# DIY

## DIGITAL
## DO IT YOURSELF

Vocabulary

# Summary

# Digital Do It Yourself and the DiDIY Project

Digital Do It Yourself (DiDIY) is a new socio-technological phenomenon, centred around digital devices that support, often through open on-line communities, the convergence of "atoms" and "bits".

DiDIY-related technologies and social practices enable the low cost prototyping and manufacturing of physical artefacts from digital specifications. They can lead to new scenarios in the roles and relations among individuals, organizations, and society, in which new opportunities and threats emerge accordingly.

The DiDIY Research Project (www.didiy.eu), which addresses the Horizon 2020 call for a "Human-centric Digital Age", is studying how DiDIY and the increasing social adoption of ABC (atoms-bits convergence) devices are:

- reshaping organization, work, education, research and creative design;

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- impacting on creative society;

- influencing legal systems;

- changing ethics.

The **DiDIY Project** is carried out, through a multidisciplinary team (www.didiy.eu/project/people), by an international consortium of seven partner institutions (www.didiy.eu/project/partners):

**LIUC – Università Cattaneo** (IT, www.liuc.it), a university established in 1991 by the Industrial Association of the Province of Varese;

**Communication and Media Research Institute of the University of Westminster** (UK, www.westminster.ac.uk/camri), a world-leading centre for media and communications research;

**Ab.Acus srl** (IT, www.ab-acus.eu), a company whose mission is to design and develop technologically advanced products and services;

**Manchester Metropolitan University** (UK, www.mmu.ac.uk), the largest campus-based undergraduate university in the UK, with

an emphasis on vocational education and employability;

**Free Knowledge Institute** (NL, freeknowledge.eu) a hub that, since 2007, has coordinated several international projects in the areas of Free Software, Open Standards, Open Educational Resources, Access to Knowledge;

**Amerikaniko Kollegio Anatolia** (GR, www.act.edu), a non-profit educational institution with a comprehensive undergraduate curriculum in Business, Business Computing, International Relations and English;

**Politecnico di Milano** (IT, www.polimi.it), a scientific-technological university funded in 1863, which trains engineers, architects and industrial designers.

The goal of the Project is to produce well-grounded models and guidelines to support both education and policy making on DiDIY, intended as an ongoing phenomenon that, while surely enabled by technology, should be driven and shaped by social and cultural strategies, not technology.

The Project, which started at the beginning of 2015 and has a duration of 30 months, is now collecting as much DiDIY-related

information as possible, and collaborating with other people, projects and communities interested in the DiDIY phenomenon, from educators to makers and public administrators.

You are welcome to join the public DiDIY blog (www.didiy.eu/blog) and to browse the documents presenting the results of the research activities (www.didiy.eu/project/results).

For any other information, or to know more about the DiDIY Project, please send an email to **didiy@didiy.eu** or use the form at www.didiy.eu/contact.

# The vocabulary

## Scope

This vocabulary is intended as a complement of the Knowledge Framework (KF, www.didiy.eu/public/deliverables/didiy-d2.4-1.0-pub.pdf) on DiDIY.

As such, its development arose a serious issue: while a vocabulary is expected to provide definitions, which for each concept characterise what is in the scope of the concept and what is not, the KF was produced under acknowledgement that the phenomenon of Digital Do It Yourself is complex and dynamic, so that most of the basic concepts related to it hardly admit a clear-cut definition. This has been implemented in the KF by presenting a range of options, from narrow to broad, in the interpretation of what DiDIY may be. Hence, the KF intends DiDIY as a more-or-less phenomenon, whereas a vocabulary has to propose a yes-or-no view of it.

In this version of the vocabulary such a complexity is reflected

through some notes that expand the information provided by the definitions and emphasise the multiple interpretations that sometimes are given to the defined concepts.

# 1. General concepts

## *Do It Yourself, DIY*

social phenomenon of personally building or customizing physical or informational objects or services not as one's main professional activity

Note – DIY is a complex phenomenon, and the distinction of what is DIY and what is not is fuzzy and contextual. Part of this complexity is the multifaceted nature of the phenomenon, that has been characterised more specifically also as an activity, a method, a technique, a process, a behaviour, etc.

## *Do It Yourself-er, DIYer, maker*

individual or organisation (formal or informal) of individuals that engages in **DIY**

Note 1 – The terms "DIYer" and "maker" are not necessarily synonymous, and in a more refined conceptualisation makers and DIYers could be distinguished. On the one hand, makers can

be considered as DIYers who build objects, and not only repair them, or who emphasise the use of technological tools in their activity. On the other hand, DIYers can be considered as makers who operate not as one's main professional activity, thus admitting that there can be professional makers. One more possible distinction between DIYers and makers is that a maker is always a single person, whereas a DIYer is admitted here to be a collective.

Note 2 – Each DIYer in response to a particular situation may operate in one or more of the following ways (adapted from (Sanders 2006)), as (i) a doer, who operates to accomplish something through productive activity with minimal amount of interest and skills, (ii) an adapter, who operates to make something one's own by changing it in some way, with the interest to personalise the object so that it better fits their personality or contextual constraints, (iii) a maker (in the strict sense), who aims at creating something that did not exist before, with a genuine interest in the practice as well as the experience, (iv) a creator, who operates to express themselves or to innovate, fuelled by passion and guided by a high level of experience, and relying on the use of raw materials and the absence of

predetermined patterns.

## *Digital Do It Yourself, DiDIY*

DIY enabled by digital tools and developing objectively as an activity and subjectively as a mindset, where the production of the outcomes is often facilitated by the access to on-line resources

Note – See the notes about DiDIY activity and DiDIY mindset.

## *Digital Do It Yourself-er, DiDIYer*

DIYer that engages in DiDIY

Note 1 – An individual can be a DiDIYer even when she is reluctant or inactive, thus emphasising the object-related and subject-related component of DiDIY respectively, i.e., DiDIY as an activity and a mindset.

Note 2 – Since a DiDIYer is a DIYer, the complexity mentioned in Note 1 to the definition of DIYer, related to the possible distinction between DIYers and makers, applies also to DiDIYers.

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### Do It Together, DIT

[DIY](#) where the activity is performed in a collaborative way by a group of individuals

Note – DIT and __DIWO__ are sometimes considered the same entity, intended as a collaborative project development technique.

### Do It With Others, DIWO

[DIY](#) where the activity is performed by an individual in a collaborative way with other individuals

Note – DIWO and __DIT__ are sometimes considered the same entity, intended as a collaborative project development technique.

### DiDIY activity

object-related component of __DiDIY__

Note 1 – In its nature of activity DiDIY can be studied, understood, and promoted in terms of tools, products, structure of collaborations, etc. This is the object-related component of the phenomenon.

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Note 2 – The component of DiDIY as an activity is the condition for considering as **DiDIYers** also individuals who engage in DiDIY for necessity rather than for personal interests, i.e., reluctant DiDIYers. This guarantees that the phenomenon can be analysed in terms of social, economic, and technological conditions, dynamics, and consequences.

## *DiDIY mindset*

subject-related component of **DiDIY**

Note 1 – In its nature of mindset DiDIY can be studied, understood, and promoted in terms of motivations, competences, social contexts, etc. This is the subject-related side of the phenomenon.

Note 2 – The component of DiDIY as a mindset is the condition for considering as **DiDIYers** also individuals who are drawn to DiDIY in virtue of their interests, but whose personal circumstances do not contingently allow them to engage in that kind of activity, i.e., inactive DiDIYers. This guarantees that the phenomenon can be analysed in terms of motivations, competences, and skills.

## Atoms-Bits Convergence, ABC

socio-technical scenario where physical and informational components of entities are progressively integrated making it increasingly easy to swap from representation to physical instantiation and back

Note 1 – The term "Atoms-Bits Convergence" derives from the metaphor according to which the physical and informational components of entities are called "atoms" and "bits" respectively. Not necessarily exactly with the same meaning, ABC is also called "physical computing" and ABC systems "cyber-physical systems".

Note 2 – While ABC is relevant also outside **DiDIY**, in particular to interpret some trends in industrial automation, some ABC systems, for example for rapid prototyping and digital manufacturing, are critical enablers of DiDIY.

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# 2. The context

## *maker culture*

culture that promotes the idea that anyone is capable of performing a variety of design, manufacturing, and service tasks rather than relying on professionals

Note – Maker culture emphasises self-sufficiency, skill development, and creativity, usually developed in a collaborative environment.

## *maker ethos*

component of **maker culture** characterising the guiding beliefs of **DIYers**

Note – Maker ethos is grounded in attitudes, skills, knowledge, and commitment, that allow people with similar interests to "hack, adapt, design, [and] create" (adapted from (Bullock 2014)).

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### DiDIY culture

**maker culture** as related to **DiDIY**, thus usually developed in the context of **ABC**

Note – Given the novelty of DiDIY, DiDIY culture does not have stable features yet and what is specific of DiDIY culture with respect to maker culture is still unclear.

### maker movement

social movement centred on individuals or groups of individuals who develop unique, often technological, products by engaging in **DIY**

### DiDIY community

off-line or on-line community whose purpose is to develop some **DiDIY product** or **DiDIY platform**, or to share knowledge, mutual support, or other services about **DiDIY**

### makerspace, hackerspace

community-operated physical place that affords sharing of tools,

resources and knowledge motivated by **maker culture**, revealing specific ways of creation, collaboration and learning

Note 1 – Adapted from (Mattos, Silva 2015).

Note 2 – Usually a makerspace (a) is owned and managed by its members in a spirit of equality, as a non-profit organization that opens the place to the outside world; (b) is a place where people share tools, equipment, and ideas without discrimination; (c) has a strong emphasis on technology and invention; (d) has a shared space as the core of the community.

Note 3 – Sometimes a distinction is made between makerspaces and hackerspaces, where makerspaces aim at enabling a variety of crafts while hackerspaces focus on working with electronic components and software programming.

## *Fab Lab*

**makerspace** structured according to a specific model of **DIY**, as proposed by the MIT's Center for Bits and Atoms

Note – Formal information on Fab Labs can be found at www.fablabs.io and fabfoundation.org.

## DiDIY project

project whose goal is the production of a specific **DiDIY product** or **DiDIY service**

Example – The RepRap project (reprap.org), whose goal is to develop a basic 3D printer, that is also able to replicate itself, that is to manufacture most of its own parts.

## DiDIY knowledge

knowledge of the actual nature and potential opportunities and risks of **DiDIY**

Note – **DiDIY competence** is what is necessary, albeit not sufficient, to personally engage in **DiDIY activities**, whereas DiDIY knowledge is necessary, and often sufficient, to evaluate which DiDIY activities to support, and how, for example by a public administrator or a school principal.

## DiDIY competence

competence required or involved in the accomplishment of a **DiDIY project**

Note – DiDIY competences are, for the most part, of a technical nature. They are the ones that are necessary to practice **DiDIY** personally (e.g., how to operate a 3D printer or CNC machine, and the software used to design the products to build with such machines), and/or the competences that are necessary to lead, or be an active member of, a specific **DiDIY project**.

# 3. The process

## *DiDIY resource*

resource that a **DiDIYer** can use to accomplish a **DiDIY project**

Note – A DiDIY resource can be tangible or intangible: it can be a **DiDIY tool**, a **DiDIY material**, a **DiDIY service**, documentation.

## *DiDIY tool*

**DiDIY resource** as physical or virtual tool or machine directly used in physical or design work for the purpose of engaging in **DiDIY**

Note – While there are specific digital tools that are not usable for DiDIY, if nothing else because of their cost, virtually every technology can be used, in some cases or forms, for DiDIY. Hence the concept of a DiDIY technology is not defined.

Examples – CAD systems; 3D printers; Arduino boards; CNC mills; laser cutters.

### DiDIY material

DiDIY resource as raw or manufactured building block of a DiDIY product, assembled or processed with one or more DiDIY tools

Examples – 3D printer filaments; sheets of plastic suitable for laser cutting.

### DiDIY product

product created by a DiDIYer using one or more DiDIY tools

### DiDIY service

(1) service that gives a DiDIYer on-demand access to one or more DiDIY tools that would otherwise be not usable

(2) online store that sells hardware components necessary for DiDIY activities

Note (to def 1) – There may be different reasons for a DiDIYer to exploit a DiDIY service, for example because too big, not convenient to buy, needed only one time.

### DiDIY manufacturing

manufacturing of a **DiDIY product**

### DiDIY design

(1) process of designing an object by a **DiDIYer**, usually by means of CAD software

(2) digital blueprint resulting from a process of designing an object by a DiDIYer

### DiDIY codesign process

process in which users or other stakeholders are invited to actively contribute with their experience to the design process considering the fundamental elements of **DiDIY**

Note 1 – Co-design builds on a tradition of user-centered design, participatory design, critical design, and ethnography. It is growing and being fertilized by many other disciplines. It is about users, or more generally, people imagining and planning with issues that are not-yet-existing and utilizing the skills that are in the core of professional design competence. Co-design is a

method and a mindset characterized by the belief that all people are creative.

Note 2 – Co-design sessions are defined as "workshops for sketching and trying out possibilities" (Binder 2010) and "temporary spaces for experimentations and collaborative learning" that are "open-ended, collaborative and creative" (Brandt, Agger Eriksen 2010). During the sessions "a set of creative techniques whose aim is to inspire the design process" (Rizzo 2010) might be used.

Note 3 – Co-design toolkit is intended as the way that specific techniques and tools are used to unlock people's creativity helping them to work collaboratively. Each toolkit is designed to serve a specific purpose.

### *DiDIY design model*

design and creativity based model that is able to generate innovation through the use of **DiDIY**

Note – A DiDIY design model will include the development of tools that facilitate the involvement of people in the design process. It has a strong social connotation and people's

creativity and self-improvement through the development of new skills and knowledge are key elements.

## *DiDIY platform*

(1) set of hardware and/or software components, designed from scratch or deliberately assembled, to be the basis for design and/or manufacturing of a **DiDIY product**, or family of products

(2) website explicitly designed to enable any combination of (co)development, manufacturing, sale, or distribution of DiDIY products or **DiDIY designs**, as well as mutual support among **DiDIYers**

Note (to def 2) – DiDIY platforms are sometimes intended as including also the **DiDIY community** that interacts through the website, for example for collaborative writing of documentation.

Example (to def 1) – The ArduPilot Mega (APM) at diydrones.com, which is "a DIY software and hardware autopilot platform usable for model planes, multicopters, unmanned ground vehicles and many other devices".

Examples (to def 2) – thingiverse.com; openbuilds.org.

# 4. DiDIY ethics and responsibility

## DiDIY ethics

(1) analysis of the ethical issues raised by the practice of **DiDIY**

(2) system of ethical values common to most, if not all, people who engage in DiDIY and that guides their practice

## DiDIY risk

risk whose magnitude or probability of happening are significantly increased by the existence of **DiDIY**

Example – **DiDIY counterfeit**.

Note – There are several different kinds of risks related to DiDIY, mainly generated by the widespread diffusion of **DiDIY tools** and **DiDIY products**. Some risks are specific and related to individual users, e.g., harming oneself or others by using DiDIY tools or DiDIY products. Other risks are broad and social in nature, e.g., the risk that DiDIY may increase pollution, or reduce jobs, or make gun control impossible.

### DiDIY duty of care

rule, coming from legal negligence doctrine, under which every person involved in **DiDIY**, or using products manufactured via DiDIY, is liable for his or her amateur production, if they did not take "reasonable care to avoid acts or omissions which you can reasonably foresee would be likely to injure [their] neighbour"

Note – As defined, DiDIY duty of care is distinguished by **DiDIY product liability**.

### DiDIY product liability

legal liability incurred by a **DiDIYer** for producing and/or selling a faulty **DiDIY product**, or maybe even for just distributing its designs without proper warranties/disclaimers

Note – At first, DiDIY product liability is a direct derivative of the general product liability doctrine that pertains to professional producers' and consumers' commercial relationships. As **DiDIY** is typically a non-commercial activity, it falls out of the scope of consumer protection and strict liability. However, "the widespread social diffusion of 3D printing, and digital fabrication more generally, is making the traditional

boundaries between producers and consumers blur and this is giving rise to liability issues for which legal solutions are not clearly determined yet neither in the EU nor in the US legal systems" (D6.1). A distinction should be made here between professional and non-professional **makers**: professional makers are treated under strict liability rules, while both the non-professional figure and non-commercial seller of "print-at-home" objects are liable only in case of negligence, under duty of care.

## DiDIY service liability

legal liability incurred by the provider of a **DiDIY service** for not performing their services as advertised, thus causing harm to those who use the service

Example – The provider of an on-demand 3D printing service who does not use "food-safe" filaments to manufacture objects that were specifically designed, and explicitly labelled when the manufacturing request was sent to the provider, as kitchen tools.

## DiDIY counterfeit

illegal replica of an original product created through the use of

## *DiDIY counterfeiting*

form of counterfeiting where illegal replicas of original products are created through the use of **DiDIY**

## *DiDIY counterfeiter*

individual or group of individuals who engages in **DiDIY counterfeiting**

# 5. DiDIY education

## *DiDIY learning*

(1) lifelong pro-active form of self-education to **DiDIY** and by means of DiDIY

(2) process of acquiring skills and knowledge by an individual involved in the process of solving a personal need, either as a deliberate outcome or as an unintended by-product

Example – The attitude toward problem solving and the microelectronics competences acquired by a 65 year-old retired librarian when learning how to program a microcontroller in order to automatically water her greenhouse while she is away.

## *DiDIY teaching*

approach to education leveraging on **DiDIY culture** and **DiDIY tools** to enhance the learner's experience

Example – The didactic approach to education held by a teacher/educator who decides to set up a project-based course

using Arduino boards, 3D printing technologies, Raspberry Pi, and other digital technologies to prompt students to investigate and solve an authentic challenge.

## *DiDIY education*

(1) integrated process made of **DiDIY teaching** and **DiDIY learning**

(2) results of an integrated process of DiDIY teaching and DiDIY learning

Example (to def 1) – The realization of collaborative activities taking place in a **makerspace** or in a classroom, bringing together **DiDIY teachers** and **DiDIY learners**.

Example (to def 2) – The awareness of a kid about the potentialities of **DiDIY** as a tool and of her own ability to use **DiDIY tools**.

## *DiDIY teacher*

**DiDIYer**, or an individual close to the movement, who takes part to the **DiDIY education** and actively contributes to its realization

typically by making use of **DiDIY tools** and project-based approaches as a didactic tools, to guide and support **DiDIY learners**

Example – A primary school teacher already knowledgeable of 3D printing out of personal, non-professional interest, who decides to involve her class in a biology project by having kids 3D printing models of the main zoological species of the local area.

## *DiDIY learner*

individual interested in or in need of improving his educational status who engages in **DiDIY education** with the support of a **DiDIY teacher** or any other form of guidance, either in a pre-structured environment or alone

Example – A kid or an adult taking part to a **Fab Lab** workshop, during which they are able to acquire the digital skills needed to operate **DiDIY tools** and contribute to the group work by sharing the proactive attitude toward the project's objectives.

# Context, justification, and rules

## Key decisions

Key decisions to be made in designing a vocabulary are about:

D1. *its intended users*: the interests of policy makers and of makers are not the same;

D2. *its scope*: given the multiplicity and the diversity of the fields in which DiDIY is relevant, their exhaustive coverage seems to be hardly possible;

D3. *its degree of formality and structure*: the definitions can be written according to strict terminological rules or in a free format, natural language.

**On D1.** In agreement with the general objectives of the Project, the vocabulary is primarily devoted to those who need or however are interested in "well-founded transferable information, models and guidelines to support both education and policy making on DiDIY as it is forming, intended as an ongoing

phenomenon that, while enabled by technology, should be driven and shaped by social and cultural strategies, not technology". The vocabulary is then a component of "a roadmap fostering a DiDIY-based human-centric European development" (both quotations are taken from the Project DoA).

It is then a vocabulary for decision makers on DiDIY, including teachers, entrepreneurs, public administrators, etc, not specifically for DiDIYers.

**On D2.** According to D1, the vocabulary only includes entries relevant to decision makers on DiDIY. Definitions of concepts and instructions on how to do something yourself, e.g., in gardening, cooking, electronics, etc, are outside the scope of this vocabulary.

**On D3.** According to D1, the vocabulary is for human decision makers, not computers, and then it is written in natural language. Some basic terminological rules (see the section "A note on terminology" below) are however fulfilled whenever possible in order to build a concept system, and finally on ontology, out of this vocabulary.

Two further decisions related to D3 are still to be made:

- whether for each term only a definitory sentence should be provided, or the entry might become a short introduction to the concept: several definitions are indeed complemented here with notes or examples, which will be possibly further expanded in future versions of the vocabulary;

- whether for each term only a single definition should be provided, or multiple and diverging definitions are accepted: while a single definition is preferred, in some cases multiple definitions have been introduced, in order to report the actual uses of the defined concept.

## A note on terminology: how this vocabulary is structured

A vocabulary is a collection of terminological entries, each including a designation, in the form of one or more terms (the first one being the preferred term, and all other ones – if any – are the admitted terms: in this vocabulary we do not distinguish between preferred and admitted terms), and a definition, possibly together with notes and examples. Each entry of a vocabulary defines a concept, where indeed a definition is the

representation of a concept by a descriptive statement which serves to differentiate it from related concepts (excerpted and adapted from (ISO 1087-1:2000, Terminology work – Vocabulary – Part 1: Theory and application)).

While there are a few types of definitions, intentional definitions are the preferred ones and should be used whenever possible as they most clearly reveal the characteristics of a concept within a concept system. An intentional definition has a well-defined structure: it specifies the superordinate concept immediately above the concept under definition, followed by the delimiting characteristic(s) (excerpted and adapted from (ISO 704:2009, Terminology work – Principles and methods)).

(see www.iec.ch/standardsdev/resources/terminology for a short introduction to terminology in scientific and technical fields)

Take the following minimal example:

### Do It Yourself, DIY

social phenomenon of personally building or customizing physical or informational objects or services not as one's main

professional activity

Note – DIY is a complex phenomenon, and the distinction of what is DIY and what is not is fuzzy and contextual. Part of this complexity is the multifaceted nature of DIY, that has been characterised more specifically also as an activity, a method, a process, a behaviour, etc.

On the whole, the content of the box is a terminological entry, in which:

- "**Do It Yourself**" and "**DIY**" are the terms;
- "social phenomenon of…" is the definition;
- "Note – DIY is the complex phenomenon…" is a note.

The definition is structured as an intensional one, such that:

- 'social phenomenon' is the superordinate concept, i.e., the definition states that DIY is a social phenomenon;
- 'of personally building…' are the delimiting characteristics, i.e., the definition states that DIY is a specific social phenomenon (i.e., not all social phenomena are cases of DIY), where the

specification is provided by the delimiting characteristics.

Even though this is a vocabulary for human decision makers, and therefore strict formal rules are not required, what follows has been adopted:

- all definitions are intensional;

- all concepts that are used in definitions and are specific to DiDIY are defined;

- the first occurrence of terms in definitions or notes that are themselves defined here is underlined;

- entries are listed in conceptual order, and any defined concept used in a definition is defined before the given definition.