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# Transferring of Digital DIY Potentialities through a Co-Design Tool

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***Abstract*—**Digital Do It Yourself (DIY) is a contemporary socio-technological phenomenon, enabled by technological tools. The nature and potential long-term effects of this phenomenon have been widely studied within the framework of the EU funded project 'Digital Do It Yourself', in which the authors have created and experimented a specific Digital Do It Yourself (DiDIY) co-design process. The phenomenon was first studied through a literature research to understand its multiple dimensions and complexity. Therefore, co-design workshops were used to investigate the phenomenon by involving people to achieve a complete understanding of the DiDIY practices and its enabling factors. These analyses allowed the definition of the DiDIY fundamental factors that were then translated into a design tool. The objective of the tool is to shape design concepts by transferring these factors into different environments to achieve innovation. The aim of this paper is to present the 'DiDIY Factor Stimuli' tool, describing the research path and the findings behind it.

***Keywords*—**Co-design process, digital DIY, innovation, toolkit.

## I. Introduction

DIDIY is a new human-centric, socio-technological phenomenon, enabled and rapidly evolving thanks to the widespread social availability of affordable technological tools.

DIY generally refers to any creation, modification or repair of objects without the aid of paid professionals [1]. The amateur creators generate an outcome that is mainly used by themselves or eventually by people with personal connections (e.g. relatives or friends), without generating direct profits (i.e. sales). Therefore, "DIY is both a producing and consuming culture" [2].

While the DIY phenomenon is surely not new, the widespread availability, versatility, and flexibility of digital tools are generating something new, with the potentiality of a game changer.

In Rise of the Expert Amateur, a large-scale study of DIY communities, Kuznetsov and Paulos point out that in the last decades, the combination of social computing, online sharing tools, and other collaboration technologies has led to a renewed interest and wider adoption of DIY cultures and practices, namely through facilitated access to and affordability of tools, as well as the emergence of new sharing mechanisms [1]. The DiDIY phenomenon thrives as a result of this changing digital context, and it can be considered as an amalgamation of different elements, politics, culture, arts and technologies enabled by digital means. DiDIY could open new scenarios in the roles and relations among individuals, organizations, and society. The spreading of this trend suggests scenarios in which non-professional people are, or will be, able to create artefacts. Such individuals are united by the will and the ability to create desirable artefacts supported by innovative technologies [3], networks [4] and, perhaps, companies with new business models [5].

It has been acknowledged that self-production is an opportunity to generate innovation, since the 80% of innovation in scientific tools have been generated by amateurs [6]. DiDIY could even accelerate the innovation process: "Access to tools capable of turning digital designs into physical objects, coupled with the ease with which digital files can and are being modified and circulated, is bringing a third dimension to the practices of sharing, mashup and remix, and giving everyone the opportunity to not only reinvent and shape the world of bits, but also the world of atoms" [7].

In a context where everybody designs [8], within the project framework, the design research team contributed by developing (co)design-driven tools specific for DiDIY. This paper will address only the "DiDIY Factor Stimuli" tool, designed to support people in applying the potentialities of this social innovation phenomenon, in different contexts.mTo make this phenomenon more effectively understandable, Section II of the paper presents the main important aspects that characterize the phenomenon.

Based on the knowledge gained through a literature review, the research team designed co-design workshops to involve people in the implementation of the phenomenon knowledge from a bottom-up perspective. Co-design activities and tools have been developed as a means that allow the active involvement and collaboration of people with multidisciplinary competencies. The tools also allow to convey the gathered information to a wider audience enabling the generation of benefits in different fields. The co-design process is described in Section III as well as the innovative and fundamental factors of DiDIY identified thorough the 18 co-design workshops. Section IV describes the activity and the tool designed to apply the fundamental factors of DiDIY to create innovative digital solution in several field.

## II. A Literature Review Investigation of the DiDIY Phenomenon

DiDIY is an ongoing social phenomenon requiring the adoption of a two-faced perspective. We consider it as a human-centric phenomenon enabled by technology ("objective" perspective) in which individuals operate alone and collectively ("subjective" perspective). According to this

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assumption, DiDIY is neither a simple technological phenomenon nor a merely sociological one, even though it includes both technological and sociological components.

Following the dual perspective, DiDIY can be considered as:

- An activity: For the creation, modification or maintenance of objects or services; in this sense DiDIY is an objective phenomenon, that can be studied from the analysis of tools, products, structure of collaborations, etc.;
- A mindset: The value to do stuff for yourself without having to get other, professionals/experts to do it for you; in this sense DiDIY are subjective phenomena, that can be studied from the analysis of motivations, competences, social contexts, etc.

The co-presence of objective and subjective components is a basic reason of the complexity of the phenomenon. Thus, after the in-depth analysis of the literature, it was necessary to build a model to simplify the understanding of the phenomenon before tackling the co-design workshops and sharing reflections with people. The model considers the interplay of DiDIY main expressions enacting on different levels, which include:

- **Cognitive process**: DiDIY is a creative process intended to generate an outcome through multiple steps from idea generation to product realization;
- **Individual practice:** DiDIY is an individual practice, requiring forms of bodily activity, things and tools, states of emotion and motivational knowledge;
- **Social phenomenon**: DiDIY is a social phenomenon resulting from the interaction between people at different levels of skills and commitment, sharing resources and collaborating on projects.

Within DiDIY, real and virtual environments are no longer distinguishable. Mobile devices, social media and information and communication technologies (ICTs) support the creation of a distributed network which allows to link and shape online and offline activities. This dualism, characterizing our lives, is evolving the concept of DIY, enabling new ways of engagement and participation. From this point of view, technologies facilitate new forms of expression and create new or alternative spaces and possibilities for engagement. DiDIYers are interested in this practice because it connects them with others and has effects in mediating and maintaining relationships between people [9].

The spreading of physical and virtual spaces where people can undertake creative activities is enabling these connections with individuals who support each other in “creative communities”, i.e., groups of people who cooperatively invent, enhance and manage innovative solutions for social challenges. For this reason, contemporary DIY is often mainly considered as a social activity, with a social dimension.

A more community-oriented society has emerged thanks to spreading several phenomena, initiatives and communities (e.g., open source, peer-to-peer, etc.) through ICT, creative platforms and social media. Thanks to digital technologies group of people starts to collaborate on a global scale for a shared purpose.

Peer production is considered as “an opportunity for more people to engage in practices that permit them to exhibit and experience virtuous behavior” [10]. DiDIY activity is recognized as a democratizing process since: It gives people independence, self-reliance from professional assistance, it encourages the dissemination and adoption of creative behavior, that provides chances to create more personal meaning or self-identity, moreover it opens up previously gendered or class-bound activities to all [11].

In contrast with the conception of consumers or more in general people to be passive receivers, DiDIY has its emphasis on "doing" and the active roles linked to that such as interventionists, makers, hackers, modders and tinkerers.

Motivation is an aspect that appears to be necessary to activate their interest in a project or a community. The possible motivations that move an individual toward DiDIY can be of various nature, such as: personal interest through the maintenance of self-esteem [12] or express one’s identity [13], development of new skills, acquisition of social reputation [14], economic need [15], local necessity, feeling of being the creator of one’s own products [6], express their own creativity [11], ethical principles (e.g., concern for the environment) or stating personal independence from consumerist society [1]. Perceived satisfaction gained in the DIY practice appears to be the crucial component motivating pursuance and accomplishment of the task, regardless of the level of the individual’s commitment and ability.

Motivational aspects are believed to be crucial also for sustaining the DiDIY practice over time, when the practitioner is supposed to persevere in overcoming the difficulties related to self-organization, use of spare time, and social interactions in collaborations: here are important in particular the rewarding sensation of being with the others and the interest of generating a positive social impact.

The DiDIY practices and its technologies have many potentialities that could bring a change in many areas of our society both on personal and community levels. This social phenomenon promotes an increase in diffused creativity enabling a wider spread of creative solutions to local, social, and environmental problems.

DiDIY allows excellent opportunities for co-design and the creation of collaborative value chains, through the shared production of creative contents. However, within the research project it appeared necessary to understand how these multidimensional elements interact with each other to generate innovation and how to make them powerful in solving challenges. The research team decided to proceed by designing co-design workshops, described in the following paragraph.

## III. An Active and Bottom up Investigation of the DiDIY Phenomenon

DiDIY is a complex phenomenon to investigate. A transdisciplinary research methodology is needed to achieve a complete understanding of DiDIY practices and its enabling factors. During the research project, after a thorough literature research and an accurate analysis of the conditions

characterizing this practice, it seemed necessary to adopt a bottom-up approach where people are directly involved in the production of knowledge. Therefore, the research team decided to make use of a co-design workshop methodology to engage people and draw insights from their experience. Starting from 2 pilot workshops, needed to refine what designed, 16 co-design workshops have been organized both in Italy and in Spain to investigate the phenomenon directly with people from different background according to the specific areas investigated by the DiDIY project: Organization and Work, Education and Research, Creative society and Law Systems.

The research group designed an explorative workshop and a generative one for each project area by using the same research model based on design and creativity, in which people made the differences. Indeed, for each workshop, experts in the field of digital making together with professionals from the specific areas investigated in the workshops were involved in order to form multidisciplinary worktables with skills linked to the themes of the project.

Educators, primary school teachers, makers, craftsmen, lawyers, policymakers, digital experts, representative from companies, FabLab managers, were involved as participants.

During the workshops they tested and validated a specific design process and a set of related activities and tools, designed to generate innovation in different areas.

The experiences of each workshop resulted in a creation of a DiDIY co-design process, a toolkit and a guideline [16]. The DiDIY co-design process is a simplified, yet exhaustive version of the creative design process. It focuses on two main stages, EXPLORE and GENERATE. The first stage aims at identifying a significant objective and its possible development in relation to a given context; the second stage aims at creating and prototyping ideas. The process is divided into four main steps, two for each stage: Immerse, Define, Ideate, and Build to Think, as shown in Fig. 1.

*Immerse (within the Explore area)* is the step of the process to get closer to the social and cultural context of DiDIY.

*Define (within the Explore area)* is the step whose aim is to identify potential opportunities. This step is essential for the goal to be fully understood. Through different approaches, research can reveal valuable information providing potential opportunities, in ways that are unexpected at times.

*Ideate (within the Generate area)* is the step allowing to generate innovative ideas. This step usually begins with a creative session that is carried out with the support of different tools, used to stimulate creativity and generate suitable solutions according with the context and the goals to achieve.

*Build to think (within the Generate area)* is the step of the process to prototype and implement a concept. It helps to make ideas tangible, so as to provide continuous learning and eventual validation of the solution.

Each step has specific activities and tools that guide non-trained people in the definition of a design challenge and the creation of a concept based on the fundamental element of DiDIY.

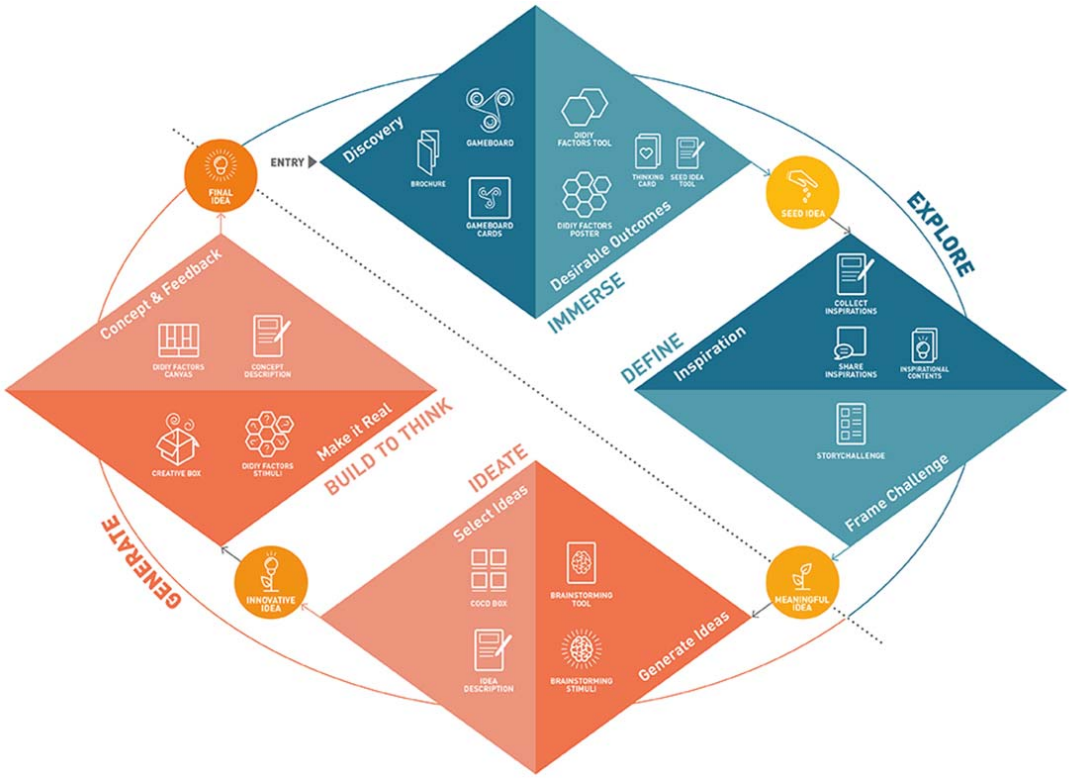


Fig. 1 The DiDIY co-design process created by IDEActivity within the European project DiDIY. In each step are shown in the picture the ad-hoc tools collected in the toolkit

Through the explorative stage people have THE opportunity to create a common knowledge regarding a specific topic/issue establishing a point of view, take in consideration scientific material and structured research, consider the target user and the market.

In order to allow people to understand the context of the DiDIY phenomenon, some DiDIY best practices outlining the framework just described were selected and proposed during this explorative stage. Indeed, the explorative workshop in each area has the objective of, through the analysis of selected DiDIY best practice, identifying the underlying fundamental element enabling the phenomenon.

Through ad hoc collaborative design tools and support, collected and described on the DiDIY co-design process toolkit, participants analysed the best practice and collected thoughts in different cluster. Each resulted cluster represents the element which, from their experience, they thought were fundamental to enable the phenomenon. These clusters were the results of the explorative workshops run in the 4 areas investigated by the project. After this stage, the research team combined and paired the numerous clusters emerged, identifying their common aspects. This systematization required different and repeated phases of processing. The result includes all the knowledge produced by the participants and the wealth provided by the specific professionalisms involved. This process allowed the research team to distinguish those elements that can be replicated and designed which were then considered fundamental factors essential for the consequent generative stage and workshops.

The first activity was to identify the common elements to all the four areas and make a detailed integration of their descriptions to reach a complete definition of these factors. After this first selection, the research team integrates the elements deemed inseparable as components qualifying one another. Concepts formulated in some clusters were transferred to others, because they were considered as facets of the same topic. Their integration in the same cluster enriched its description. This massive work of data re-elaboration led to the identification of the fundamental common factors that shape DiDIY.

The DiDIY co-design process is a human-centred design process that, using the potential of creativity and the approach of Design Thinking, involves people in the development of ideas or strategies, using the fundamental elements of DiDIY. Through the process, people with different backgrounds can actively contribute with their experience and knowledge.

The following paragraph describes the fundamental factors and the related ad-hoc tool.

### *A. DiDIY Fundamental Factors*

The fundamental factors of DiDIY represent essential elements that must be taken into consideration to design solutions drawing on the innovative features of this digital social phenomenon.

As illustrated in the previous section, they are present in most of the significant DiDIY case studies and were recognised as fundamental by numerous people, expert and non-expert by using a bottom up methodology.

This section shortly describes the fundamental factors that were progressively transformed into a specific ad hoc design tool, reported in the next section, to allow the generation of innovative products, services or processes. A complete overview of the factors can be found in a dedicated section of the DiDIY toolkit.

*Do It for Yourself – Personal Motivation.* The DiDIY practice creates a new work paradigm based on openness and sharing that differs from the traditional one. This scenario introduces matters such as understanding how to trigger and maintain people's motivation through a remuneration system that is not necessarily based on money.

The personal motivation is a fundamental factor of DiDIY. Indeed, motivation is the needed factor that allows to activate interest in a project, take part in a community and keep the involvement alive. Motivation can be intrinsic - linked to an innate predisposition of the individual - and extrinsic - related to external factors of reward and satisfaction.

*Do It Together – Community and Sharing.* A community of individuals, who share common interests, vision and ethical values and that actively take part in the collaborative construction of an ecosystem, is a fundamental factor of DiDIY. Each member is an active user who shares the community ideas, knowledge, skills, spaces, and tools. Sharing represents a new way of operating, and a new attitude. Inside the community, people are peers who often work together in a collaborative model. This allows the creation of a global network of individuals and communities who share challenges, problems, doubts and grow together, switching sometimes the concept of Do It Together into Solve It Together (SIT). This refers to the attitude of facing a challenge using collective knowledge and active cooperation of the community.

*Accessibility.* The easy access to technology, knowledge and skills, both online and offline, in the virtual and the real world, is a fundamental factor of the DiDIY. Accessibility is understood also as the need to simplify technical and scientific languages, which will make consulting the content more manageable for a vast public of peers, men and women, of different ages. The ease of access to technology allows individuals and organizations to draw upon skills, consequently allowing their growth. Accessibility also means the need to understand how to utilize the available resources, by using a strategic approach.

*Glocality.* One fundamental factor of DiDIY is Glocality. It refers to the interrelation between local demands, resources, actions, and flow of global skills. The motto is "Think global, act local." The thought originates mainly from the idea that a problem or a need comes into being at local community level, encouraging the creation and the increase of the need itself. From the local level, there is then a diffusion of an idea at a global scale. The force of this element is that a local problem (and relative solution) can be shared globally, in different situations, in different countries. Therefore, there is a reciprocal influence between local and global. The local area is a stratifier and a simplifier of contents.

*System Economy.* One fundamental element of DiDIY is System Economy, where system means a set of components that are interconnected with one another by mutual relations but behave like one.

The components that contribute to making a project sustainable in the DiDIY context are business models, social impact, economic sustainability, and planning. According to the workshops' participants, the DiDIY phenomenon could generate two different business opportunities: on one side, by enabling the creation of new markets in which promote the traditional production, on the other, by allowing the generation of new business models that did not exist previously.

*Digital Technology as a Means for Innovation.* Digital production technologies allow to make the manufacturing process easier and cheaper and to customize products based on people needs. In a wider prospective, digital technology allows the global expansion of different local communities' ideas and projects by breaking down borders. By sharing solution online, other communities can adopt it and readapt it to meet their local needs according to their culture and geographical area of reference. Digital technologies are also social process facilitators and through the DiDIY practice has the potential to bring innovation to different fields.

## IV. From Research to Practice: Designing a Tool to Transfer the Knowledge

The analysis of the current scenario of DiDIY through the literature review and the co-design explorative workshops enabled the definition of the crucial factors of the phenomenon. These factors, transferred into a different environment, such as the school and work, can generate innovation in products, services or processes.

The aim of the research is to enable people to adopt the factors when facing a design challenge, allowing them to shape and build ideas, solutions and concepts that include these aspects. In order to achieve this goal, the research team designed a tool that could help people in managing the ideation and development of a well-defined concept, which includes the fundamental factors. The set of generative workshops were a good stage to test the tool.

### *A. Make it Real Activity and DiDIY Factor Stimuli Tool*

This paragraph describes the DiDIY Factor Stimuli Tool designed to put the factors in action through the active involvement and collaboration of participants. The tool was used during a step of the DiDIY Co-design process called "Build to Think". This step aims at making ideas tangible through a prototyping activity called "Make it Real", which results in a conceptual prototype. A series of raw materials (string, cardboard, games, toothpicks, Styrofoam, sticky tape, etc.), are used by the co-design team to produce "rough prototypes" that visualize the selected idea tangibly.

The "Make it Real" activity give way to continuous reinterpretation to re-establish priorities and achieve a collective product.

The three-dimensional assembling of materials enable people to evaluate the quality of their idea and immediately determine its success within the group.

"Make it real" is divided in two parts: In the first part, the team can freely prototype their idea, during the second one they are invited to implement and expand on their idea, integrating the fundamental factors by using the "DiDIY Factors Stimuli" tool.

The star tool called "DiDIY Factors Stimuli" is composed of six extremities that joined together form a unit. A star shape has been chosen to visually express the concept that only the intersection of all the fundamental elements of DiDIY at the same time can lead to innovation. It is important to highlight that it is not the single factor itself that generates a meaningful solution, but that only the integration of all of them in a project, creates innovation.

Each part of the star describes shortly a fundamental factor which lead to reflect on the meaning of the factor itself. The tool provides questions for each factor that help people to design and enrich their project by using the DiDIY factors.

The tool has been tested during the generative workshops after brainstorming ideas related to the challenge launched in the explorative workshop series. The "Make it Real" activity is then introduced to transform the idea into a concept.

During the second part of the activity, each area of the tool, that identifies a specific factor must be picked up and analyzed one by one. All the team members read the factor description and the related questions trying to answer it or get inspired by the description, continuing to build their idea by adding details or by redesigning some aspects of their project. The tool help to understand if the concept already considers the specific factor or if it needs to be implemented and activated. In turn each participant takes a point, reads the content and together with the group implements the idea.

The "DiDIY Factors Stimuli" tool can be used in different ways, according to the level of energy and involvement of the team.

The activity of building the idea through the tool can be iterative, and there isn't a specific order for the introduction of the factors. It can be repeated as many times there is a need to obtain a successful and satisfying result.

## V. Conclusion

"DiDIY Factors Stimuli" tool has been tested and validated throughout 8 human centred co-design generative workshops repeated with the same structure in two different countries, by the research team.

The tool has been used by more than 60 people with different background to implement ideas and concepts related to the four project areas.

Through co-design workshops, the research team involved both laymen and DiDIY practitioners in the testing and refinement of tool and the overall DiDIY co-design process. Experts from the DiDIY field collaborate with professionals from the 4 areas, in order to design innovative concepts that include the DiDIY enabling elements. During this experimentation, the tool has been continuously refined and improved relying on the participant feedback collected during each workshop session.

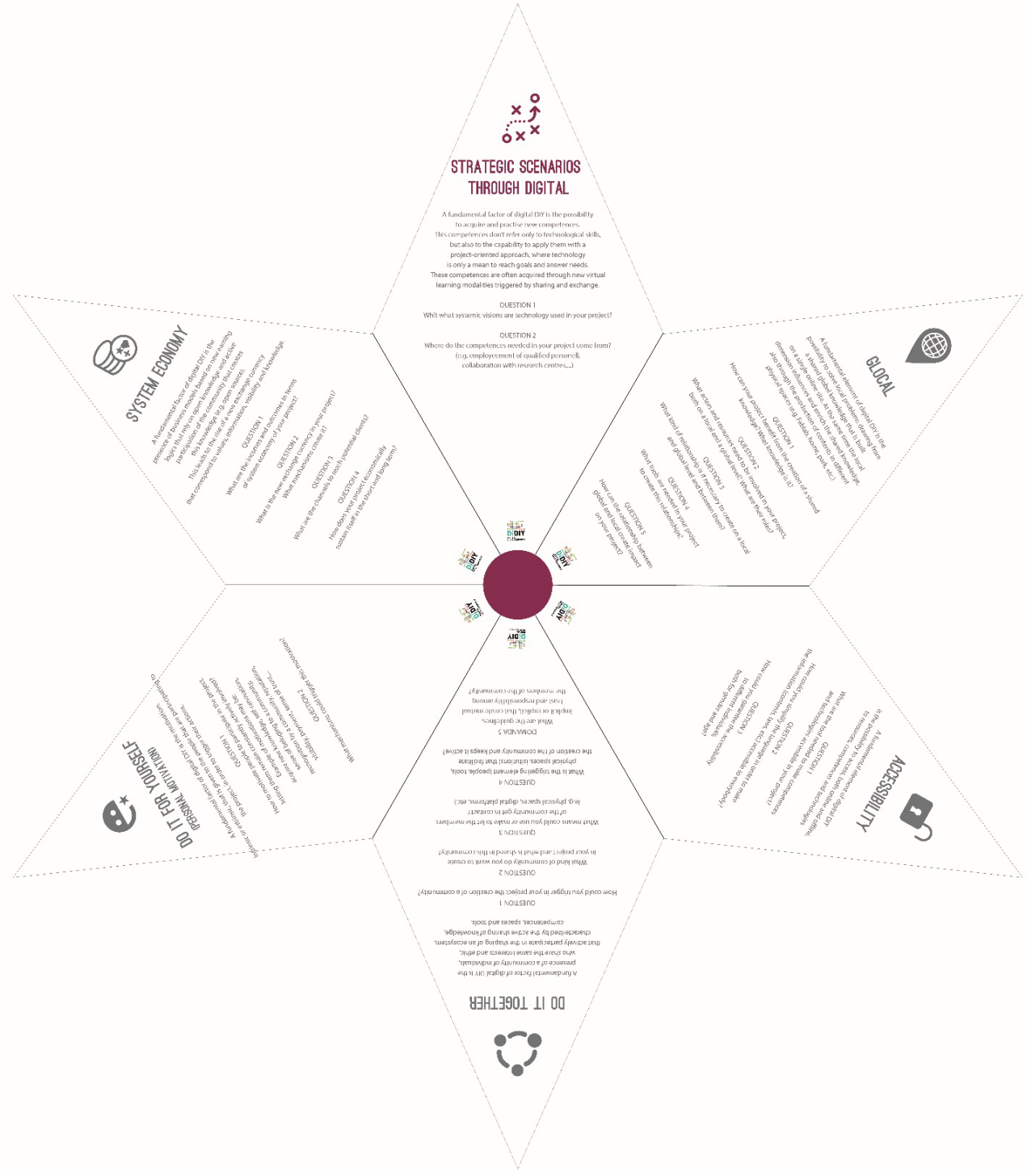


Fig. 2 DiDIY Factor stimuli tool. Each part of the star describes shortly a fundamental factor and provides questions that help people to design and enrich their project

The tool has undergone two significant conceptual changes and many small adjustments of content both in the description of the factors and in the formulation of the questions.

The second relevant conceptual change concerned the shape of the tool. In the final version, implemented for the DiDIY co-design toolkit, in fact, the star shape has been replaced with a hexagonal shape composed in turn by further hexagons representing the fundamental factors. The idea arose from the need and desire to provide an open tool which can follow the continued phenomenon evolution and transformation. In this

way, people can add new factors and replace others keeping the tool always up to date. As the six-pointed star concept, the hexagon also gives the same ideas of union in the central part. Only the simultaneous implementation of all factors can generate the desired innovation in digital-enabled projects.

Fig. 3 DiDIY Factor stimuli tool used during the "Make it Real" activity

As a main result of the explorative and generative workshops, the research team developed a toolkit and guidelines called "Co-design in the Digital DIY scenario" IDEActivity, 2017 [16].

The toolkit includes all the tools and activities based on a co-design process explicitly designed for the field of DiDIY, built with and for non-designer, to generate innovation in several areas. The toolkit comprises the final version of "DiDIY Factors Stimuli" tool. This tool is the most significant ones due to its specific content and distinctive flexibility.

More experimentation is needed to improve the tool further, mainly in two directions. Firstly, the tool should be applied in a real context with defined challenge and its constraints, to evaluate the effective benefit and the innovation it could bring. Secondly, further evaluation should be done on the practical ability of people in using the tool and in facilitating the co-design session. Indeed, during the workshops, the tool was used with the help of a designer that played the role of a workshop facilitator. Our concern was to provide the toolkit with facilitator cards that include instructions, tips and insights on how to use it effectively.

We want to emphasize that despite DiDIY is perhaps not a mainstream practice yet, the spreading of such practice on a wider level might bring additional benefits. Therefore, a deep knowledge of this practice by the designer is certainly strategic for the management and support of the development of the practice itself.

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