 4.9 (Page 70). The interconnection between *Experimentation*, *Relationship*, *Discovering* highlights evidences that describe museum experience as a set of activities that have a lot to do with the intention to learn something new and share what has been learnt. In fact, ethnographic notes that refer to the analysis of connection between nodes point out social experiences of interpreting and sharing:

Sustaiability this node refers to those ethnographic description of investigative actions and behaviors such as:

> "[. . .] the two men enter into the Discovery and pushing the red-dotted mushrooms on the plastic bush they look around to see what happens."
> [Wrong push - Discovery]

Interpretation this label group ethnographic notes related to moment in which visitors create some new relationships that serve them to understand the surrounding environment:

> "[. . .] they build the game on a new interpretation of it, while one is describing what is feeling with the hand the others have to guess the object. While doing so they tell about their experience at the museum mentioning what they remember from other places pointing at things or asking things related to objects around"
> [Guess what - Discovery]

Table 7.2: Relationships between nodes: *Sustainability* and *Interpretation*

side the rooms (see Figure 7.1); similarly, rhythmic performances have been
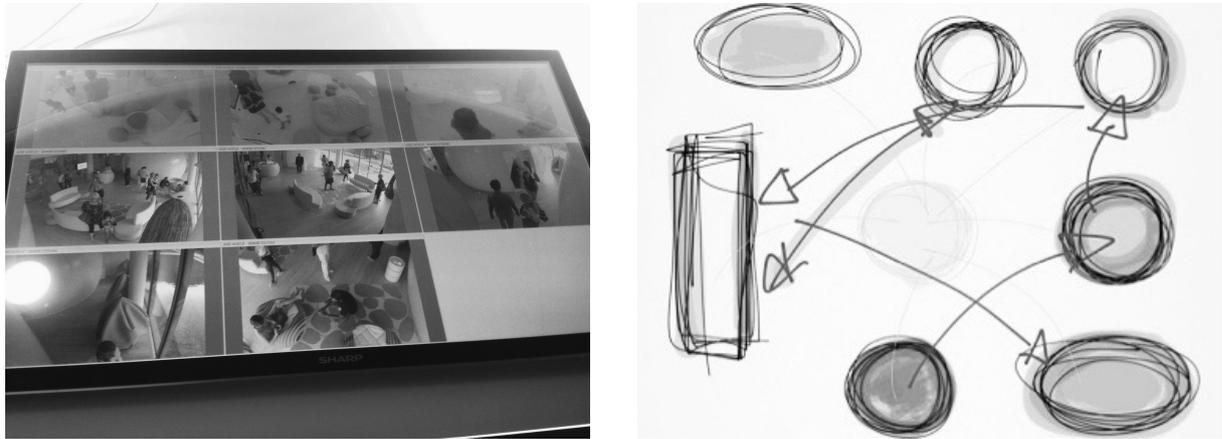
(a) Different spaces in the Maxi Ooh.

(b) How people move in the Discovery

Figure 7.1: How people move in the Maxi Ooh and in the Discovery

registered in the Discovery in relation to visitors' movements between installations (see Figure 7.1b).

Information collected in the areas are quite different in regard to what might be defined as *rumors*: while the Maxi Ooh is a protected area in which people move inside and outside rooms (see Figure 7.1a), in the Discovery the space is much smaller and defined through a squared exhibition space. Of course this difference stimulates some diverse outcomes and activities that have to be considered while analyzing the data. Meanwhile, comparing the areas sets the basis for understanding a diverse universe made by different "*human experiences and contexts*" [Macchia et al., 2016, Nardi et al., 2011]. Differences and comparisons are worth a lot to build a clear image of contexts and situations; nevertheless comparing data from quite different contexts is a complicated task that has to be sensibly faced. Because of this, first I focus on the Maxi Ooh, which revels how people move in a TEE, and then I concentrate on the Discovery where the flow of interaction shows interesting paths in respect how the DIT intervenes in the visiting experience. The observations show similarities in respect to the way to use the space and interact through it, and highlights some differences related to creating connection between people, however we have to remember the *rumors*.

The following subsections focus first in the dynamics of visiting the Maxi

Ooh and in those registered in the Discovery.

7.3.1 Maxi Ooh: rhythmic interaction

As mentioned several times, visiting the Maxi Ooh is a collective and sharing experience that has some constant features in respect to time organization and use of the space. As Figure 7.2 displays, people behaviors and
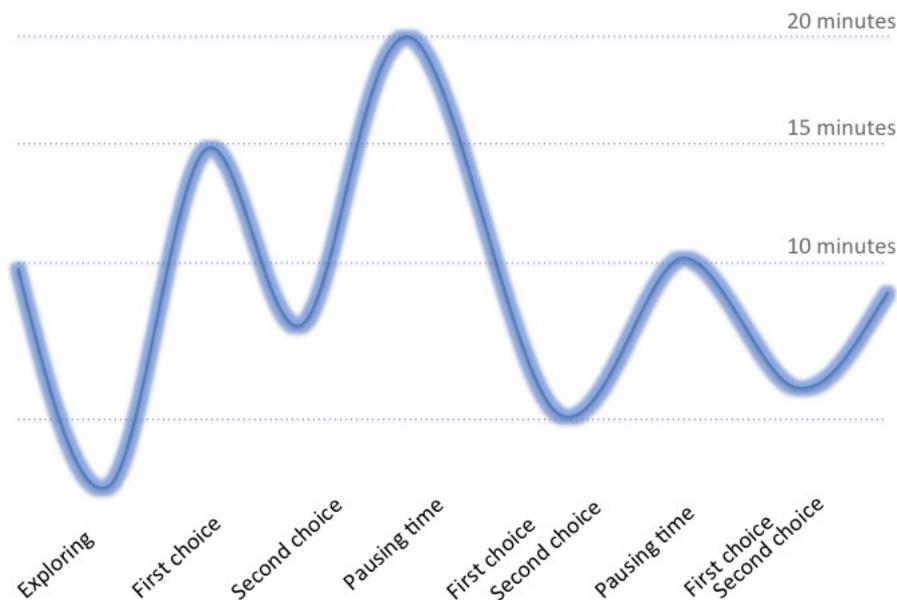
Figure 7.2: How people spend time in the Maxi Ooh

activity in the Maxi Ooh is repetitive and follows a specific path of actions of experience:

First step of experience: visitors spend between 7 to 10 minutes going around swapping from an installation to an other for grasping ideas of the space and rising a personal sense of appreciation of the area. This first step serves visitors to understand the space, to have an image about its organization and about the installations. The area for relaxing, described as Visual Room in Page 55, is attractive for the very short time of a maximum one and half minute; thus the remaining time is spent between the other two rounded rooms and divided for

two thirds in favor to the preferred one, which is averagely around six minutes.

Second step of experience: after having spent some time exploring the areas inside the rooms and having selected the preferred one, visitors move in the favored room for about 10 or less minutes if they are alone, while the experience extends to 20 minutes or more when there are other people to interact with. This second step serves visitors to test their first hand understanding about the installations. This stage helps visitors to advance consideration about how the interaction happens.

Third step of experience: after having experienced and interacted with the installations in the preferred room visitors change the room and move in the other where they usually spend half of the time spent in the first.

Fourth step of experience: this step draws the first significant brake between interactive experience and *reflective* activity. At last, the amount of time for pausing is equivalent to the time spent in the first room; this when adults are not pushing children for doing things faster. The time spent outside the room is a sort of *chill out* time when visitors read books and play with toys and instruments and/or just mingle around and sit in snugly armchairs and cozy sofas. Generally visitors meet together in the central space in the same time during the first pausing time. This is a precious time for visitors to know each other in a sort of neutral context where they are not suppose to interact with something specific like happen in the rooms.

Fifth step of experience: even though the influence of adults over children could be observable at first glance the effect turn the other way round when adults and children cooperate and complementary interact; for instance, while adults are more acknowledge about reasons for interactions output, children ask for more unusual questions that bring adults and children to investigates together to find answers. Usually, this turn occurs after the pausing time when the visitors move again in the rooms and begin new forms of experiences. The second tranche

of interaction in the rooms is shorter than the first and can be followed by several other pausing time and interactive tranches that last between five and seven minutes each.

These five steps of experience describe the average line of activity through which people can develop an interactive experience that lets them participate together to the creation of knowledge. The analysis of movements and activities draws lines to figure out the spatial and interactional conditions for stimulating people to connect and relate together rather than not. Moreover, the steps described here refer to those situations in which cooperation and active discussions have been observed. Thus, when these steps did not take place, the level of cooperation and discussion was unlikely to occur. For instance, few occasions demonstrate that spend too much time inside the rooms *doing things* instead of *understanding things* the level of people interconnection is really low and individually oriented. Similar performances have been observed in the area of Discovery: in this case we could observe how moving in the space and the development of social and relational behaviors are actually related together and can be established through DITs. The following section describes how moving in the space and directing towards DIT actually put in action light relationships between people.

7.3.2 Discovering each other in the Discovery

The main difference between the Maxi Ooh and the Discovery is about the protective feeling people have in the rounded rooms and the gesture of taking off the shoes (see Page 55 and the ethnographic note "Taking off the shoes" Page 96), which help people to open to each other and prepare for collaborative interactions. The absence of physical protections in the area of Discovery, but a short bush-like fence (see Figure 4.3 Page 58), is not creating basis for people to perceive the condition as protective enough to trust immediate interactions. Nevertheless, the absence of walls and barriers let people to encounter each other eyes and to feel what the others do.

In the previous Chapter 6, a vignette describes two children who get connected by looking at each other pointing out the impacts the context has

(a) A shoot of the the Discovery that pictures the stairs too.

(b) What people see from the stairs

Figure 7.3: Discovery form the perspective of the stairs

on affecting visitors relationships. Moreover, as the vignette introduces, the context is essential for building relationships. However, the context is essential as combined with the aims and the purposes of the context itself. The way people move in the Discovery is related to the instructive and educational scope of the place. As pointed out in the previous two chapters there are signals that describe visitors' inclination in respect to the visit experience and in respect of sharing information and understanding of the surrounding context. Moreover, the flow of visiting expresses an overall attitude of visitors to avoid digital artifacts, likewise these objects might be useless in terms of providing information or keeping long term and consistent learning insights. However, as described previously in Chapter 6, visitors find the DIT of interest at the end of their visiting experience. There might be a number of reasons for people to think about DIT in this way, starting from the position where the artifact is fixed but nevertheless, it happens to be the last installation through which people interact with. Even though I observed this thing since the beginning of the ethnographic period spent in the Discovery, I decided to avoid direct questions on this specific aspect and differently, trying to grasp reasons through details. Therefore, *details* contain whole world of information. For instance a father walking up on the stairs (see Figure 7.3a) once gave a first hint about reasons to use the DIT at first:

> "After having visited the labyrinth (see Figure 5.3 Page 78) The father walking up to the stairs with his two children, a little exhausted in his voice, says quite clearly *"And then when we come back downstairs you can play with the game"* pointing at the interactive game ALP. As the two children turn to the ALP and see what the father is talking about the two tired children (I daresay one is a teenager more than a child) sprint up excited."
>
> [**Sprint up to the stairs looking forward to play - Discovery**]

It is true that sometimes the area is taken as a sort of kinder-garden where parents sit on the benches while children play. Even though this attitude still persists, the museum staff elaborated a couple of techniques for discouraging adults to be detached by the children and by the situation. For instance, the simple act of positioning the benches before the plastic-bush fence had significantly changed adults' attitude, but still some time situations in which adults sit and children play still survive.

Differently, the following vignette shows how the decompressing role of the ALP can switch the perception of exhibition of the Discovery.

> "While the mother is holding the skull of the ibex and is commenting with the daughter the bones inside the horn, a group of teens enters while making a lot of noise and actually jump over the interactive game. Since the group is quite dull and loud, the Pilot is approaching it and starts telling stuff about the game and about the articles exposed in the area and bringing the grizzly-skull moves towards them explaining the differences between brown bears there are in the alps and the grizzly. After this chilling and engaging interaction, the teenagers play with the game without actually thinking about that and when the child asks to the Pilot more information about the antler of the deer, one of the teens turns and asks "what about the deer?". Then he and the other boy jump up and go towards the Pilot who's holding the antler and explains how this follows every year and every year during spring grows again. With this episode everyone in the Discovery moves closer to the Pilot and listens at the explanation. After having listened and asked for details about the items exposed, the young visitors move towards the ALP and play another match before leaving."
>
> [**Dear deer breaks the game - Discovery**]

As emerged by these last two vignettes, the interactive game is perceived as a sort of restful, uncomplicated, fun and attractive artifact with the principal aim to distract children from the educative experience of museum and providing parents with the occasion to take a breath from the enthusiasm

of children. In other words, a DIT can be considered a decompressing artifact. For sure, these vignettes are representing a quite extreme and not very common situation. However, these pushing episodes describe how visitors consider DIT and which kind of value the DIT has at first glance when visitors seems to be not interested in the rest of the exhibition. The tired attitude of the father looking at the interactive game as an escaping opportunity is rising doubts and hesitations about the role of DIT because after the children came back and played the family left the museum. Differently, the vignette "Dear deer breaks the game" shows a rather more hopefully and optimistic understanding on the position of the DIT in the museum environment.

The DIT in the Discovery seems to take an opposite position in respect to DITs in the Maxi Ooh, where people were looking for non-digitalized environment for decompressing from the intensity of inputs provided by DIT. On the other way round, the role of DIT in the Discovery serves visitors to decompress from the information got from the surrounding environment. Thus, the visiting experience in the Discovery displays and pushes a non-digitalized involvement that grows bodily rather than visually. In fact, visitors build on their experience through moving, touching and catalyzing senses that are not common in museums.

These two episodes describe how the interactive game is symbolically relegate to the corner of the exhibition and visitors mainly move toward it as they are almost to exit (as introduced earlier in Chapter 6) or as they have the feeling to need space and to detach from the exhibition. The role of the ALP is rather significant for visitors to get together the information. For instance the following vignette describes an episode in which the ALP became a sort of *battery recharger* for an exhausted and polite child with the brother and their father:

> "A father and two sons (they are from South-Tyrol and are talking German, while the father is talking to me in Italian even though the children are not understanding it) are timidly entering in the area; they move around to have an idea about the place. There is no one, but them. They approach the chest of drawers with all the items from the forest and carefully discuss each object. The father from time to time asks for additional information. They

are a quiet group. Together they are talking really low and don't say much, preferring eye-contact as communication channel rather than words. After a while the father with the younger son moves towards the bush-of-forest-smells (see Figure 4.4a Page 59) and the older son join them. They continue their visit really peacefully, for it they don't really care about ALP since the younger child, quite exhausted by the visit sits on one of the stools around the interactive game. At this point he wakes up again and begins to play alone. The older brother interested on the new game leaves his exploration and approaches the ALP with the father too. They begin the game and continue for a couple of matches before to go back to the exploration."
[**Moving calmly through the installations - Discovery**]

This third vignette describes a deep example of what reconfiguration of the environment and intervention to the visiting experience people can perform. In relation to this last vignette "Moving calmly through the installations" the intervention is not about adding some objects to the existing condition, as the vignette [Coming through the interaction] Page 82 might suggest, rather it is about reconsidering how *to* interact.

People's *intervention* in Technologically Enhanced Environment (TEE) is expressed in terms of rethinking and using the environment following personal needs. Complementarily, *reconfiguration* is referring to the outcome of the TEE. Thus, while the previous Chapter 5 and Chapter 6 mainly refer to the reconfiguration of the environment, here I want to bring the attention to the ability to intervene in the environment. In this frame, DIT supports both, the reconfiguration of the environment and the intervention to the environment that shift to a sort of experiential laboratory. In these terms *intervention* and *reconfiguration* are coming along within the visiting experience and are mutually related. Moreover, intervening on the meaning of the space and making of it a place enhance the meaning of interaction that, as explained in Chapter 3.1 Page 38, deals with processes of connection between human and technology, and on the understanding of mediated activities in social and everyday contexts.

The point of focusing on the process of configuring the environment and intervening in it helps us - researchers and designers - to understand which dynamics make of an environment a sustainable one. The following section discusses how we can reconsider HCI in terms of designing sustainability.

7.4 Guidelines for Designing DIT for Public Space: Sustainable Interactive Experience

The previous section introduces the way people interact in the environment and describes how people intervene for changing and arranging the aim of the environment. Hence, with *intervention* I emphasize the active participation for changing stable or existing situations redefining roles. Therefore, people's intervention reconfigures the environment changing the structure of objects and the patters of possible interactions.

Intervening on the environment and reconfiguring it adjusting dialogues and established practices (see Chapter 5 and Chapter 6) transforming the core of the environment. Thus, the way people interact in a TEE evolves and changes in respect to features of the circumstances and in relation to the reconfiguration and intervention in the environment. Moreover, DIT changes meaning in relation to what people do with it and in regard to the situation when it is used. Interacting in the environment, moving from one installation to another highlights the kind of shape the actions take for intervening in the environment blurring personal and shared understanding of the space stimulating each other using objects.

As observed and described in the previous section, it is possible to observe a rhythmic process of action in the two areas, even though the main evidence is related to the Maxi Ooh. What is of interest in this rhythm is about the connection between the digital and non-digital features of the environment. Thus the rhythmic process of actions refers to the construction of relationships, engagement, and motivation for interacting in a TEE. For instance, getting out the sound room where people experiment their voice (See Figure 4.2d Page 56) helps them to rethink and reconfigure their interaction. Thus, smoother levels of digital interaction help people to interpret the physicality of their voice in the sound room and engaging in discussions about the explored environment supports people for intervening in the space making changes and according it in respects to new needs. Moreover a physical turn from an interactive space to a restful space helps visitors to rebuild and reframe the received input, and construct insightful meanings.

While, the area Maxi Ooh provides this opportunity by configuration and

intervening in the environment following needs, in the Discovery visitors find different ways for decompressing from the interactive paces for instance, sitting on stools and chatting about unrelated subjects or telling to the museum staff about personal experiences in the forest. On the opposite side interacting with DIT in a low level digitalized area, as the Discovery is, helps people to organize thoughts and to reframe what they have learnt. Although the interactive tabletop of the ALP helps people to collaborate for creating knowledge (see Chapter 6) it is also an occasion for taking distances from the informational inputs and stimulus. Hence, DIT inspires people in two opposite ways for intervening and configuring the space: in the Maxi ooh, the high level of interactions stimulates people to take distances from the DIT; differently, the Discovery provides visitors with information and interactive ways to share the experience stimulating them to use DIT for grounding the gathered information. In both areas, DIT supports a combined and cooperative approach to learn and to share information that blends with a rhythmic way of interacting in the space. However, DIT provides people with room for harmonizing inputs and stimulus with pausing time and reflections; for instance, ALP creates the occasion and the space for four people to interact and collaboration for having fun (see Chapter 6), while unruffled discussions for understanding how the game works are occasion for visitors to re-think and re-consider their experience.

Designing TEE and DIT has to consider people's needs to break actions and to stimulate a rhythmic process of interacting and of making things together. Moreover, blurring digital and non-digital interactions introducing wooden toys in the sound room to produce different reactions and reconfiguring the space through (see Chapter 5) is a way for people to connect spaces together with experimenting. Thus, the strong connection between the digital and non-digital installation makes DIT a space for users to connect and balance the museum experiencing between learning and fun, stimulating the alignment commitment for designing sustainable DIT.

Designing sustainable DIT constitutes a relevant strand of designing activity. A DIT has to stimulate a constructive (futuring) approach instead of disruptive (defuturing) one (see Table 7.1 Page 121). The light relationship between constructive and disruptive approaches depends on the

configuration of the environment, if there are or not exits for taking time from inputs, for decompressing thoughts. As researchers and interaction designer we have to face and trust people ability to summon DIT. Still, designing DIT and TEE has to confront with need for moving, interpreting, reframing, sharing interactions, intervening and configuring.

Chapter 8

Addressing Interactive Design Challenges

> This had about a hundred tiny flat press-buttons and a screen about four inches square on which any one of a million 'pages' could be summoned at the moment's notice. It looked insanely complicated, and this was one of the reasons why the snug plastic cover it fitted into had the words DON'T PANIC printed on ti in large friendly letters.
>
> *- The Hitchhiker's Guide to the Galaxy, Volume 1* - Douglas Adams

This Chapter goes through the pages written until now, unpacking the different dimensions of designing Digital Interactive Technology (DIT) for Technologically Enhanced Environment (TEE). What the last three chapters describe are guidelines for designing DITs for actually engaging visitors in the creation of knowledge.

The first step for designing DIT for sharing experience and participating with the goal of creating knowledge focuses on *Crafting Dialogue* and adopting the space as an opportunity for balancing the connection and the relationships with other people. The second step for designing DITs describes the opportunity to move things and to adapt the configuration

of the environment - in both digital and non-digital environments - as a crucial requirement that allow people to create knowledge. Reconfiguring the space helps people interact with each other for identifying a new interpretation of information. These two steps guide designers through a walking path for designing public spaces and for providing opportunities to people to gather and reassemble information. While, these two first steps address the relationship between people and the space, and invite us to think of interactions as opportunities to stimulate creative skills; the third and last step aims to rise awareness of the implications of the design of today to the value of tomorrow. The three steps summarize an interpretation of DITs as tools for people to participate to a shared re-interpretation the space. Moreover, these steps foster an interpretation of interaction design that encourages and allows people to *"find room for moving, interpreting, reframing, and sharing"* [Macchia et al., 2016]. The overall idea of these guidelines is defining the design of DIT in terms of challenges for the present: the meaning of designing DIT, rather than being on actions and new designs, may lay on socio-cultural challenges and on collective reconfiguration of the environment.

This chapter is organized as follows: it first recalls the general concept of Infrastructuring Knowledge used in this work for framing the creation of knowledge in terms of relational and temporary process, focusing on the meaning of practicing-community, something that specifically occurs in TEE between interacting strangers. The second section of the chapter summarizes the steps that drive the discussion to an *-ing* interpretation of design for HCI. The Chapter concludes providing a grid for designers to get to understand the features of designing DIT for Infrastructuring Knowledge.

8.1 Looking behind the scene

Description and analysis of episodes related to the use of DITs in the museum areas investigated, acknowledges that fact that certain kinds of action and interaction help and support shared knowledge more than others. Understanding the implications and potentials of DIT in public spaces

triggers design perspectives that stress the role of the environment. Thus, for answering the question of: *"how to design DIT for making knowledge together"*, I developed guidelines for thinking, planning and designing DITs for sharing knowledge, linked to the ecology of the public space of museum. Exploring the way that people create knowledge in TEE using DIT contributes on designing spaces for public environments such as Museums. I explored the creation of knowledge because I am fascinated by the amount of different channels and frames we can facilitate for gathering information and for translating this information into knowledge. Moreover, I am fascinated by the chance of using DIT for bodily connecting people in a public space and for engaging them through this space.

For dealing with the complexity of knowledge processes [Hakken, 2003], I adopted a specific intellectual tool that describes the on-going, contextualized, shared and relational features of knowledge: *Infrastructuring Knowledge* (IK). I needed an intellectual tool for setting path-lines for diving in the broad concept of knowledge. IK helps to include together challenging elements of infrastructure and relational processes (see Figure 2.1 Page <u>29</u> and the description of IK in Page <u>34</u>). However, contradictions and intriguing aspects that characterize the process of IK rise questions about how knowledge happens in public contexts. For instance, the relations within *time* and *space* is intriguing in respect to IK in Cultural Infrastructure (CI). The discussion about *time* underlines the evolving and on-going nature of IK, and describes knowledge in terms of evolutionary, long term and relatively un-limited relational aspects. Meanwhile, the on-going feature of IK interweaves the temporary and contextualized nature of cultural activities. Thus, IK in CI has a double and un-conventional link with *time*: knowledge for its own nature is about the future, while the way people create knowledge in CI is about the present and to a specific context. Following this understanding of features of IK in a museum TEE with D'Andrea, during the workshop on *"Infrastructuring, collaboration and evolving socio-material practices of changing world"* [Bossen et al., 2014], we re-arranged the concept of infrastructuring as an expression of the design in-use (consider Binder et al. [2011] and Karasti and Syrjänen [2004]), describing it as an example of design while-using.

With the label *while-using*, we emphasize the *here* and *now* features of

infrastructure-*ing* [Karasti, 2014, Karasti and Syrjänen, 2004]. Moreover, *while-using* description of design stresses on people's experience of refining designs in respect to individual and/or collaborative preferences and needs [Bratteteig et al., 2013]. Furthermore, this label underlines how the process of creating knowledge in a museum has a relevant component in the *temporary*, *relational* and *contextualized* experience between strangers. However, the difference between in-use and while-using lays on the detail of limited time frame and experiencing technology. While-using technology at the museum visitors focus and concentrate on the relational and the sharing condition allowed by the context. Thus, focusing on sharing contextualized information, the process of IK is about elaborating former, un-contextualized and un-related information together with *new*, *contextualized*, and *related* one. Differently from design in-use, the interpretation of technology is framed in respect to the limited time and the context of museum. While discussing about design in-use and relating it to the concept of Infrastructuring, Karasti and Baker [2008] and [Björgvinsson et al., 2010] refer to an established and long-term relationship, in which people participate to the creation of new technology meaning.

Designing DITs for people that create knowledge, grounds on the context and relationships developed through ecological conditions and dialogues (see Chapter 5) that grows together with the configuration of the environment itself (see Chapter 6) during the visiting experience (see Chapter 7). Thus, DIT happens to be an opportunity for processing and re-elaborating acquired information - either absorbed by the environment or received by people around.

Designing DIT for museum is a puzzling and tough activity, which involves differentiated groups of people with divergent needs. Therefore, designing DITs - and related performances - has to balance values, norms, habits and changes that differentiate among participants to the life of museum [Stuedahl, 2015b]. Participatory Design (PD) is moving towards this direction.A particular branch of PD is turning towards a concept of design that lasts from designing services and products, responding to the needs of a quite specific group of people - such as people working in organization, to designing for inspiring people to reconfigure the given design [Karasti and Syrjänen, 2004, Binder et al., 2011]. Hence, scholars re-interpret the lines of

PD highlighting people's natural ability to reconfigure the established and defined design according to new and contextualized requirements and/or wishes, and preferences.

Reframing and reconsidering the implication and the meaning of PD as a contextualized interpretation of flexible designs, stimulates an interpretation of the design experience that is located and is owned by people. This specific branch of PD rather than being a constructive workout for delineated working/social/life environments and defined groups of people, is worth to be adopted as a design vision for designing public spaces with unstructured and shared norms, values for groups of people who interact together.

In relation to this discussion, PD helps in two main directions: on one side PD helps designers in the process of designing services and products that encounter people's actual needs; on the other side this design approach focuses on perspectives, activities and processes for engaging people to get involved in the creation of spaces, services and artifacts. Hence, the way people interact through artifacts and with other participants, and move in the space, re-frames the meaning of devices and relationships. For instance, in the Maxi Ooh, the creation of the tree in the Tactile room (see Figure 5.1 Page 74 and the ethnographic note [How to make a tree - Maxi Ooh] Page 76) expresses a differentiation in terms of meaning making and of ways to achieve the outcome of a new tree. The process of creating a tree reveals the constant re-configuration of new sets of activities, relationships, interactions, norms, artifacts, and people involved. This process fits in the notion of the ecology of devices and underlines the relational features of DITs. Hence, DITs relate to the contextualized and potential interaction within the elements of the space and between the space [Ehn, 2008].

This understanding of space and of DIT depends on the actual participation of people in the actions and interactions in the space, and can be indeed described as a design exercise or as community-of-practice [Binder et al., 2011]. However, since the visiting experience is related to the delimited area of the exhibition during the time of the visit, I argue for the possibility of discussing about *practicing community. Practicing community* would describe the fulfillment of relationships and norms in relation to the understanding and sharing of meanings of artifacts.

8.1.1 Practicing community

The concept of *practicing community* helps us illustrate how people interact together in the limited period of a museum visit that allows the reconfiguration of the space.

The museum experience is charming: people, strange to each other, find ways to connect and share their visiting experience like if they have always known each other. I personally felt cheerful every time I spent my day at the museum. Thinking about this aspect I realized that every time and every day at the museum was different and at the same time familiar. The ability of people to interact and build a temporary community has been something I found specifically interesting for understanding the change of the environment. Creating knowledge while practicing community is the outcome of the intervention of different elements and because of the reconfiguration of the space by people's intervention to the interaction.

The main point of reconfiguring the space is about framing interactions and building relationships in connection with DIT, which is introduced in the spaces for engaging visitors. As soon as visitors interact with it, the role quickly becomes relational and collaborative. Thus, DIT engages visitors and invites for connections, stimulating configuration of practices that frame in *here and now.*

The concept of practicing community connects and takes into account the *"interdependent relations between materials, competences and meanings"* [Shove et al., 2014]. However, the concept of practicing community underlines the participatory and temporary exploration of the interdependency, rather than underlining a stable, routinized and normalized linear process. The use of this concept emphasizes the contextual and related intervention of technology in the realization of a *community of practice.* A community of practice changes and evolves in respect to new contexts, materials and involved people, which set *ad hoc* rules and norms. Practice of use is about how people re-use and frame a DIT through the relational experience each time and in respect to the collaborative needs embedded to the specific group of people, who arrange information and compromise construction of knowledge.

The intervention of DIT in compromising information offers the occasion

for people to re-balance the relationship and to elaborate on the information. Balancing relationships through DIT helps people in museums to extend and realize new associations of understanding. This process is based on key features of museums. In museums, conditions for people to connect with each other are mainly related to the possibility to interact with artifacts and to find excuses for constructing dialogues.

Practicing community combines factors embedded in ecological conditions meant for stimulating people to interact and replicate culture and knowledge. These factors are contextual and temporary linked with materiality of the ecology. People's adaptive skills for drawing temporary practices and settling a germ of temporary *communities*, helps designers to reframe the implication of designing technology for public space. Understanding people aggregation set directions for interpreting design as a continuative interaction. In this respect, design aims to answer differentiated and controversial social and technical conditions that are rising because of the design of complex and *ad hoc* technology as, for instance, the issue of obsolescence. Discussing about obsolescence, Blevis [2007] argues over technological lifespan indicating two core spaces of action: on one side, designer and researchers have to stimulate and encourage a longer life of technological product making that is flexible in changing condition in order to avoid fast and continuous replacement processes; on the other side, designers and researchers have the responsibility of improving the quality of technology. Many different design activities are taking place for making technology flexible - for instance in design context like Fab Labs, everyone can design and produce feasible products for personal and collaborative needs. Fab Labs answer to the growing need of people to make by yourself and to the increasing sense of responsibility for the future generation [Posch et al., 2010]. In this very direction, we - researchers and designers - have to be similarly responsible in admitting that, while it is desirable to collaboratively construct things in a Fab Lab, this is not always the case for design processes. However, we are in the position to design following an approach that stimulates and encourages people's sensitivity while using technology, inspiring a participatory and collaborative mindset in the creation of knowledge in a public environment. In this direction, I suggest a set of key points for designing DITs.

The following section describes how design processes can adopt a challenging approach, at least in respect of designing DIT for TEE.

8.2 Facing design challenges

This section takes into account a specific frame for designing DIT, which faces contemporary design challenges in HCI that deal with the future of the society. Namely, the section focuses on analytical phases for designing for IK.

IK as described, is a continuative process that interweaves people and artifacts, setting interactions and norms for sharing and building knowledge among participants in a temporary community. This concept helps for understanding the dynamics and the complexity that characterize a Cultural Infrastructure such as museums. Moreover, the inclusive and eclectic combination of elements, relations and actions that compose the *Infrastructuring* invites to interpret the design of DIT in terms of the potential relationships and interactions. However, the adoption of the concept of Infrastructuring instead of prescribing the solution for developing the perfect DIT, addresses and focuses on the challenges that designers for public spaces should face.

8.2.1 Constructing a link; Maintaining the link; Making sense of the link

Design challenges deals with the complexity and the overwhelming conditions of our present that displays continuous performances and actions meant for people to know. Designing DIT for museum is rather challenging and - broadly speaking - deals with the future of humanity (as inspired by Fry [2012a]). Thus, the design challenge in museums faces three levels of performance and space usage - which is about discussing the *space* in terms of *place* (see Pages 10 and 79). As introduced earlier, discussing about *place* builds on the interpretation of the context in relation to interactions, norms and to the development of a meaningful interpretation of people's interpretation of the *space*.

Going through the evolution of *space* in favor to the configuration of the

place, the analysis of the ethnographic observations suggests the three levels of IK I described in the last three chapters. Similarly, designing for public space faces the same three design challenges (see Figure 8.1).

The Figure 8.1 depicts the process of stimulating and sharing knowledge
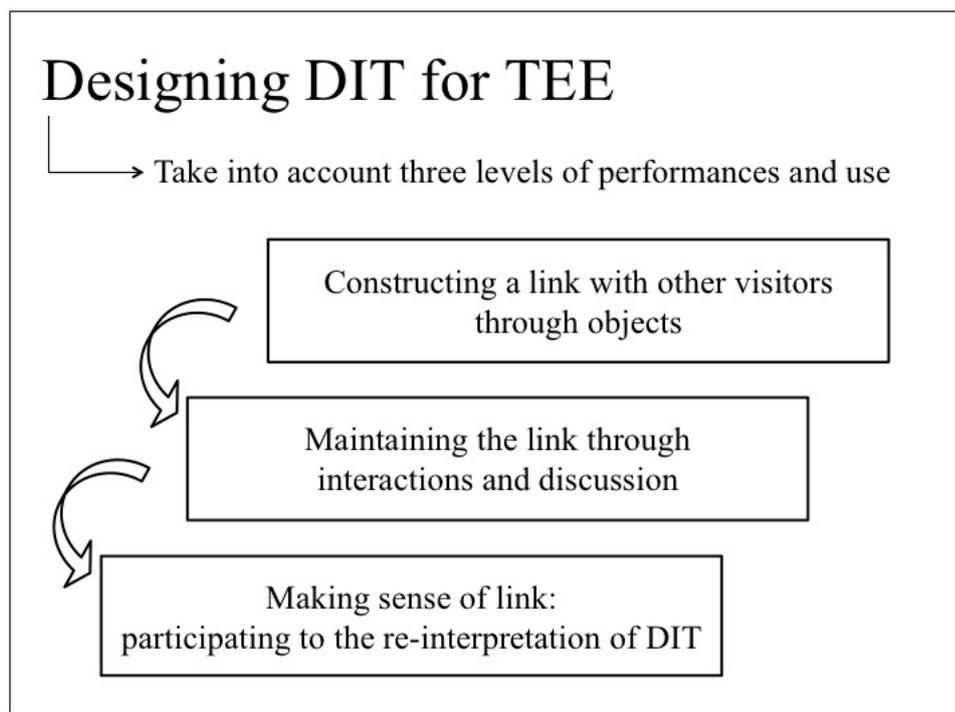

Figure 8.1: Challenges for designing TEE in DTE - Sketches of thoughts

between people, while also displaying the relevant challenges. The first challenge is about engaging people in connecting with other people and with objects. This design challenge establishes a first stand of relationships between people, who participate to the same set of interactions. The second challenge is related to the capacity of maintaining and enhancing the link between people while interacting. The third challenge is that of grounding the link between people to the visiting experience and it is about making sense of it. Therefore, the third challenge is about making sense of the interactions at the museum.

The following paragraphs take into account these design challenges that make the Infrastructuring process possible.

Constructing a link between people

This challenge is at the base of the meaning of IK as a participatory and shared experience. In this respect, the first challenge deals with proposing spaces and DIT that get people together encouraging a certain level of contiguity for developing a first step dialogue. A big challenge is that of finding the right trick to encourage people to open-up at first. For instance, the unexpected environment of the Tactile Room in the Maxi Ooh (see Figure 5.4 Page 84 and Figure 5.5 Page 85) stimulates a strong reaction on a man, who entered almost on tiptoes with some other visitors in the room. Because the complete group of five visitors entered quietly without touching anything; nothing in the room reacted and the man loudly exclaimed *"what is this sh*t?"*. Even though the exclamation was not really polite, it broke the ice and connected people together engaging everyone in a bright conversation that let them to successfully interact with the installations.

To answer the challenge of how to engage people in a dialogue, there is no need to invite people strictly break the ice, while there is the need for people to engage in details like taking off their shoes (see Page 55) or intervening in others' discussions as in in the Discovery (see Page 138). While I cited two examples that trigger dialogues, other episodes observed at the museum reveal "gazing" as a core triggering point for visitors to relate together. The main aspect for triggering relationship is about feeling part of a group, which implies letting people look in the others' eyes. Even the teen described in the vignette [Dear deer breaks the game - Discovery] (see Page 7.3.2) after having asked a breaking question, gazed at the components of the small group of people for accessing their dialogue.

Gazing into each other's eyes represents a way for people to establish a first step of relationship a way for understanding if people wish to participate to a dialogue and share their experience. Thus, designing DIT for TEE has to allow people to find themselves in open conditions or in pleasant situations through which people feel part of a group. For instance, the enclosing feel of the Discovery invites people to feel the relationship with the other people in the space. Moreover, those moments when visitors in the Maxi Ooh take off their shoes or when they are together inside a room and something triggers the general curiosity is an occasion for setting a

link between the participants to the visiting experience.

This first experience of interaction, more than opening dialogues, is what bring people to the process of IK (see Chapter 6), aiming to create a link between the participants to the visiting experience. Hence, this first interaction between visitors sets the connection between people *and* DIT, which becomes an instrument for people to get along with the infrastructuring process. Let say that this first step is the key for accessing and then constructing knowledge.

Maintaining the link

The first link and connection between people establishes a relationship that keeps going during the visiting experience. For instance, one day a child of seven with whom I played ALP with (see Figure 5.2 Page 77), after having visited the rest of the museum with his parents, run into me while I was leaving at the closing time of the museum. The boy was excited by having seen two chameleons hosted in the tropical garden of the museum - I felt a bit frustrated, I never saw these reptiles even though I spent several time in the tropical garden for resting; but I was really happy for the boy! This episode is interesting because it describes the persistence of the relationship we constructed by playing with ALP.

Interacting with the DIT is an occasion for temporary maintaining a relationship and for extending the space through the interaction. The abstract extension of the space occurs through the use of DIT and the interacting peoples' interpretation of it and the context. In this respect, the design of DIT should respond to the requirement of flexibility: this requirement identifies and proposes interactive components which are *simple*. In this circumstance, the word *simple* does not mean trivial or obvious; differently *simple* describes a DIT which is giving the opportunity for people to develop their own rules. For instance, an installation, which evidently was not taking this direction in the Maxi Ooh, was the alternative scenario of the Fairy like environment in the Tactile room (see Figure 5.4 Page 84). The alternative scenario of the Fairy-like one was a Sea-like landscape. The Sea-like landscape has some fishes floating across the projection. The number of projected fishes is fixed and they just move across the wall. Differently,

the Fairy-like scenario engages and challenges visitors with appearing and disappearing objects and the possibility to act for doing something new like the tree on the wall (see Page 76), and the light stream on the floor (see Page 114). The two installations mainly differ in the way the objects float on the wall: while in the Fairy-like scenario the objects appear here and there and are surrounded by other stable elements, in the Sea-like scenario the number of fishes is constant and move following a regular path over a pale-blue ocean background. Some can argue that younger children may prefer the Sea-like scenario, which is more basic and essential. However, I have noticed that the age of a child mainly changes the reaction time rather than the kind of interaction.

Engaging people and providing an occasion for them to elaborate and interpret the space is an opportunity for participating in an investigative and learning process, establishing the so called *"reflection-in-action"* [Schön, 1983].

Making sense to the link

Visitors at museum build their relationships through unplanned and perceptive interactions. As discussed in the previous paragraph, people investigate, understand, experiment and reflect upon discussions and feedbacks coming from their interaction. However, visitors interact mutually constructing and developing a new interpretation of the space. In this respect, visitors participate together to the process of interpreting and understanding the museum.

Building a participatory museum experience describes a level of visitors' commitment to each other during a visit. Hence, people's participation and relationships grows through interactions, and collaborative learning occasions and appropriation of the space. In this respect, the visiting experience is rather a reflective and participatory process that depends on recognizing the familiarity of phenomena and re-framing phenomena for regulating the contextualized experience upon each other's awareness of the context. Thus, the step of creating the link shapes the collaborative participation for interacting within the space and for constructing shared meaning. The process of establishing and maintaining the relationship

between participants occurs through the interaction with DITs. In this respect DIT helps people to ground the process of creating knowledge on the *materiality* of DIT. However, elaborating the meaning of DIT includes the different interest of participants of interaction who develop together interactions norms and discussions.

Together with constructing relationships between people and maintaining the relationship, the participatory interpretation of the interaction is relevant for making a worthwhile DIT for public space. As transpired earlier, worthwhile DIT is an artifact that stimulates and supports the process of creation of knowledge. Thus, designers should interrogate themselves in respect to what the DIT is useful for: is it giving enough space to people for establishing a relationship? Moreover, how can this relationship last longer?

As introduced at the end of the previous paragraph, for the relationship to last longer participants have to develop a common and shared meaning over the interaction. Thus, for people to develop meanings on what they are doing, they need to build together while-interacting.

Building together and while-interacting make the interaction valuable for the different participants. Shaping the value of the interaction in a flexible and unique experience to each participant. Hence, the collaborative participation for creating the meaning of the interaction through DIT establishes a resistant, while temporary, connection with the DIT too. Broadly speaking, "making sense to the link" is a design process in which participants with different needs, perceptions, skills and competences, collaborate for. Participants elaborate together an *ad hoc* use of the DIT for helping their own process for sharing information and creating knowledge. Thus, the design of the space has to let people move and across active areas and the design of DIT has to answer to people's need for discovering, experimenting and pausing, in order to build the occasion for making sense to the developed relationship. In this frame, while non digitalized artifacts, by their own nature, let people find their own pace of use, DIT follows a sort of predefined rhythm that has to be *broken* by people for making sense of the collected information and for building meanings upon it.

8.3 Designing Challenges

Thinking about design in terms of people's participation in reframing the space is matter of changing researchers' and designers' mindsets. It is about re-considering DIT for public spaces as tools for people to (re)establish human contacts and shared experiences, rather than providing people with additional information. Can you process all the information you find at the museum? Isn't elaborating information easier when you have discussed it with someone else?

Framing the design experience as a participatory, collaborative and temporary process is a way to think about designing DIT as a contextualized process which brakes the productive cycle of design. Developing *ad hoc* technology has a temporary definition that tackles the current interpretation of a productive system, which needs a reiterated re-innovation of things and of spaces. Encouraging an open design of DIT and intellectually balancing present and future, the design process is meant to leave space for people to participate and make sense of the public space they are interacting in. Moreover, the interactive experience at the museum is about discovering information and building knowledge through DITs and artifacts and other people. Thus, visiting a museum is a social and temporary experience, which works because of the differences and the interaction between people. In fact, subscription at the museum and multiple visits to the same exhibition cope with the social and participatory scope of IK. Visitors break and re-configure the meaning of the space each time, adopting new perspectives, answering to new relationships and new needs.

Working through challenges includes the pivotal scopes of designing DIT for public spaces. However, these challenges are not the final answer for designing DIT, rather they are guidelines for interaction designers to look at public context and for including into public context DIT for inspiring people to connect and participate together to the creation of knowledge. For interaction designers, these three challenges provide the occasion to look at different interaction stages, which DIT can improve and enhance. Moreover, these challenges inspire a revised interpretation of Interaction Design inviting for a deeper understanding on the effects of technology on human life. With the intention to provoke reflections and critiques in

respect to the effects of technology on our lives, the following section describes the revised interpretation of Interaction Design describing it as -ing Design.

8.3.1 The -ing Design

Designing Digital Interactive Technology for Technologically Enhanced Environment is an activity that lasts during the production of the DIT. Designing DIT continues with people's interaction and participation to each other's experience of the environment. I would describe this example of design as **-ing design**. -Ing design defines the flexibility of DIT in respect to people's participation to the interaction and reconfiguration of the environment. The principles of this interpretation of Interaction design help to consider designing technology as a combined and continuative experience for making it cooler and enjoyable for people to share their interpretations of the context. -Ing design provides a participatory perspective about how the meaning and the use of DIT can be reframe in respect to different contexts and conditions.

-Ing Design includes a set of heuristics for developing DIT that can be reinterpreted by people who use it, no matter if we have to develop an interactive surface, a vocal reaction, or other multi-sensor experiences. By adding meanings to human-to-human relationship, this interpretation of interaction design unveils the core role of the participatory experience for a DIT to actually provide an enhanced experience for people at museums. The participatory collaboration drives people to further interaction steps: people elaborate together a new objective and meaning of the technology using the planned design as a springboard for their creativity. However, for a DIT to become people's creativity springboard the design may fulfill specific features in respect to the space. For instance, the design of DIT should answer to questions such as:

- *"is the space open enough to let people gaze on each other?"*;

- *"are there intrusive structures in the way of people interaction?"*;

- *"is the space fostering people grouping?"*;

- *"is the space stimulating people's commitment?"*.

Even though these questions are useful as a starting point, the -ing design aims to stimulate practices for creating alternatives to present interactions. The following Table 8.1 aims to provide a representation of potential outcomes of designing DITs. The axis of Y indicates the levels of *prescription*, which means how much the technology guides and prescribes interactions. Differently the axis of X indicates the level of people *participation* to the interaction. In this framework, I prefer to discuss about participation instead of collaboration for underlining the mutual and equal role of participants' interaction (see Page 11 and consider Ehn [1992]). For a DIT to inspire people to create knowledge, the level of *prescription* would be minor, while the level of *participation* would be high.

	minor	a person uses the DIT without reinterpreting it	people collaborate for creating new meaning of DIT
prescription	major	the DIT provides *precooked* information	the DIT engages people to collaborate and extrapolate new information
		low level	**high level**
		participation	

Table 8.1: Guidelines for understanding effects of designing DIT for creating knowledge: different level of people's participation and prescription of interactions.

Table 8.1 is a tool for evaluating the potential support of creation of knowledge of a DIT. This design framework highlights the features that make a DIT a trigger for creating knowledge. The matrix displays abstractions of interaction categories supported by DITs in museums. For instance, audioguides can be described as a technology with a high level of *prescription* and a low level of *participation*. However, new guiding systems can be organized in line with visitors preferences. In this case, the technology may be described as less prescriptive but still non-participatory. Technology, such as interactive tabletop, provides participatory experience even though the level of prescription is generally high. The intersection between

minor prescription and *high level of participation* represents the conditions through which a DIT supports people to share and create knowledge. Also, the anecdotes and the analysis discussed in the previous chapters refer to DIT that inspires high level of participation and that stimulate people creativity. However, for a DIT to encourage the creation of knowledge, the environmental conditions are fundamental for people to rethink technology and move away from prescribed information to new and - possibly - unexpected ones.

Chapter 9

Infrastructuring Knowledge: principles for designing TEE

> The reason why it was published in the form of a micro sub-meson electronic component is that if it were printed in normal form, an interstellar hitchhiker would require several inconveniently large buildings to carry it around in. Beneath that in Ford Prefect's satchel were few biros, a notepad, and a largish bath rowel from Marks and Spence.
>
> *The Hitchhiker's Guide to the Galaxy, Volume 1* - Douglas Adams

Exploring the implication of *Digital Interactive Technology* (DIT) for supporting the creation of knowledge in public environments, I moved through related theoretical frames that provided a safe grid for balancing technological intervention with human beings.

In this chapter, I re-compact the goal of the exploration on how to design DITs for TEEs. By outlining aspects of interaction design and DIT built on relation to human and social life, I focused on aspects of Human-Computer Interaction (HCI) and Computer Supported Cooperative Working (CSCW) that include a description of design as a participatory and lively human activity. I to this design activity as -ing design. I adopted the perspec-

tive of Infrastructuring Knowledge for describing the position of DIT for people to create knowledge. However, looking at HCI and CSCW focusing on people's experience emphasizes specific research criticism related to the implication of DITs on the environment. In Chapter 1.2.1 Page 6 I describe the notion of Technologically Enhanced Environment as an environment *"in which relationships and practices blurred with technologies"* (see Page 6). This is a definition that helps to frame implications of producing and using DIT for/in public environment. Moreover, the analysis of DIT for creating knowledge focuses on much more complex dynamics of interaction between people and technology. Thus, in order to take into account this complexity I adopted the concept of Infrastructuring as analytical tool (see Chapter 2 and Chapter 6).

While the notion of Infrastructuring solves analytical issues related to the dynamic and temporary involvement of multiple people and technology in the process of creating knowledge. The concept of Infrastructuring is embodied into the extensive cyborg consciousness that implies the embodiment of acknowledged use of technology by a recognized group of people. Combining together these different and complementary notions helped to structure the research experience at the Museum of Science in Trento. Thus, since the objective of the research was about technological intervention for creating knowledge, I focused, on the other way around, on people and bodies and relationships in order to emphasize how the DIT intervenes. The following sections of the chapter retrace the outcomes of this work, focusing on the analysis of the outcomes and recalling my interpretation of how to design DIT.

9.1   The other way around

"The statistician Abraham Wald (1902-1950) [. . .] studied the location of enemy bullet holes in planes returning from combat. He plotted the locations on an outline of the plane. As data accumulated, most of the outline filled up. Put the armor in the few spots with no bullet holes, said Wald. That's where bullets hit the planes that didn't make it back." [Moore, 2010]

This work focuses on a wide concern I developed when I first approached Human-Computer Interaction: the assumption that people want to use technology. Particularly, approaching the museum research field, I understood how massive technological interventions in these cultural contexts are. Thus, I developed a certain level of skepticism on the way we think, produce, and use technology - realizing soon of not being alone [1]. Additionally, I fully agree with Fry [2012a] when he claims for balancing *"our technological being and our becoming fully technological"*. Thus, I went through the ethnographic notes collected at the MUSE following the broader interest on combined interactions.

Even though the core of the work is based on DIT, I adopted an approach to the collection and analysis of data that was, vice versa, pointing on human-to-human interaction. Adopting such an approach, some interactions with technology distinguished from others because of the meaningful interpretation visitors' gave to their interaction. In this respect, the analysis focuses on those interactions through which people shared and discussed information structuring occasions for developing understanding on the interaction.

The value of technology is highlighted and framed by the meaning people construct through interactions. The core interest on technology for improving people's museum experience leaves space to the concept of *supporting*. Hence, the analysis and the selected nodes capture people's movements through and towards DITs (see Table 4.2 Page 66).

9.1.1 When it comes to support Infrastructuring Knowledge

Focusing on people's interaction and activities for sharing information and for making sense of information, technology arises as a supporting tool for Infrastructuring. In this respect, DIT provides the occasion and the material for people to keep the process of creating knowledge. Hence, the analysis highlighted the capacity of people to use and model DIT in relation to their needs, rather than being overwhelmed and affected by the interface

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[1]Several scholars' works touch through different nuances of issues about technology production and use; see for instance Akama [2014], Bardzell et al. [2012], Bardzell [2010], Bardzell and Blevis [2010], Baumer and Silberman [2011], Blevis [2007], Fry [2012a], Nardi and O'Day [1999], Pierce [2014], Tomlinson et al. [2013]

and its implied instructions.

It is a *feature* not a *bug*

As discussed in Chapter 7, people make sense of the interaction with DIT taking times for pausing and reflecting on what they acted with and for. This specific aspect of the interacting process with DIT came from the analysis of those lines of notes that I grouped in the node *Sustainability* and *Interpretation.* The analysis and the conjunction of these two nodes describe how people continuously balance interaction and pause for making sense of collected information. This description of interaction can be explained as a constant interaction spin. Thus, the way people use DIT and DIT frames and supports Infrastructuring Knowledge combines together the capacity of people to interpret the environment and reframe the obsolescence of DIT as a *feature* instead of a *bug.*

Thinking about the *features* of using DIT in TEE brings my attention to the ideas behind *futuring* [Fry, 2012a] and *not to design* [Baumer and Silberman, 2011], which from my understanding have a positive accent in respect to what *design* implies. Thus, while the current HCI debate grounds on the cultural frame of building and constructing new and ready-to-hand devices and services (see Macchia and Salgado [2014]), the everyday people's performances set out a much different attitude to what HCI implies. The concept of everyday design that, with my colleagues, we described as infrastructuring [Macchia et al., 2015b], implies a redefinition of designing DIT for TEE providing people with the occasions for participating to the interaction and to the construction of knowledge.

Between Discovering and Experimenting: Understanding

The background of everyday design includes the redefinition of designing DIT with the intention to let people build on their relationships and making these relationships as enduring enough for providing occasions for pausing interactions. Enduring relationships implies the opportunity to pause the interaction, to move and return to the interaction. This way of interacting happens because of the value perceived by people.

Designing DIT is about understanding, enhancing and appreciating the differences between people who interact in the public space. Thus, it is about people practicing the feeling of community and learning from each other. This interactive and community experience develops and roots in discovering occasions, which involve aspects of the exhibition that were unexpected or previously missed. Moreover, discovering interweaves the process of experimenting and is about digging in the outcomes of the interaction. Thus it is not exactly matter of surprising, rather the relationship-*glue* is the debate for interpreting information. Furthermore, *Discovering* and *Experimenting* is about participating for finding reasons and meaning for the interaction in order to elaborate and understand shared information (see Table 4.2 Page 66).

Combining factors for Infrastructuring Knowledge

Infrastructuring Knowledge is a process that combines three main elements for describing the visiting museum experience. The intervention of DIT in this process influences relationships among visitors because of the way the use of DIT can configures the use of the space: are DITs stimulating people to move across the space? The museum experience is a social experience that includes opportunities for discussing and reasoning about the understanding of the space. Still, museum learning experience combines people relational conditions and events. Moving in the space and connecting through it is the base and the root of Infrastructuring Knowledge, which happens to be an essential condition for interacting with DITs. Thus, DITs stimulate people's knowledge when first people develop a relation together and configure themselves in the space, rather than directly invite and sending inputs to visitors to interact.

Digital Interactive Technology in the context of museum supports the construction of what can be defined Technologically Enhanced Environment, an environment in which technologies concur to engage people relationships for getting involved in a cooperative and shared understanding of the environment. Hence, designing DIT is about providing an occasion for museum visitors to reframe the information acquired through the environ-

ment, rather than providing additional information which might get lost through the other information offered by the exhibition as a whole. Moreover, designing DIT for museum TEE faces multiple and different people, each person with different competences and interests. Dealing with designing DIT for museum visitors is about appreciating the value of differences and relationships practically supporting and encouraging situations for constructing knowledge. Furthermore, understanding DITs as a support for re-framing information, instead of providing information, challenges the way through which we currently think about interactive technology for public spaces.

The following section describes a critique about how Infrastructuring Knowledge in museum is actually a slow experience, an occasion for people to look at their experience. Hence, the following conclusive section sums up the understanding on the role of Digital Interactive Technology on the creation of knowledge in the context of museum.

9.2   Taking time: Infrastructuring Knowledge

Museums are fascinating institutions to work with. They aim to preserve our historical past and culture for the present and the future generations. The increased introduction of Information and Communication Technologies (ICTs), museums provide people with additional information and occasions for interacting with and through the space [Macchia et al., 2014]. Moreover, through the introduction of DITs, museums engage visitors and allow them to participate and interact together for enjoying new information and, likely, *"to add their own voices to ongoing discussions about the knowledge presented"* [Proctor, 2010]. Hence, DITs encourage visitors to get together and participate to the reduction of natural boundaries between people, supporting instead forms of aggregation that recall community of practices.

In this work I analyzed the dynamics and the interactions that happen in two areas of the Museum of Science in Trento (MUSE). The two areas, designed for children highlighted some commonalities about the ways visitors - both adults and children - experience the museum.

Visitors I met at the MUSE were really different from each other - having different expectations and knowledge about the content of the exhibition. However, they shared the interest for learning from each other and testing together new interactive methods and directions. In this respect, the analysis suggested a re-consideration of designing DITs in relation to the participatory opportunities.

DITs enhance the space, helping to make of it a *place*: the place is the expression of people's participation to the process of creation of knowledge and of practicing community in a rather pleased scenario. DITs draw a central line for visitors to practice the sense of community, to develop a mutual understanding and an integrated group-feeling. In this respect, Infrastructuring Knowledge happens with the involvement of DITs and in those spaces where DITs configure occasions for people to get together and to relocate previous information and processing knowledge along with each other.

I personally embrace and welcome the introduction of DITs in museum contexts. DITs are tools that can stimulate and enhance the reconfiguration of the environment, and provide people with the bases to participate and reframe information. In this respect the kind of experience I describe as -ing Design leads the interaction to a constructive direction (paraphrasing Fry [2012a]). The point of -ing Design is to rise awareness on what DIT can help us for. So far, we do not really need further information, rather we need ways to let information circulate for becoming further knowledge.

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