



## D3.6 REVIEWED RESEARCH MODEL

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## Executive summary

The aim of this deliverable is to present the results of the research within WP3, as a significant update of the research model submitted in D3.1. The deliverable is structured like D3.1 as a collection of the research results of each of the Research Topics that have been identified. The general framework developed basing on the exploration in these domains shows the emergence of a profile of the 2020 worker, that we call “DiDIY worker”, which appears similar to the promising but rarely realized figure of the “smart worker”. The DiDIY worker, and a DiDIY-friendly organizational environment, represent a credible possible alternative scenario to the dark forecasts of a jobless economy as a sole consequence of digital innovation.

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## 1. Introduction

As already highlighted in D3.1, the nature itself of the DiDIY phenomenon, its multidisciplinary roots and its novelty, make it unfeasible to study it in general terms.

Thus the research approach followed in WP3 has been: a) to create a background context, pertinent and relevant with the WP3 subject, based on a systematic review of the scientific literature, and an ongoing collection of white papers and practitioners' reports; b) to launch a series of studies, focusing on specific research topics, defined by a specific organizational role following the operational definition of DiDIY (D3.1, par 2.4), that we report here at the reader's convenience:

- a DiDIYer, i.e., certain *organizational roles* (or, at a higher level of aggregation: certain organizational units, certain enterprises),
- carries out their own certain *activities*, activities previously carried out by experts (or specialized companies) – this aspect deals with the traditional notion of Do It Yourself –
- by exploiting certain digital *technologies*
- and possibly exploiting the knowledge sharing within a certain *community* (of individuals, of organizational entities) – these aspects deal with the innovative notion of Do It Together, where “together” refers to a community the DiDIYer belongs to.

As a consequence, this deliverable is structured as a collection of vertical studies, referring to a specific empirical domain (a specific organizational role), based on a specific theoretical backgrounds, specific research methods and specific outcomes, framed into a general Research Topic, defined as RT0 (Figure 1). The results obtained in each of these RTs will be merged in the final steps of the DiDIY Project in order to complete the general knowledge framework and to provide general guidelines for the understanding of the DiDIY phenomenon and possibly to design DiDIY-compliant organizations.

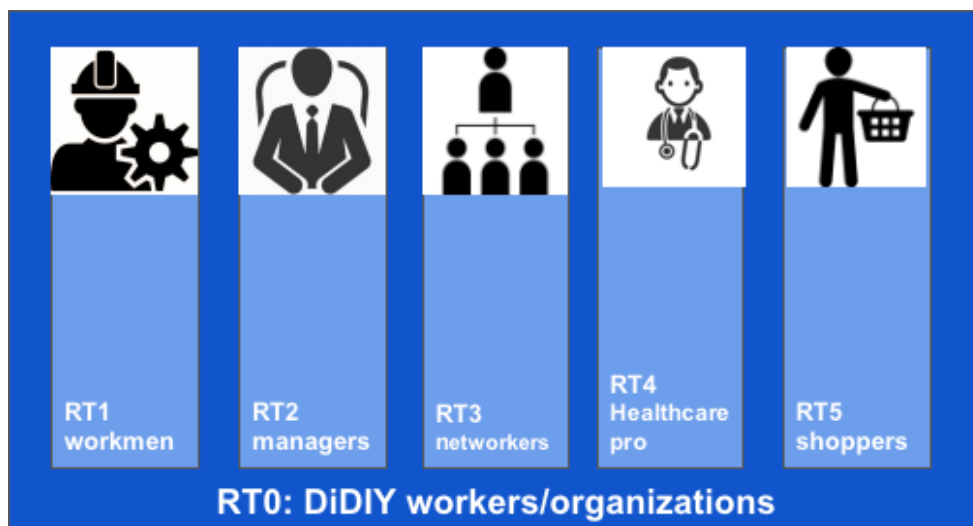


Figure 1 – General research framework and vertical Research Topics.



### ***1.1 Terms and acronyms***

DIY	Do It Yourself
DiDIY	Digital Do It Yourself
ABC	Atoms-Bits Convergence
KF	Knowledge Framework
RT	Research Topic
ICT	Information and Communication Technology
IT	Information Technology
HR	human resource
CEO	Chief Executive Officer
CIO	Chief Information Officer
CDO	Chief Digital Officer
NMDSO	Network Marketing Direct Selling Organization
KA	Knowledge Artefact



## 2. The reviewed research model: overview of the WP3 general framework

### 2.1 Introduction to the general WP3 framework: smart workers and DiDIY workers

The fundamentals of management and organizational science have been developed and consolidated in an era structurally different from today (Dobbs 2015). Economy was mainly based on goods and not on services, economic transactions mainly occurred at the local and not international level (when globalization was not yet a mature phenomenon), the so-called first world experienced a constant economic growth. In that era technology used to provide tools supporting materials handling (atoms) and not information management (bits). In an era when the concept of physical goods were set against the concept of intangible services, the managerial models developed in such a context leveraged on an analytical approach synthesized in the Taylor's model of work.

Nowadays, services are at the edge of competition, business models are changing fast and the impact of technology on society is important. We observe the rapid growth of digital technology and a change in paradigms not only in everyday life but also in organizational contexts, and, in particular, on job occupations: “thanks to digital technology [...] business is evolving into an office-less enterprise that's more mobile and fluid than the “desk jobs” of decades past – which presents a challenge to the companies that supply businesses with the nuts-and-bolts of their physical infrastructure” (Kane 2015).

The so called “fourth industrial revolution”, which includes developments in previously disjointed fields such as artificial intelligence and machine-learning, robotics, nanotechnology, 3D printing, and genetics and biotechnology, is claimed to cause over the next five years a widespread disruption in business models but also to labour markets, with enormous change predicted in the skill sets needed to thrive in the new landscape (World Economic Forum 2016).

This new environment is quickly reshaping – besides business models – also skills and abilities. According to the Strategic Policy Forum on Digital entrepreneurship (2016) “reskilling the workforce in different EU industrial sectors is a major priority and challenge”. People will need to learn new skills, otherwise they will risk to fall into obsolescence: the rising of technology is radically transforming several industries and is making many manual jobs obsolete, while the demand of new types of skills, not only technical but also relational, are even more useful (Wang 2012).

Technological disruptions create substitute specific tasks. New technical skills will need to be supplemented with strong social and collaboration skills. Digital technologies can create and expand virtual work spaces, enable and support new ways of working, facilitate communication, collaboration and the creation of networks of professional relationships between and external figures. The development of such “professional clans” is strongly possible thanks to the diffusion of digital mobile tools that turn to zero the issue of space and time distance (World Economic Forum 2016).

However, while the new so-called “gig economy” may be one of the most visible and current manifestations of disruptions to the labour market, many more changes – both positive and negative – are expected in most industries, leading to new management and regulatory challenges. In this work we present a conceptual framework showing the bright side of digital technologies as their



impact on jobs is concerned. While machines get smarter, many jobs will keep on maintaining critical components that are social, emotional, where the presence of individuals' skills is essential. We provide support to the thesis that technologies can help organizations evolve beyond the mere substitution of men power if workers will be able to empower themselves becoming knowledge workers.

## **2.2 Theoretical Background**

### **2.2.1 The impact of digital technology on organizations besides automation**

The findings of a recent report by the World Economic Forum (2016) pointed out that the fourth industrial revolution is consolidating new ways of working and new organizational models. The report presents a framework to classify digital dependent phenomena and their effect on work, among which a loss of 5.1 million jobs, due to the advent of this “revolution” and the related automation of increasingly complex tasks.

However, the report provides several other relevant insights beside this worrying forecast. The changing nature of work, and skills instability – the rapid change in the skills requirements of all existing jobs – are nowadays among the most important drivers of change. These phenomena are further compounded by the rise of mobile internet and cloud technology, enabling the rapid spread of internet-based service models, where the relevance of the physical components of organizations, including employees, appear to fade (World Economic Forum 2016).

The impact of concurrent disruptions in technological, demographic and socio-economic level will transform the employment landscape and skills requirements, resulting in substantial challenges for recruiting, training and managing talent, new emerging job categories and functions are expected to become critically important by the year 2020 (World Economic Forum 2016, Strategic Policy Forum 2016). For example, developments in technologies related to coding have facilitated the rapid growth of new roles and lowered the barriers to entry. Or, in another business domain: Google Analytics, marketing automation software tools, and the accessibility of growing volumes of data have raised employers' expectations that a broader set of employees – not just statisticians or business analysts – will drive analytic insights. Roles such as Digital Marketer, Data Analyst and Mobile Application Developer are often accessible to job seekers with technical training short of a computer science degree (Bittle 2015).

This drastic change of profiles is not perceived or implemented by all the firms in many different industries undergoing digital transformation, due to several factors: resistance to change by entire established firms and their executive managers, traditional mind sets and old procedures, scarce urgency pushed from the market (so far) towards change.

### **2.2.2 From teleworking to smart-working**

In opposition to this scenario, where technology is seen as inevitable and problematic, since the early 90's other researchers have been highlighting that digital tools have opened up many options in terms of the location and time frames of work. Digital is said to bring value to work within those organizations able to exploit technology to create a variety of workplace settings, and tools that support different types of work: individual or collaborative, focused individual procedural work or work based on social interactions and improvisation, and even the opportunity to work in a variety of different locations throughout the day. At the same time, such a flexible work configuration allows to fulfil improvements in term of work-life balance (Morganson 2010; Krishnakumar 2014,





Irfan 2015). Employers who can accommodate this new way of working are finding it easier to attract and to retain digital-savvy employees (Morganson 2010; Attia 2014).

During the 90's, the popular (although broad) term used to describe such arrangements was *telework* (Niles 1998). According to Sparrow (2000), teleworkers represent “privileged core employees, enjoying high trust relationships, and given autonomy over work location and time, i.e., the re-emergence of industrial guilds serviced by a small technical and commercial elite”. Telework initially aimed at cutting organizational costs associated with maintaining and leasing property, and more recently has been implemented to reduce work pressures and facilitate work-life balance (Wang 2012; Irfan 2015). Kossek and Friede (2006) suggest four types of work-life policies: flexibility of working time, flexibility of working place, support with care responsibilities and informational and social support. Flexibility of working time includes reduced hours or part-time; flexitime; compressed work-week; job-sharing; compensatory time (extra time gets recouped) and leaves of absence. According to Krishnakumar (2014), flexibility of working place refers to “teleworking, that is working from another location other than the office”.

More recently, following the diffusion of the adjective *smart* to generally address business components supported by digital technology, the term *smart work* has been largely adopted to refer to employers providing employees with flexibility in their working hours, following practices of part-time working or flexi-hours, that, however, do appear essentially similar to those described already two decades ago under the term telework. A recent survey on 100 large Italian companies (Gastaldi 2014) identified four categories of smart working organizations: inconsistent, analogical, digital, and complete. If we exclude the last category, the large majority of companies claiming having adopted smart working have actually carried out initiatives limited to the adoption of digital devices and policies of work time flexibility. Some of them are even mere employer branding initiatives, as it has been confirmed in a more recent report (Osservatorio Smart Working 2016).

In other words, one may question whether the main innovation between the current initiatives labelled “smart working” and the telework of two decades ago, consists in the technological innovations available (high-speed Internet, cloud computing and mobile devices) that let companies displace workers at their own houses.

### 2.2.3 From smart workers to “Digital Do It Yourself workers”

If this is the case, the promised, positive disruptive potential of the scenario depicted by the World Economic Forum (2016) appears to be very limitedly exploited, leaving the stage to the darkest forecasts on job occupation. We believe that the roots of the lack of full exploitation can be found in the pervasiveness of the impact of digital technology on work, which leads to overlap different effects that technology can enable:

- *automation*, i.e., independence on humans or “Do Without People”. It consists in substituting individuals with machines to perform certain tasks. Emerging digital technologies such as the Internet of Things and Big Data appear to enable computers to perform highly sophisticated tasks, typically qualifying the so-called white-collars, while the application of artificial intelligence to robotics lets machines to cover complex operative tasks, until now requiring the work of the “blue-collars” (Lacity 2015; World Economic Forum 2016);
- “*self-service*”, i.e., operational autonomy, or “Do Without Asking”. It consists in allowing individuals to become independent of certain organizational entities for carrying out



operative tasks. It is the typical effect enabled by the adoption of intranets to support employees in many administrative and communication tasks;

- *virtualisation*, i.e., independence on physical proximity or “Do Without Touching”. It enables the employees to overcome space constraints by carrying out tasks involving distant organizational resources (e.g., people, plants, archives) as if she was in presence of such resources.

One might observe that the current “smart working” practices exploit self-service and virtualisation. These technology-enabled effects – although relevant – do not add value to the workforce: they provide workers with new, efficient (hardware and software) means, without significantly changing the way they work. It seems unlikely that, by these means, companies can compensate the occupation losses inevitably consequent to automation. Conversely, as reported by Quinones (2014) in its qualitative study, “the challenge is not just to design innovative ICTs with tailorable system design principles, but to consider the appropriation work that occurs at the user level – supporting good understandings of technology and cultivating practices around it. Such work is akin to establishing what MacLean et al. (1990) called the culture of tailoring”.

To evaluate the impact on occupation we should change paradigm and move from a paradigm based on space, time and efficiency (the bases of the three effects mentioned above) to a new paradigm, focused on the effect of technology on the value of the competence at work.

In this Project we have named this fourth effect *Digital Do It Yourself*: by exploiting the availability and ease of use of digital technologies, organizational roles typically dependent on experts (internal or external to the organization) can carry out, autonomously, innovative practices.

For example: workmen in the production plants can set up a pilot project to monitor the production flow (using Arduino boards and sensors) without or limitedly asking support to the IT department; R&D employees can create (with 3D printers) prototypes of new products, without requiring consultancy from R&D consulting firms; marketing employees can set up a marketing campaign by creating a mobile app, without or limitedly asking support to the IT department.

By enabling disintermediation of experts, the DiDIY effect shakes organizational roles, something that can be recognized in the makers communities (Anderson 2012), and has been described with the term “democratization of manufacturing” (Tanenbaum 2013; Williams 2014).

In synthesis, we can add a fourth item to the list introduced above:

- *Digital Do It Yourself*, i.e., the integration of activities, amplification/empowerment of workers, autonomy of decision making, knowledge sharing. Contrary to the previous effects, it is not qualified by independence, but rather by inter-dependence between individuals (sometimes described as a “Do It Together” practice) and between an individual and technology.

By assuming the very existence of this effect, we can introduce the role of the “Digital Do It Yourself worker” (or “DiDIYer”), a type of proactive, digitally-enabled knowledge worker (Mikulecký 2008; Moon 2009; Cannella 2012) that exploits digital technology both to exert her creativity and to share knowledge to achieve higher goals. At the organizational level the effect of DiDIY is effectiveness and not increased efficiency (Kinnie 2012; Lacity 2015). In other words, a DiDIYer is the really “smart” variant of the current actual “smart worker”.



## **2.3 Research design: WP3's Research Topics as empirical domains for DiDIY reshaping work and organization**

The novelty of the paradigm introduced in this work requires, besides a solid theoretical background, the identification of potential organizational domains in which empirical research should explore the applicability of the paradigm. We have identified five domains, that are introduced below. Each domain can represent a Research Topic, a specific area of investigation under a general research framework.

- *Manufacturing workmen.* Manufacturing workers can exploit digital technologies to develop new methods and technologies for production (e.g., digital desktop fabrication): knowledge work, craft, and design are recombined in novel ways (Ratto, Ree 2010). The diffusion of 3D printing, laser cutting, and garage-scale CNC mills have created contexts of democratized technological practices. It has given hackers and hobbyists modes of production previously only available to large organizations (Tanenbaum et al. 2013). Rapid prototyping technologies are impacting business processes because they enable sharing knowledge about product design and fabrication (Oxman 2007).
- *CIOs and other executives.* The role of the Chief Information Officer (CIO) is undergoing major changes in relation with the DiDIY affecting other managerial roles. CIO work is progressively overlapping with the work of designers, operations managers and particularly CMOs (Ariker 2014; Deloitte 2015). In this new scenario a new executive position is getting increasing credit: the Chief Digital Officer (CDO), typically emerging from the marketing department where abilities related to e-Commerce and web-based communication are increasingly available.
- *Networkers.* This is a new type professional that is gaining market space at the expenses of sales agent. In certain B2C industries, namely cosmetics, companies are transforming the sales department by welcoming initiatives of network marketing spontaneously growing from single individuals. Networkers are able to exploit their knowledge of the business (the product and the market), to launch sales initiatives based on the effective use of digital tools and enabling the creation of a social network of dealers and final customers.
- *Healthcare professionals.* 3D printing has a potential to change the work of surgeons, both in regard to surgery planning, and in educational activities with novices, as well as in the communication with the patient. In this sense, medical 3D printed objects represent a new toolkit for healthcare professionals.
- *Shoppers.* Shoppers of retail chain are progressively capable to run certain step of the buying process on their own, by collecting information on the web and/or by creating on-line communities where they share the expertise on producers of goods. The aim of this research topic is to study the changes in the shopper buying behaviour process and their fall-out on retailer structure, marketing strategies and organization. In this case the subject is not a worker, but the DiDIY behaviour of shoppers possibly would have a relevant impact on work in the retailer industry.

In all these cases we can use as a reference role the one of the makers. The rise of the maker culture (Anderson 2012) is closely associated with the rise of a totally new entrepreneurial ecosystem made of hacker spaces, fab labs, makers spaces, tech-shops, co-working spaces, crowdfunding platforms, related and supporting industries (such as laser cutters and 3D printer makers and consultants;



dedicated vocational training and education; academic and corporate research), local and international associations, clubs and institutions. Makers tend to concentrate mainly around large and medium cities, forming local communities. Often physical proximity and geographical clustering play a critical role in the rise and success of such communities and in the exploitation of their capacity to act as incubators for knowledge creation and sharing and eventually for innovation, leading to entrepreneurial initiatives.

The domains of application of the DiDIY phenomenon presented above belong to a widely heterogeneous set of environments (different industries, different business processes, different organizational roles). However, it is possible to recognize a common ground, that can be synthesized in terms of a structure, a general framework, enabling defining constraints (although blurred to some extent) for the identification of any domain of application of the DiDIY effect.

## ***2.4 Implications of the new paradigm***

In recent years the interest in the Digital Do It Yourself organizations has grown significantly, as per all the latest research related to smart working. Digital Do It Yourself means rethinking the work in a more intelligent way, challenging the traditional constraints related to location and working hours, leaving to workers more autonomy in defining the modalities of work, be it intellectual or manual, compared with greater responsibility for results.

Not simply autonomy, but also flexibility, accountability and trust are the key principles of this new approach to work. The DiDIYer seen as a knowledge worker elaborates and programs his activities without the need of specialists in the field, but not alone: together – i.e., sharing knowledge with – other DiDIYers operating in the same application domain. This helps her to identify the objective, focusing on the problems that she likely will have to face to achieve it.

At the organizational level, the presence of DiDIYers has several implications. Firstly, it requires monitoring skills of the context in which she operates, not only the mere execution of her tasks. Secondly, the value of an individual is not related to her position in the hierarchy but to the contribution that he is able to provide to the community in which she is recognized. Thirdly, if the DiDIY paradigm is based on value, it does not matter how much a DiDIY worker takes to perform an activity: “time is money” is not meaningful any more. What matters is not how much time she needs to perform a task but the added value generated. This conclusion is openly in conflict with the traditional approach to the evaluation of work, based on the effort measured in time units. It is worth noting that in some contexts such an approach is already in place. For example, sales agents are measured in sales orders and not in hours of work. Thus the point is how to measure the value added by other jobs where time is the traditional measure.

In general, the human resource (HR) function, rather than the IT department, appears to be affected by the emergence of the DiDIY worker. HR professionals should develop new skills (or at least be aware of some techniques) in order to fully grasp the rapid current developments in the digital landscape. Furthermore, the human resources should also optimize internal communication making an appropriate use of all the available channels such platforms of social intranet or business social networks, besides the traditional communication channels. In this sense the digital transformation process can be seen as a social and technological transformation process that requires the development of new skills in the HR function and, more generally, a change in the organizational culture. To this aim, HR people should work together to the marketing and communication functions.



By leveraging on DiDIY, we propose to challenge the dramatic scenarios of job destruction portrait by recent economical reports, and, on the other hand, we discuss the actual novelty of smart work practices, as they are carried out now.



### 3. Research Topic 1: Workmen

The fundamentals of management and organizational science have been developed and consolidated in an era structurally different from today. Economy was mainly based on goods (atoms) and not on services (bits), economic transactions mainly occurred at the local and not international level (no globalization), the so-called first world experienced a constant economic growth. In that era, technology used to provide tools supporting materials handling (atoms) and not information management (bits). From a demographical point of view, this era was characterized by a far shorter life expectancy and a lower average age of the employed population. The managerial models developed in such a context leveraged on an analytical approach, synthesized, almost ideologically, in the Taylor's model of work emphasizing specialization and a representation of organizations as deterministic machines. Despite criticism about specific aspects (Yetton 1992; Sharp 1996; Merchant 2012), or the way they have been taught (Spender, 2011), the dominant models taught as fundamentals in business schools are still the managerial classics of two decades ago, such as Ackoff's, Mintzberg's and Porter's models which are rooted, more or less explicitly, in the assumptions listed above. It is at least questionable that these fundamentals, originally designed as conceptual tools to improve organizations and society, constitute as a whole a model appropriate to represent the current state of work and organizations. Hence it becomes crucial to project future scenarios based on disruptive phenomena like DiDIY.

Assuming that DiDIY is characterized by an infrastructural and social nature, it is necessary to explore its impact beyond the changes of the skills of individuals, but also on work and organizations across the industries. In this paper we aim at providing both a characterization of makers and DiDIYers operating in the business context of a manufacturing company. As a first step we transpose makers' characteristics into a business setting; as a second step we investigate whether these characteristics favour a positive result and in which cases digital technologies can be used to favour DiDIYers (e.g., people empowerment) or digital technologies are used for tasks automation only.

#### 3.1 Background

##### 3.1.1 Do It Yourself

Do It Yourself (DIY) leverages on the relationship between production and consumption that is being reshaped by amateurs committed to self-production. First examples of people learning how to use new tools, and developing specific skills, for improving homes (Goldstein 1998) can be traced back to the end of the 19<sup>th</sup> century. The very big change happened in the middle of last century, where DIY emerged as way to pay for professional help after World War II (Atkinson 2006) and on the other as a way to realize the American dream of an affordable and modern home' (Goldstein 1998). In the following years the interest in DIY rose according to a wealthier society where people could afford greater incomes, greater leisure time and improvements in lifestyle.

Recent literature defines DIY as related to "both a producing and consuming culture" (Edwards 2006). By taking into consideration people making, at the individual level, we found out that makers evolved from sharing knowledge into cooperating in organizations with different business models. A brief history of makers stands from the 1980's, where computer hobbyists formed communities to create, explore and exploit software systems, resulting in the Hacker culture. Over the past few decades, digital tools such as social networking platforms, online sharing platforms,



and other online collaboration technologies facilitated a renewed interest and wider adoption of DIY cultures and practices through easy access to and affordability of tools and the emergence of new sharing mechanisms. Recent breakthroughs in technology afford sharing in a way that anyone can quickly document and display their DIY projects to a large audience (Hoftijzer 2009; Kuznetsov et al. 2010). An emerging body of tools allows enthusiasts to collaboratively brainstorm and troubleshoot their work, often in real-time (Franke et al. 2006). This accessibility of information, wider than before, is attracting individuals who are curious, passionate and/or heavily involved in DIY work. Thousands of DIY communities exist today, varying in size, organization and project structure (Leadbeater 2008). Some allow members to contribute asynchronously on a variety of topics, while others focus on specific projects, some revolve around smaller in-person gatherings, some enable hobbyists to trade or sell their projects, and decentralization has enabled large communities to form around the transfer of DIY. Conventions and Maker Faires also provide opportunities to meet other makers, show off projects, and exchange information on ways of making.

The entity of the Maker movement led to an increasing interest both from the academy and practitioners (Anderson 2012; Buxmann et al. 2013). One of the open issues is represented by the study of the skills characterizing a maker, and which among those skills can enable her to achieve superior performances. To this aim, the research on DIY can provide only a limited support. Besides the skills related to the manipulation of physical objects, it is necessary to take into account the specific competences related to the use of hardware and software tools and the characteristics of the environment in which such competences are developed, applied, shared.

### 3.1.2 Digital Do It Yourself

DiDIY, among all its impacts and changes brought at both societal and organizational levels, is reshaping work and organizations due to the interactions between DiDIY-ers (and their aggregations) and their environment (Grover et al. 2012). The spread of DiDIY mindset and DiDIY activities among individuals acts as a strength influencing the evolution of the socio/economic/technological environments, together with other global phenomena, such as technological progress, globalization, migration (McKinsey 2015). By exploiting these trends (digital technologies and the knowledge sharing) within certain community, activities previously carried out by experts are now carried out by DiDIYers therefore asking for a reshaping of certain organizational roles (or, at a higher level of aggregation: certain organizational units, certain enterprises), workplace processes and structures.

In order to understand which are the skills characterizing DiDIYers we believe it is necessary to draw insights from the Maker movement, that shares some fundamental elements with DiDIY. One of them is participation in a community, where we have to take into consideration its main drivers: values (Dewey 1929), beliefs (Elby et al. 2001), and dispositions (Perkins et al. 2000). These drivers help in shaping the maker mindset: playful, asset- and growth-oriented, failure positive, and collaborative (Martin 2015; Peppler 2013). As investigated by Dougherty (2013) it is “experimental play” that have fostered the rise of new digital tools, an easier access to components and growth of online communities eventually culminated with the explosion of the Maker movement (Martin, 2015). Playful activities along with fun are at the hearth of makers’ activities that group and work together for “their pleasure in making and using their own inventions” (Gershenfeld 2005). Persistence in the challenge of making (Vansteenkiste et al. 2004) as long as environmental conditions such as a playful learning environment encourage experimentation and create the basic



conditions for the development of conceptual knowledge and adaptive expertise (Hatano et al. 1986). Another important element emerging from seminal papers is the freeness of makers to focus on doing the task or job they want. They can strengthen their expertise background as long as focusing on something new to learn. Within the Maker movement the crucial topic is that, they focus on skills rather than abilities. As reported by Martin (2015), “making advocates a growth mindset, where, given effort and resources, anyone can learn the skills needed to complete any project they can imagine”.

Learning environments that advocate a growth mindset encourage persistence, challenge seeking, and learning (Dweck 2000). Making environments typically give youth substantial say in what and how they make. Learning environments that support youth autonomy and control of their endeavours are more motivating, support engagement and persistence, identity development, and the growth of resourcefulness” (Azevedo 2011; Ryan et al. 2000). What is remarkable within the maker community is that free-choice nature of making, emphasize assets and the ability to learn over deficits—an orientation sometimes missing in school settings (Gutierrez et al. 2003). Therefore, makers do not experience failures of making as demoralizing (Soep 2014) but they understand that overcoming small obstacles is equally important. Petrich et al. (2013) state that “the process of becoming stuck and then unstuck is the heart of tinkering”, and they find that such moments are often among the most salient in participants’ post-activity interviews. Sharing ideas, project, helping others, making and connecting characterize makers under the collaboration perspective. This mindset is probably the most important element when talking about makers and is shown both in online and in offline communities where makers group and collaborate to show their work (Kuznetsov et al. 2010).

### 3.1.3 DiDIY within Information Systems

A recent stream of research arising within the Information System domain deals with new business roles reshaped by the rise of new DIY technologies. In D3.2 we reported the detailed results of the literature review in the IS field. In synthesis, research in this field follows two streams, reflecting the twofold nature of the DiDIY concept. A first stream focuses on the new requirements in terms of competence profiles of the individuals, the other deals with the transformation in the manufacturing processes under the general umbrella term “digitization”.

From the literature review carried out the following research questions, and related sub-questions, are arising:

1. How will the work of a worker in a manufacturing firm be reshaped due to the influence of DiDIY (Morris et al. 2010)?
  - a) How will the work of a worker in a manufacturing firm change in relation with the evolution of other organizational roles in her firm (Zhang et al., 2013)?
2. How can makers’ characteristics (both personal and environmental) be translated into an organizational context (Martin 2015; Peppler 2013)?
3. How do these characteristics favour a positive result?
  - a) Do digital technologies favour DiDIYers (such as empowering people)? If so, in which situations? If not is technology used for tasks automation only?

A possible interesting scenario in the context of production processes could be drawn if we shifted away from the traditional view of process automation, where the inclusion of hardware and/or





software is considered just as a way to get productivity gains. This technology-centric view sees the process – and the tools supporting it – as the subject of the study.

Focusing on observing the changing role of technology (according to the classical models and theories of technology adoption), leads to see the increase of process efficiency – guaranteed by the superior performances of machines substituting people – as the inevitable and unique consequence of the process automation. On the contrary, and coherently with the human-centric view of this Project, we foresee that we could observe different potential implications focusing on the *modus operandi* of those who work within that process.

The study of the evolution of the organizational role of the worker allows to consider an alternative scenario, in which the worker takes advantage of technology to reduce the time spent on repetitive tasks, thereby achieving two orders of results:

- *direct* results, on the governance of the process and on its effectiveness. The worker can devote more time to ensure that the process to which she contributes produces the expected results. This change could be enabled by (partially) transferring to the worker the responsibility for programming and control activities, previously held by an organizational role of a higher hierarchical level;
- *indirect* results, on the redesign of the process. The worker could shift her attention from the execution according to predefined (and undebatable) methods and tools into the study of how the resources available for the process could be improved. And such a study could be facilitated just by the direct knowledge of the worker about the process.

### **3.2 Research design**

The literature review aimed at highlighting which are the relevant elements that characterize a maker in terms of her/his skills, activities, technologies and knowledge sharing mechanisms. This approach has been carried out with the aim to transpose it to traditional organizational settings and link it to the phenomenon of DiDIY that has been described within the previous section. An important difference between makers' aggregations and DiDIYers within organizations is the freedom of makers to act independently from the governance (formal or informal) of a traditional organizational setting. Moreover, any organization has specific mechanism of incentives and rewards for its workers and this can drive their motivation to perform better. Eventually, we believe that makers connect on a voluntary basis and are driven by grassroots passion to build and innovate using digital technologies. On the opposite, DiDIY-ers in organization are using digital technologies, introduced by the top management as an outcome of an overall firm strategy, to perform better, where performance can be evaluated through different dimension such as financial, operational as long as organizational improvements.

The job transformation, as well as the transformation of business processes, deriving from the introduction of digital technologies is at the core of the DiDIY phenomenon. We believe that makers (and therefore, by extension, DiDIYers) can be described among two main dimensions: personal characteristics and environmental characteristics. Autonomy and job attitude of the makers have to be adapted within the organization to favour a playful context similar to what happens inside offline makers' environments (e.g., makerspaces) where people can meet and learn one from the other. The playful context is surely relevant as a characterizing property of makers' aggregations and we believe that it can be replicated within an organization as a way to make workers participate more proactively to the processes.



These two dimensions (personal and environmental) create a framework that aims at defining DiDIYers and organizations DiDIY-friendly, or DiDIY-compliant. The framework of the DiDIYer’s personal/environmental characteristics was described in detail in D3.2. We attach it in Annex 1, and simply list these characteristics in the following table.

<b>Personal characteristics</b>	<b>Environmental characteristics</b>
<ul style="list-style-type: none"> <li>• Job attitude;</li> <li>• Autonomy;</li> <li>• Failure positive;</li> <li>• Multidisciplinary;</li> <li>• Playfulness;</li> <li>• Anti-consumerism behavior;</li> <li>• Computational thinking.</li> </ul>	<ul style="list-style-type: none"> <li>• Quality and availability of tools;</li> <li>• Connected facilities;</li> <li>• Gamification;</li> <li>• Openness;</li> <li>• Learning as social interaction.</li> </ul>

Table 1 - DiDIYer’s personal/environmental characteristics.

### 3.3 Research method

The research method followed in this RT1 has been detailed in D3.2. Here we can limit to highlight the explorative nature of the study, that drove the selection of the case study method, that we applied to 4 manufacturing firms located in Northern Italy, described below.

	<b>FIRM 1</b>	<b>FIRM 2</b>	<b>FIRM 3</b>	<b>FIRM 4</b>
<b>#industry</b>	Mechanical	Mechanical	Thermo-electro mechanic	Textile
<b>#employees</b>	140	180	240	91
<b>#turnover ('15)</b>	60-70 Mln. €	60-70 Mln. €	34 Mln. €	14 Mln. €
<b>Age of interviewee</b>	n.a.	45	36	33
<b>Business Unit of Interviewee</b>	ICT and R&D	After Sales	After Sales	Production

Table 2 – Overview of the firms.

#### Firm 1

Firm 1 is an important Italian player working in the mechanical industry and producing professional and industrial coffee machines used in a large number of bars, restaurants and hotels. Today, Firm 1 has 140 employees and a turnover of 65 Mln. € in 2015. It provides its customers with technologically advanced products thus making it one of the most appreciated firms in the market. In the last years Firm 1 started to invest more and more in R&D to develop new innovative products and to offer better solutions and services to its customers and employees: e.g. use of electronic documents for a better flow of information; a new automatic warehouse to increase the efficiency of the process and to decrease loss of time and a new automatic trial process to save time.

#### Firm 2

Firm 2 is a company, operating in mechanical sector, that designs and produces machines and plants for textile and plastic industries. Founded in 1885 now it counts 180 employees and has an average turnover of 60/70 Mln €. It provides customers with high quality products and services thanks to the



large investment in R&D in the past years. Up today, in order to improve its offers to customers, Firm 2 has implemented a new innovative service, (i.e., tele-service), that allows remote access to machines with the aim to perform real-time check of parts thus being able to search and solve problems faster than before. In that way, Firm 2 can increase its reputation with customers and, at the same time, gain higher autonomy from its suppliers.

### **Firm 3**

Founded in 1911, Firm 3 is an important Italian firm working in the thermo-electro mechanic industry. Its main business is the furniture of services for protective and aesthetic treatment for all kind of supports and industrial plants. Today, Firm 3 counts 240 employees with an average turnover of 34 Mln. In 2015. The firm claims to “use the newest technologies to offer the best services to its customers and to achieve better results”. Recently, Firm 3 has introduced a new software that allows the location of all machines they have and an immediate access to all information needed.

### **Firm 4**

Firm 4 has been founded in 1969 and it is a third party supplier of cotton fibres that are processed with rotary and flat machines. Its mission is to be a vibrant competitor offering the highest standards of quality at low cost. The firm is proud of giving attention to the most recent production technologies and management control systems that are therefore introduced in its plant with the aim to add innovative material handling techniques. Technological innovations are supported by a fully integrated software that manages the production progress and allows workers to access the full information flow in the process and improving, at the same time, the process of training.

## ***3.4 Main results: Emerging profiles***

In this study we investigated the impact of digital technologies on the activities carried out by a worker in such a way that his/her role will be critically reshaped. The focus is on analysing whether and how the characteristics of makers, and the ones of the environment in which they operate, can contribute to organizational change.

Details of the result of the study have been already published in D3.2. Here we want to point out that the interviewees agreed – although with different emphasis – on the relevance of the personal and environmental characteristics presented above. However, In none of the firms we studied we found personal/environmental context showing all the characteristics of the DiDIYer’s personal/environmental profile framework.

Rather than a complete correspondence to that framework, the research allowed to identify three profiles of workers.

The first profile is the worker from Firm 2. He is closer to a supervisor than to a worker. With the new technology this is truer and more valid than before. He increases his autonomy, having more decisional power, and flexibility because he can focus on the aspects of his activities he likes more. He contributes to achieve better results for all the company. All this is sustained by a pleasant work environment in which collaboration and sharing are key points of organization’s culture.

A similar profile, but not equal, is the one of the worker from Firm 4. He is more close to a supervisor too, but differently from the previous type, he is less free. He has some decisional power but he is still stuck in the rigid organizational structure in place with the aim to avoid mistakes and problems. The environmental context is different too: in Firm 4 there is less collaboration and



sharing than in Firm 2. That is due to a different work organization: in Firm 4 people work in shifts and it is difficult to find and create moments for sharing knowledge. Nevertheless, a less collaborative context, the company organizes and manages contests in which each worker can propose an idea to improve efficiency and efficacy of the process.

Last profile is the worker from Firm 3, where there is a really different situation than the two before. Here there is not any increase of freedom, the new software does not allow the worker to have more autonomy or to focus on the activities he likes more. He only has limited decisional power on the activities necessary to repair something, but for all the rest he still completely depends from his superior. The new software only impact on the speed of the process. Eventually even in this firm there is a collaborative environmental context but no real cases were provided from the interviewee.



## 4. Research Topic 2: Managers

The purpose of this Research Topic is to explore the phenomenon of the digital transformation and the impacts of it on the organization and the strategy of companies. In particular, this study aims to investigate DiDIY and managerial roles, and the impact of digital transformation on managers with particular attention to the CIO and CDO. The rapid growth and the speed of diffusion of the new digital technologies are having a disruptive impact not only on the business but also on the society. Firms have started to incorporate those technologies into their business to improve processes and products, giving rise to new opportunities and challenges, and bringing on new ways of working, communicating and interacting with customers. According to MIT Sloan Management Review and Capgemini Consulting this world is going through a kind of digital transformation as everything – customers and equipment alike – become connected (MIT Sloan Management Review 2013).

What is important to understand is that *digital transformation* is a phenomenon that goes beyond the idea of IT innovation as a tool to merely automate the processes inside the organization, rather, “digital is how technology can transform the business” (EY 2014a). More generally, we can say that digital transformation is about the adoption, by an organization, of a set of technologies which consequently fit and change its pre-existing structure (Berman 2012).

Gartner asserts that this is the “third era of enterprises” and it means that the growing amount of digital technology and information, as well as the process innovation, should trigger a shift to a highly integrated and innovative collaboration between business and IT, rather than considering IT as business within a business (Gartner 2014c). Therefore it is important to make a distinction between IT-enabled business innovation and general IT innovation in order to understand better how the innovation in IT can lead to organizational capabilities and competitive advantages (Lucas et al. 2007). The main difference lies in the fact that IT-enabled business innovation gives rise to changes in process, product and services by introducing new information systems that inevitably require new expertises and activities, and the development of new institutions to transform the existing ones (Wang, Swanson 2007). IT innovation, instead, refers to the “innovation in the organizational application of digital computer and communication technologies” (Swanson 1994; Fichman 2004).

Another important aspect that should be considered is the different types of organizations. Some of them, called “Born Digital”, like Facebook, Google, and Twitter, have already incorporated the new technologies. This allows them to have a stream of innovation triggered by the IT that enables new opportunities of cost saving and revenue (EY 2014a). Conversely, all other organizations inevitably need to adapt themselves to these new trends if they want to remain competitive, not to weaken their market position and to have a place in the ecosystem. In doing this, they need a digital transformation that would embrace all the aspects of the organization, like the organizational structure and culture, the business structure and operative models, the infrastructures and processes, the new forms of interacting with customers, partners, employees, etc, and of course the technology that should support the entire change process. It goes without saying that the silos structure is no more adequate in this context where all functions, processes and systems should be strongly connected and integrated with one another.

Digital innovation is therefore something that all companies across all industries inevitably will face, soon or later, in different manners, if they want to stay in the market and to preserve their competitive position.



The choice of the leader who is going to drive digital transformation in organizations is a crucial step. Due to the technological nature of such a transformation the responsible of this process is expected to be the Chief Information Officer (CIO), and in some cases it is the CIO who really leads the process. Sometimes is the CEO, and in some cases it is the new born figure of the Chief Digital Officer (CDO), who is charged from ever many companies in different fields to carried out the Digital Transformation of the company where he is hired.

## **4.1 Background and literature review**

### **4.1.1 The innovation process and the digital transformation**

The innovation process in organizations is complex and it involves the implication of people that could be supporter or opponents, each of whom play a role in the innovation decision process (Oliveira, Martins 2011). Rogers (1995) elaborated the *Diffusion of Innovation* theory with the aim to explain the spread of innovation at an operating and firm level. In his theory he argues that innovativeness is based on three independent variables that are:

- a) the individual characteristics of the leader in managing the change process;
- b) the internal characteristics of organizational structure, i.e., *centralization*, “the degree to which power and control [...] are concentrated in the hands of a relatively few individuals”; *complexity*, “the degree to which organization’s members possess a relatively high level of knowledge and expertise”; *formalization*, “the degree to which an organization emphasizes its members’ following rules and procedures”; *interconnectedness*, “the degree to which the units in a social system are linked by interpersonal networks”; *organizational slack*, “the degree to which uncommitted resources are available to an organization”; *size*, “the number of employees of the organization”;
- c) the external characteristics that is the degree of openness of the systems.

The MIT Center for Digital Business and Capgemini consulting have developed a useful framework to help the organizations to face the digital transformation; in their research they have identified three main elements that are being implemented in the companies: customer experience, operational processes, and business models (MIT Center for Digital Business and Capgemini Consulting 2011).

As far as the customer experience is concerned, organizations should be able to combine digital technologies with information and business resources in order to have a clear “customer understanding” and transform the customer experience (Cognizant 2014).

Social media and Digital media allow identifying customers’ preferences; using CRM and other analytics tools it is easy to predict and influence the consumers’ behaviour.

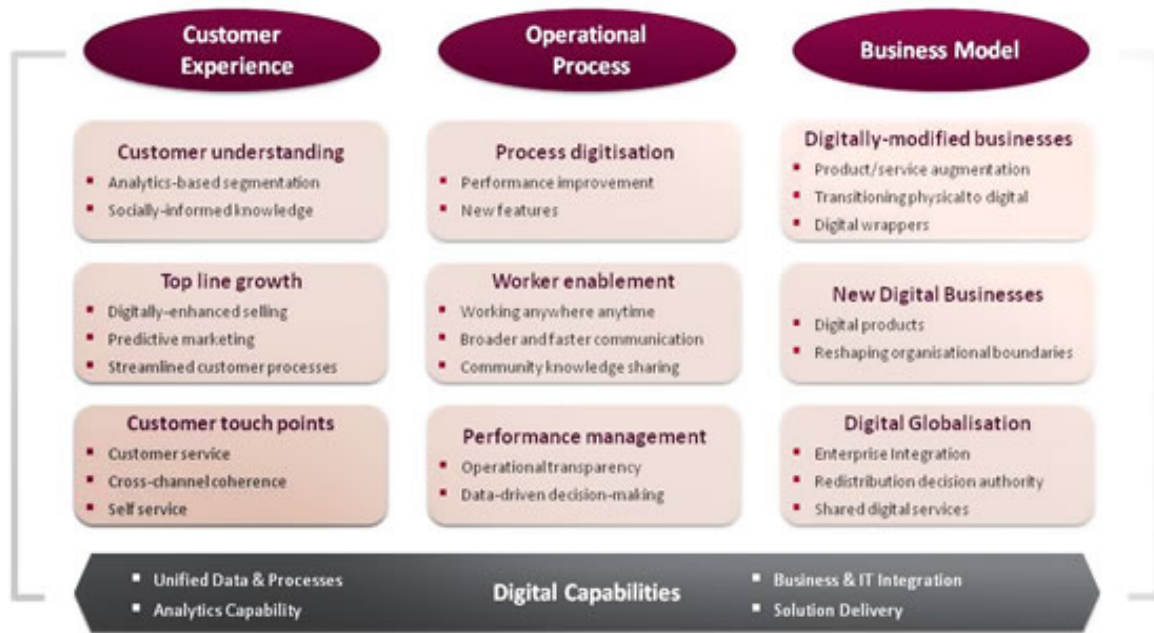


Figure 2 – Digital transformation framework (source: Westerman et al. 2011).

New information technologies enable the “digitally-enhanced selling”, where technology has been used to make the sale more endearing and effective both for customers and sales people. The third step concerns the use of a digital plug-in in order to simplify the shopping process. The retailer loads the customer’s latest online shopping list into its e-commerce site, while customers can look at other products.

The second value pillar involves the operational process: “by automating, standardizing and globally sourcing processes, organizations can become more agile, more responsive to changes in demand, and better able to increase and sustain profitability” (Corver, Elkhuizen 2014). The individual-level work has been virtualised and as a consequence the tools that virtualise individual work, while implemented for cost reasons, have become powerful enablers for knowledge sharing (MIT Sloan management review 2014).

Digital transformation impacted also the performance management changing the process of strategic decision-making. Executives have a deeper knowledge of products, regions and customers so that decision can be taken based on real data, rather than on assumption.

The third building block of the digital transformation is the transformation of the business models. Digitization is not about changing the way of using technology, but changing the way of doing business. Companies aim at implementing physical with digital offerings and at using digital to share content across organizational silos. They are developing digital products that increase traditional products and are reshaping their boundaries through the digitalization. Through digital technologies and integrated information, companies are going global while remaining locally responsive (MIT Center for Digital Business and Capgemini Consulting 2011).

Together, the three building blocks form a unique block called “digital capabilities” that are considered the foundation for a successful digital transformation. Digital capabilities should be viewed in a holistic manner, not just from an IT point of view. Any kind of change in one entity would have repercussions in the whole model. Many components are embodied in such capabilities,



like the ability to unify data and processes, analytics capabilities, the goodness of fit of the alignment between business and IT and how well an organization deliver new solutions to rising needs. Hence, it is crucial to forget the idea to think about the value pillars as three different and separate concepts, as in the silos organization, and to approach a holistic view during the decision-making process.

#### 4.1.2 Digital transformation and strategy

During the last decade there has been a rise looming of new functionalities due to the improvements in information, communication, and connection technologies (Bharadwaj et al. 2013) that are deeply reshaping traditional business strategy as modular, distributed, cross functional, and global business processes that enable work to be carried out across boundaries of time, distance, and function (e.g., Banker et al. 2006; Ettl, Pavlou 2006; Kohli, Grover 2008; Rai et al. 2012; Sambamurthy et al. 2003; Straub, Watson 2001; Subramaniam, Venkatraman 2001; Tanriverdi, Venkatraman 2005; Wheeler 2002). Therefore, the understanding of the main features of digital innovation is a key challenge for any organization that wants to manage the digital innovation (Yoo et al. 2010).

Considering the increasing digitalization of business products, services and processes, the focus of this section is on the impact of the digital transformation on business strategy and on the analysis of what the literature and academics call “digital business strategy”.

According to the traditional view, the concept of digital business strategy should not be confused with that of IT Strategy; if the latter refers mainly to the role that IT should play in the firm and it can be positioned as a functional-level strategy, the former is more than a cross-functional strategy and it goes beyond the traditional functional area (Bharadwaj et al. 2010). Digital business strategy is based on rich information exchanges inside and outside the firm’s boundaries, enabled by digital platforms that make multifunctional strategies and processes strictly interconnected with the support of the firm’s IT capabilities (e.g., Rai et al. 2012). However, it should be treated as a business strategy to foster the digital transformation even if until now business strategy has directed IT strategy despite calls for understanding the importance of IT strategy shaping business strategy and transforming business processes and business scope (Venkatraman 1994).

In contrast with this theory according to which IT is a “functional level strategy that must be aligned with the firm’s business strategy” (Bharadwaj et al. 2010, p. 1), S. Mithas, A. Tafti, and W. Mitchell proposed another and different vision of IT as crucial for the development of the overall business strategy that is a fusion of IT and business strategy (Mitchell 2013). In keeping with this assumption, to gain competitive advantage there should be a dynamic synchronization between business and IT (Mithas 2012; Mithas et al. 2012a; Mithas, Lucas 2010; Prahala, Krishnan, 2002); a particular business strategy will require a particular IT strategy in order to achieve the expected performance (Sabherwal, Chan, 2001; Yayl, Hu, 2014). For example, when companies decide for a differentiation strategy, they will adopt new and emerging technologies that allow to face the changing market and to detect new opportunities and emerging markets. Firms using cost leadership strategy, conversely, would be more focused on implementing technologies in order to achieve the operational efficiency in business processes (Yayl, Hu 2014).

What we can get from these two theories is that although there is a divergence about the concept of digital business strategy, there is a common view about the main purpose of its implementation: the competitive advantage and the profitable interaction with the business ecosystem.





The relation between business strategy and IT strategy is therefore an area of concern and, as confirmed by several studies, organizations that reach the digital maturity (successful alignment between business strategy and IT strategy) outperform their non-aligned peers (e.g., Chan et al. 1997; Irani 2002; Kearns, Lederer 2004). A research conducted by MIT Sloan management review and Deloitte (2015), through an annual survey of more than 4800 business executives in 29 countries and 27 industries and organizations of various size, shows the main differences between maturing digital business, where the focus is on the integration of digital technologies in order to transform the business, and the less mature digital business that uses individual technologies for solving discrete business problems. One of the main findings of the survey is that strategy, not technology, drives digital maturity; the lack of digital strategy, indeed, is the biggest barrier to digital maturity, and an effective communication of it is equally important. Early-stage companies often fall into the trap of focusing on technology over strategy, and to avoid this the solution is to focus on technology as a means to strategically potent ends (Carr 2003).

Several studies have been conducted in order to identify the key elements for assessing alignment maturity. J. Luftman developed a model indicating IT-business alignment maturity based on six components: communication, value measurement, governance, partnership, scope and architecture, and skills.

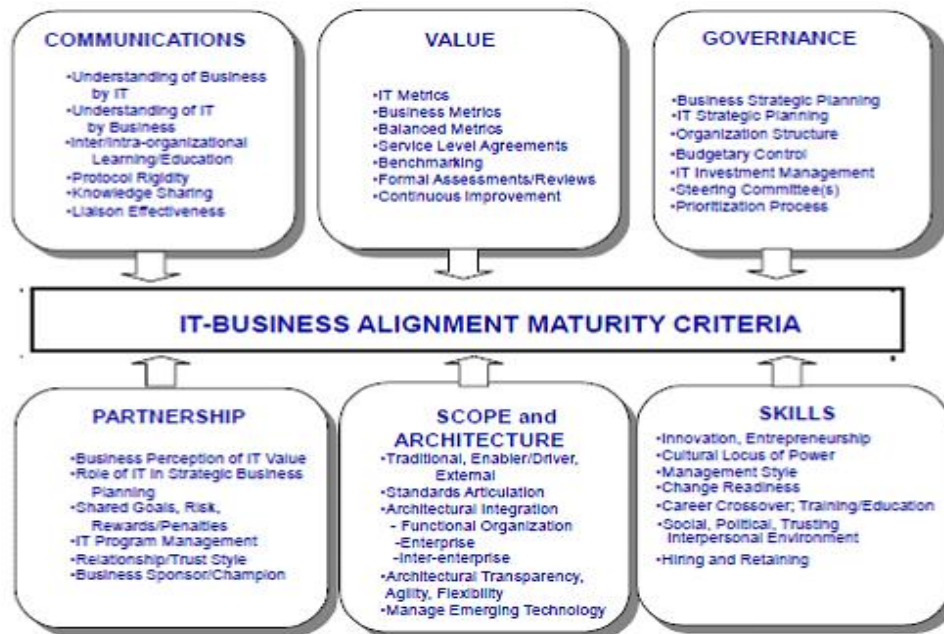


Figure 3 – IT-Business alignment maturity criteria (Luftman 2007).

These six components are then compared to a maturity model consisting of five levels of alignment maturity: initial/ad-hoc processes, committed processes, established, focused processes, improved, managed processes, optimized processes.

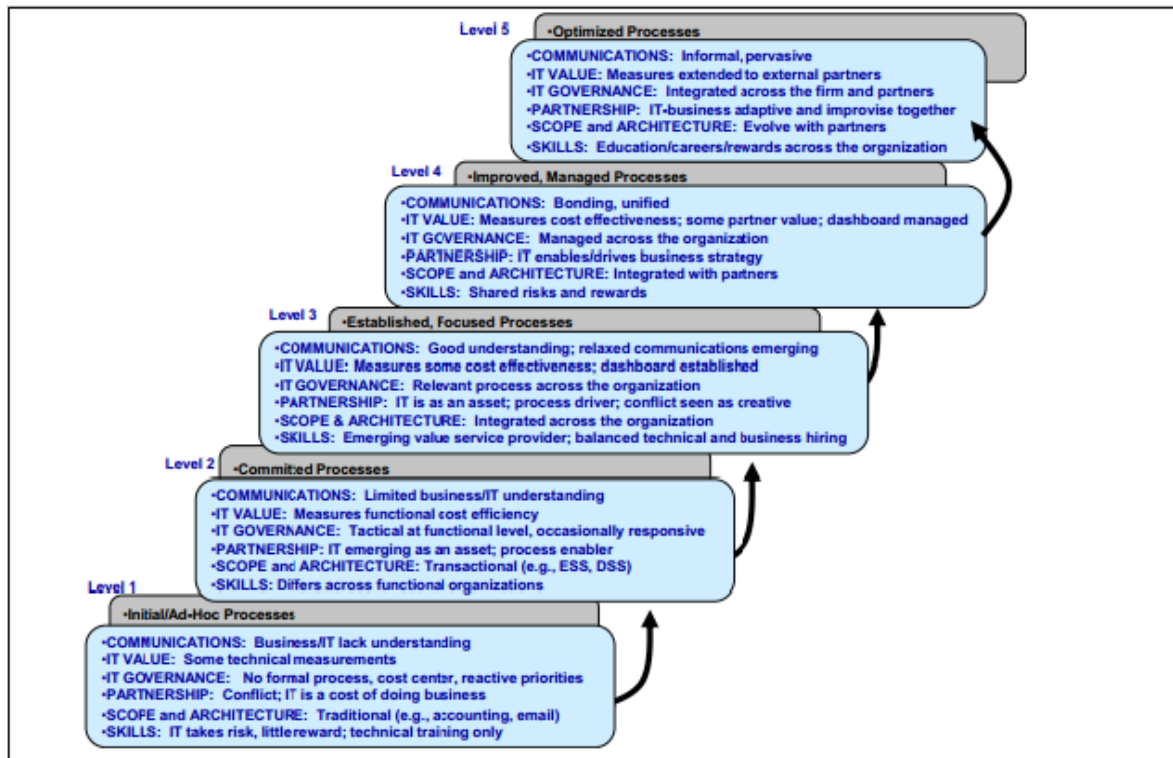


Figure 4 – Strategic alignment maturity summary (Luftman 2007).

However, what results is that a mature alignment between business and IT can happen only with the balanced development of all six building blocks (Luftman 2007). So this model allows us to have an overview of the six main components of the alignment and a clearer understanding of the characteristics of the five level of maturity, but it does not provide indications of how to move from one maturity level to the higher one.

One of the crucial debates the literature deals with is how firms can exploit digital systems to differentiate their business processes, products, and services from the competitors. Organizations are continuously adapting to changes in the environment (Silvius 2009b).

In this regard S. Mithas, A. Tafti, and W. Mitchell (2013) studied how the competitive environment affects the way that digital posture (a firm’s level of activity in a given strategic dimension relative to industry average) influences firms’ digital business strategy. They identified two measures for the digital business strategy, general IT investments and IT outsourcing investment, considered relevant because differing levels of these investments can significantly expand or constrain a firm’s strategic choice sets (Mithas et al. 2013).

The first result highlights the convergent effect, i.e., firms converge towards the industry norms of strategic posture for general IT investments while there is a divergent effect for IT outsourcing investment at the mean value of industry factors. To figure out the second result they first identify three focal industry factors that affect the convergence and divergence with respect to digital strategies, that are: industry turbulence, industry concentration, and industry growth. According to the findings, greater industry turbulence increases the degree to which general strategic posture has a divergent impact on general IT investment, but has little or no moderating influence on outsourcing investment; greater industry concentration has a weakly convergent effect on



outsourcing strategic posture, but does not moderate the effect of general IT strategic posture; greater industry growth generates a convergent moderating effect in both forms of strategic posture, likely because firms are less inclined to diverge in their digital strategies when demand is growing rapidly (Mithas et al. 2013).

So, after having explored the literature arguments about the digital business strategy, the objective of the study of this RT is to understand how the people in the industry define this concept, if companies have a real strategy to handle the digital transformation and how they are managing it.

#### 4.1.3 Digital transformation and organization

The advent of the new digital technologies is reshaping the industry environment, and organizations increasingly perceive the need to “go digital”. As mentioned above, digital transformation is not simply about the latest technology’s implementation, but it concerns a fundamental change to all aspects of an organization.

The starting point is the strategic vision of IT, since it outlines the role that IT should play in an organization. The table below summarizes 10 different typologies of organizational views and assumption detected by the previous literature.

Organisational views and assumptions about the role of IT	References
Support; Factory; Strategic; and Turnaround	McFarlan et al. 1983
Exploiter/innovator; Competitor/early adopter; and Participant/ effective or efficient follower	Cash et al. 1988
Automate; and Informate	Zuboff 1985
Automate; Informate-down; Informate-up; and Transform	Schein 1989, 1992
Automate; Informate; and Transform	Venkataraman 1991
Build things; Help people; and Change things	Dahlbom et al. 1997
Support tool; Critical resource; Means of transformation; and Unclear	Earl 1996
Utilitarian; Strategic	Weill and Broadbent 1998
Necessary Evil; Support not a partner; IT rules!; Business can do IT better; and Equal partner	Kaarst-Brown 2005
Technical resource; Business enabler; and Strategic weapon	Weiss et al. 2006
IT Doesn’t matter; IT Pushes the business; Business Pushes IT; and IT Does matter	Marchand 2007

Table 3 – Literature summary. Main IT role typologies (Al-Taie et al. 2013).

The most widely used strategic IT vision typology (Schein 1989, 1992) has been adopted by several researchers (e.g., Armstrong, Sambamurthy 1999; Bassellier, Reich, Benbasat 2001; Feeny et al. 1992; Hallikainen et al. 2006; Sherer 2004; Smaltz 2000; Smaltz et al. 2006; Smaltz 1999; Tripp 2008) and classifies the IT vision into 4 different views: automate, informate-down, informate-up, and transform.

The purpose of the *automate* view is the cost displacement and the efficiency through automation, hence the IT should be able to replace the expensive, unreliable human labour or improve its productivity and quality. In the *informate-down* perspective the IT is used to empower the employees’ performance providing data and transaction that yield a complete picture at “operator” level and the staff’s members can gain greater insights into their own. The *informate-up* view aims



at increasing the managerial control of the organization. So the role of the IT is to provide data and transaction that enable management to have clearer and organized view of the organization. The *transform* view implies radical change in some aspect of the business. The IT should create new products and services that involve the redefinition of relationships with the organization's customer and/or suppliers. Despite this, several studies show that most companies are unable to obtain clear business benefits from new digital technologies because they lack both in management temperament and relevant experience to know how to effectively drive transformation through digital technologies. The enterprises that want to prosper in this new era need to learn how to manage a complex ongoing interplay of value creation, organizational learning, and business transformation on a global scale (Montreuil, Vallerand, Poulin 1996).

There are many factors impeding the digital transformation, the most important of which, according with the literature are the lack of vision, the alignment between IT and Business, cultural issues etc. In a study published on MIS Quarterly Executive, 2013, L. Kappelman et al. identified the main IT management concerns. This study is based on the SIM (Society for Information Management) surveys began in 1980. Since the beginning of the research study, aligning IT with the business has been the top ten concerns. The reason lies in the incessant changes of organizations, economies, markets and technologies that make the alignment a continuous process. The consequences of a weak alignment may be the reduction in the business value of IT, a decrease in the effectiveness of the CIOs and problems in the relationship between the CIO and the CEO (Al-Taie, Lane, Cater-Steel 2013).

The second IT management concern, since 2009, is business agility. This might be due to the economic crisis that entailed a great business uncertainty and a growing speed of change that called for a more flexible and responsive to market's organizations. Business agility imply also IT agility, i.e., technological infrastructure that can be quickly and economically changed.

At the third place of the IT management concern there is business productivity, that brings to the light the inability of organization to "do more with less". In the same way also M. Fitzgerald et al. investigated about the main impediment that companies face to achieve the digital transformation. They highlighted 9 obstacles grouped into three broad areas that are leadership, institutional obstacles, and execution. In the first area of leadership, the authors recognized the biggest barrier as the lack of urgency in achieving the digital transformation caused by leaders that don't let managers understand its importance. Another heavy impediment lies in the absence of a shared common vision across the organization, and in this regard G. Westerman asserts that the biggest difference between companies that are just doing technology initiatives and companies that are leading a technology-based transformation is the way they are putting the leadership framework in place. The third impediment is the lack of a roadmap towards the digitization.

As for the institutional challenge, at the first place there is the attitude of older workers that in most of the cases do not want to deal with technological changes. M. Fitzgerald et al. affirm that old executives and managers should understand that their age can undermine confidence in their ability and interest in leading the digital transformation. The second concern is about legacy technology, one of the main issues for the digital transformation because of complications arising from older systems that sometimes inhibit the updates. The last two barriers consist in the innovation fatigue for people of any age and the last obstacle and in politics, meant as internal power centres that in many cases impede any type of changes that can undermine their power.



From the execution side, the researchers detected two impediments: the first is that only half of the companies surveyed use business cases to undertake business initiative and established key performance indicators to measure the benefits of their digital transition. The second is the use of incentives to empower employees in the digital transformation process; only 38%, among the beginners, use incentives, compared to 68% of the digital-mature companies (MIT Sloan Management Review 2013).

The figure of reference as regards the role of IT into the companies, its strategic implementation and how it can be leveraged for the competitive advantage is the Chief Information Officer. As IT is becoming a fundamental element for the business success and it is increasingly embedded in products, services and processes, the CIO role is evolving and it is gaining a particular attention. Managerial roles for the digital transformation able to bring benefits to organizations should manage some main steps towards the transformation (Andriole 2015):

**Model and Simulate.** The first step to begin a “Digital Transformation” project should be that of using proper tools, such as for example Business Process Modeling (BPM). The next step should be to simulate transformation hypothesis to grasp which scenario will have a major impact on the firm performance. Projecting and analysing data in this phase is very important and consultants such as Subject Matter Experts (SME) may help obtain unbiased final data.

**Identify High-Leverage Opportunities.** In this phase it is necessary to detect the main processes, inside the organization, characterized by a minor contribution to the added value of the firm. In this step it is fundamental to collect data and understand the contributions and costs related to each of these processes, by simulation of the “what if” kind, if necessary. A final list of processes ranked in order of importance for the Digital transformation is the outcome of this step.

**Prioritize Transformational Targets.** Once the main digital transformation goals are fixed, it is necessary to prioritize such targets: from the time devoted, to the costs and benefits, to other factors, and to control their proper execution.

**Identify Digital Opportunities.** In this phase is fundamental to detect the technologies allowing the organization to reach their fixed goals. The technological understanding and the what-if analysis on their exploitation are the main steps of this phase. The outcome of this phase is a list of the technologies that should be developed to reach the predefined goals.

**Find Courageous Leaders.** The search of leaders able to support the digital transformation is the final phase of this methodology. A business case should be presented to the leader responsible for the project that will initiate the change process. At this point the next phase can become the first one (i.e., Model and Simulate) as this process cannot be carried out once and for all but is an ongoing process.

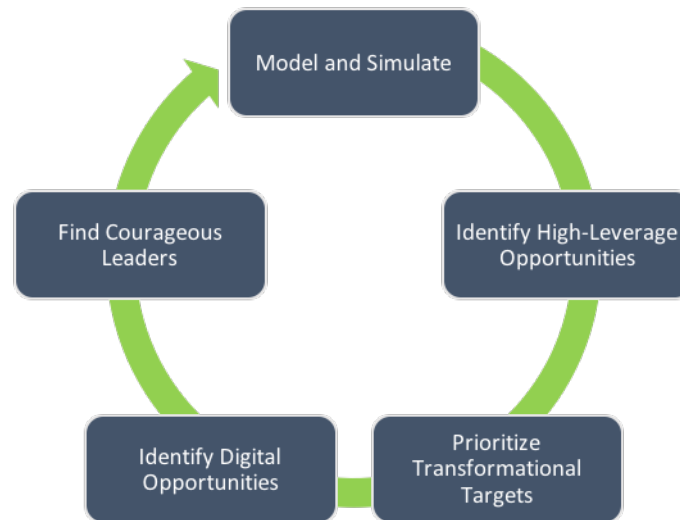


Figure 5 – The digital transformation process.

#### 4.1.4 The strategic role of CIO in digital transformation

##### CIO role overview

Since the IT has become a strategic resource for business and it is increasingly ubiquitous and seen as an integral part of ongoing business success, the role of the Chief Information Officer (CIO) has gained much attention from researchers and practitioners.

Although the literature has dealt extensively with this topic, it has not yet agreed to have an unambiguous and clear definition of the CIO role so that it is a confused role in the C-suite. The CIO concept was born during the 1980 when computer usage changed from pure accounting to more creative work; information was recognized as a critical resource that required active management and oversight from a senior management perspective. It was defined as “senior executive responsible for establishing corporate information policy and management control over information resources (Synott, Gruber 1981). The newly created position of CIO emphasized information over technology, enterprise over function and strategy over operations (Peppard et al. 2011). However, since the emergence of the CIO role in the early 1980s, many researchers have attempted to apply the roles developed for general managers to the position of CIO (Al-Taie et al. 2013).

As for the tasks of the CIO, in the literature can be found two main approaches. The first approach is derived from Mintzberg’s work (1980) on “Managerial Roles” which extracted ten roles common to all executive jobs regardless of their functional or hierarchical level. The following roles have been identified to be of specific importance for CIOs: Leader, Spokesman, Monitor, Liaison, Entrepreneur and Resource Allocator (Grover, Jeong, Kettinger, Lee 1993, Karlsen et al. 2002). M. Carter, V. Grover, and J. Bennet (2011) have further investigated the topic and they argued that the ability of CIOs to undertake strategic initiatives can be affected by their skills in the three traditional IT management roles described by V. Grover et al. (1993), i.e., Informational, Interpersonal, and Decisional. Spokesman and Monitor roles are included in the Informational role. One of the main issues about the CIO is his/her difficulty to communicate with the other CxOs using a business language. As a Spokesman, the CIO should communicate information or ideas to people outside the IS function and educate them on the strategic role of IT. Being a Monitor entails to get information



on organization and the external environment to be ready for changes in technology and competition.

Entrepreneur and Resource Allocator are part of Decisional role. Acting as an entrepreneur, the CIO should have the capacity to understand the business needs and to build up solutions that change business situations. Entrepreneur CIOs act as change agents. Resource Allocator CIO is responsible for allocation of human, financial, material and other resources including information.

The Interpersonal role comprises Liaison and Leader activities. Leader CIO is responsible for the internal management of the IS function; he should be able to motivate subordinates, to evaluate the quality of their performance, to solve conflicts and to direct the subordinates' work. Liaison is responsible for establishing personal network of external relationships.

The second approach suggested that companies can get more productivity from their IT by dividing IT into demand and supply organizations (Mark, Monnoyer 2004; Gens et al. 2004; Gomolski 2000; Barnett 2004).

The supply side is concerned with satisfying the business processes through the sourcing and deployment of IT. Here, the main aim is to increase the operational efficiency and the CIO should aim at providing new IT resources, integrating, servicing and running them. The demand side focus on creating new business value through IT. In this case the CIO role is critical, since the value for the company derive from his job and his ability to respond faster to changing business needs through the development and integration of IT, and to use IT to monitor business performance facing the changing market environment.

A further model for the identification of CIO's tasks was developed by Kitzis and Broadbent (2003), in collaboration with Gartner, which integrates the two approaches described above. They assigned the six primary CIO tasks, identified before, to either the supply and demand side. The roles Leader, Monitor and Entrepreneur have been assigned to the demand side, since they aim at delivering value for the organization; the roles Spokesman, Liaison and Resource Allocator have been assigned to the supply side considering that the primary task, in this case, is to support business processes or to enhance the efficiency of these processes, with IT.

Anyway, a research study conducted by M. Sojer, C. Schläger and C. Locher, and published in 2006 in the paper "The CIO- Hype, science and reality", showed some evident gaps between theory and reality about the CIO's tasks. Filling this gap the authors developed a new model based on the previous one (Kitzis, Broadbent 2003) using the McFarlan's grid and borrowing the nouns used to describe the respective roles from Polansky, Inuganti, and Wiggins (2003). How the other chief experience officers (CxOs) consider the IT inside the organization can affect the impact of the CIO. On one hand IT is seen as an administrative expense and a cost to be minimized, while on the other hand IT is considered as a significant and strategic opportunity (Peppard et al. 2011).

This approach involves to define the CIO role considering two dimensions: the strategic importance of running IT and the strategic importance of changing IT.

- In a company where both the dimensions are low, i.e. the current and the future role of IT systems has any significant impact, the IT director assumes the role of "Supporter" or Manager of Information System.
- When IT has a strategic relevance but it will not be improved in the future since it is not considered to have a significant impact, the IT director can be described as an "Enabler" or a Chief Technology Officer.



- In a company where the current IT is not considered strategically significant but the future IT is expected to have a high impact, the IT director can be a “Cost Cutter” or a “Project Manager”.
- If the strategic importance of both the current and the future role of IT is high, the IT director can be considered as a “Driver” within the company. In this context the CIO gives up the operative duties to deal with strategic long-term issues, and he finally can be considered a true “organizational architect” (Sauer, Willcoks 2002).

### **CIO’s personal skills and capabilities**

During the last decade IT has been increasingly gaining importance from the strategic point of view as a source of competitive advantage, hence, the role of CIO inside organizations is changing accordingly. CIO, indeed, is now responsible not only for providing the right technology and running the IT department, but he is progressively more involved in the strategic business decisions process (Grant, Urbanik 2012). One of the main goal of CIOs is to achieve the strategic IS alignment, defined as “the congruence between the business strategy, managed by the Top Management Team, and the IS strategy in the organization” (Handerson, Venkatraman 1999; Sabherwal 2001). Therefore, having a CIO involved in the C-suite allows companies to have a better alignment between technology and business strategy.

After having identified the different IT management roles, the potential factors that can affect the growth of the CIO role inside organizations and his credibility will be analysed.

Personal skills and characteristics have been considered to be influential on the ability of CIO to play strategic IT roles. The most mentioned personal skills, according to the literature, seem to be communication skills, building relationships, organizational development and ability to motivate people. H.G. Enns et al. deepened this topic through a research on the CIO influence behaviours, with a particular focus on the differences among CIOs resulting from their technical backgrounds. They adopted the influence behaviours and definitions elaborated by G. Yukl (1998): rational persuasion, consultation, ingratiation, personal appeals, exchange, coalition and pressure. However in the literature there is not a single theory on how technical background affects the choice and use of influence behaviours by CIOs.

According to Kipnis and Schmidt the influence behaviours can be classified into three main categories: “Soft” behaviours in which are included consultation, personal appeals and integration; “Hard” behaviours include pressure coalition and exchange; rational persuasion is treated as a separate category. The purpose of the investigation was to understand whether CIO with “greater” technical backgrounds differ from CIOs with “lesser” technical back grounds with respect to the influence behaviours they use when attempting to influence peer executives (H.G. Enns et al. 2002). This study is framed around the socialization theory (Schein 1988; Schmidt, Kipnis 1984; Segars, Grover 1998; Smith 1998; Van Maanen 1979) according to which CIOs with greater technical background do not have a successful influence on top executives. Technically oriented people are more focused on technical skills, tend to avoid non-technical issues and are not interested in social networking. The preliminary phase of the research was consistent with the socialization theory and the results confirmed that the more influential CIOs had significant employment background in non technical functions while the less influential had a predominantly technical background. Furthermore, CIOs with greater technical background seem to be unwilling to adopt “soft” behaviours such as consultation, personal appeal or ingratiation.





However in the second phase of the research, the entire hypotheses were not valid and the results suggested that there are no significant differences between “greater” technical and “lesser” technical CIOs with respect to their use of influence behaviours. Thus the socialization theory applied to CIOs was not supported (Enns et al. 2002). As far as CIO’s capability is concerned, it refers to personal skills, knowledge and abilities that CIO should have in order to achieve certain goals and lead the people inside organizations (Smaltz et al. 2006; Feeny, Willcocks 1998; Pretson et al. 2008).

According to B. Liu et al. (2014) and prior researchers, the most important CIO capabilities consist of political savvy, communicative ability, relationship building ability, strategic business knowledge, and strategic IT knowledge. Political savvy is about the ability to negotiate influence and persuade (Hambrick, Mason 1984); communicative ability allows to communicate clearly, persuasively and using business terms (Smaltz et al. 2006); strategic business knowledge involves the understanding of people, business strategy and competitive forces of the firm (B. Liu et al. 2014); strategic IT knowledge concerns the “awareness and understanding about current and emerging information technologies, their relevance for the firm, and insights related to investment timing and acquisition of information technologies” (Smaltz et al. 2006).

According to the authors and to the literature in general, CIOs capabilities or IT managers capabilities are essential for the effectiveness of the CIO role and the effectiveness in running IT (Smaltz et al. 2006; Chen, Wu 2011; Feeny, Willcocks 1998). The right capabilities confer the CIO the possibility to be a potential innovator.

Considering the growing responsibilities of CIOs from strictly technical to more business focused, K. A. Grant and G. Urbanik (2012) identified, throughout a survey, the most adequate skills that CIO should have in order to address the requirements of the specific organization. First of all, CIOs or IT managers should be able to communicate technology issues using simple terms and business language in order to let all the stakeholders understand regardless of their knowledge of technology. It contributes to create an environment where everyone is comfortable in discussing technology. The other important skill is the ability of CIOs in building relationships since it makes easier to strengthen their role internally and to advance in their career. Being good at people and organizational development and the ability to motivate people are considered important skills. Besides, creating good work environment facilitates people to reach their objectives, to work in a more efficient way to be successful. An additional competence highlighted by J. Peppard in his study is the ability to read the external market and use it for potentially sourcing IT services and to understand risk (Peppard 2010). Summarizing, CIO should possess necessary skills, knowledge, and abilities to educate their business counterparts to potential opportunities offered by the emerging technologies and persuade them to become business innovation champions, who provide extra resources for new IT initiatives (Smaltz et al. 2006). At the end, CIO with these capabilities not only has more opportunities to influence the other managers, but above all he can have big influence on the strategy and introduce successfully transformational projects (Grant, Urbanik 2012).

#### **4.1.5 The strategic role of CDO in digital transformation**

##### **CDO role overview**

The Chief Digital Office (CDO) role is one of the roles with the highest growing rate in the last years; though the most part of them is in the USA, CDO is a global phenomenon (Mathison 2014). Considering the fast pace of this role, its newness is witnessed by the fact that in the first 1.500



emerging companies ranked by highest revenue, only 6% of them have a CDO in their organizational chart (Friedrich, Péladeau 2015).

This role is usually created in big companies, whereas it is more rare in organizations under 10.000 employees, it is mainly played by male people between 40 and 49 years old. CDOs with an age between 30 and 39 years represent however a big part of this category, around 31% (Mathison 2014). According to Westerman et al., 2014, CDO has the following responsibilities: (1) define a clear digital vision shared by all the company; (2) coordinate digital activities; (3) exploit the digital opportunities offered by the tech trends; (4) drive the company towards the digital transformation.

Not all CDOs are assigned all these responsibilities. Some of them undergo a sort discrimination, especially in those company where other CxO levels people see their power and control decrease due to the introduction of a new C-level role and of a new responsibility balance. For this reason, CDOs should possess excellent leadership skills. The most part of CDOs operate in big and distributed companies, where they can exert a certain degree of autonomy.

Westerman (2013) claims that the CDO should unify the digital vision of a company, and harmonize the activities and the processes related to this visions accordingly, as well as promote the digital opportunities inside the organization and coordinate the activities to innovate products and / or processes towards these new digital technologies. Other literature sources focus on the responsibilities that this role has in driving the digital transformation (Hess et al. 2015). In this role, a unique CDO should constantly monitor inbound and outbound “digital disruption” opportunities.

According to an MIT survey, the CDO is identified as someone who is biased towards the outside of the firm rather than to the inside. His overall objective is to focus on the management of digital initiatives of the whole firm as well as of some of its parts. According to this survey, indeed, this role is created only for discovery their internal competencies or to control under a unique responsible centre all the digital activities management. Ariker et al. (2014) present a totally different vision, under which the CDO would have as primary responsibility that of connecting CMOs and CIOs as these roles are very distant for which concerns their competences and the need of technological skills and mediation between these two roles. In this case the CDO is a support to these two roles and should not interfere or prevail upon them.

### **CDO operational activities**

Peppard J et al. (2011) define the CDO operational activities based on the two categories of Supply-side and Demand-side. The former addresses the performance improvement and optimization of business processes thanks to the adoption and development of the proper technology. The goal is to a better service lever by lowering infrastructural costs (inside the organization). The latter category regards all those activities allowing business innovation, and the improvements of revenue and new added value for the customer (outside the organization).

Managerial roles using such technologies should be able to respond rapidly to the changing needs of the organization.

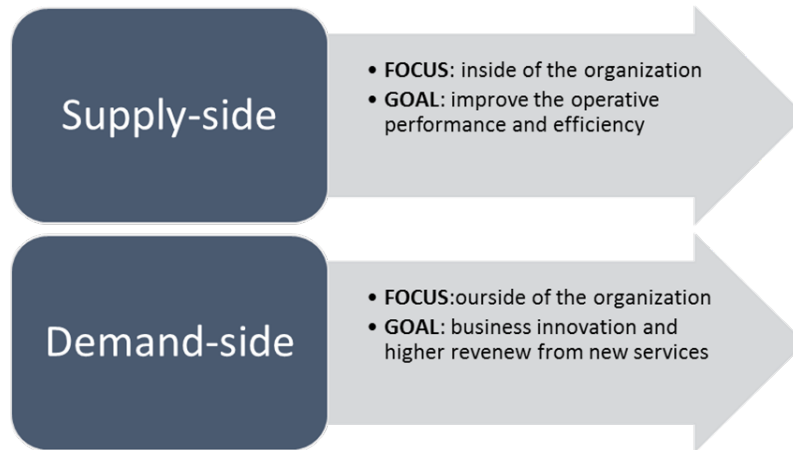


Figure 6 – Supply-side and Demand-side activity framework.

### CDO competences

CDO competences can be divided into “soft skills” and “hard skills”. The former regard the relational sphere of the CDO with other people in institutional roles and are not easy to define and measure. The latter are related to the technical skills and abilities and are easier to measure and learn. Starting from these last competences, we report a survey by (Friedrich, Péladeau 2015) on the PwC enterprise, where CDO background are emerging. The main backgrounds are: marketing, selling and, lastly, technology.

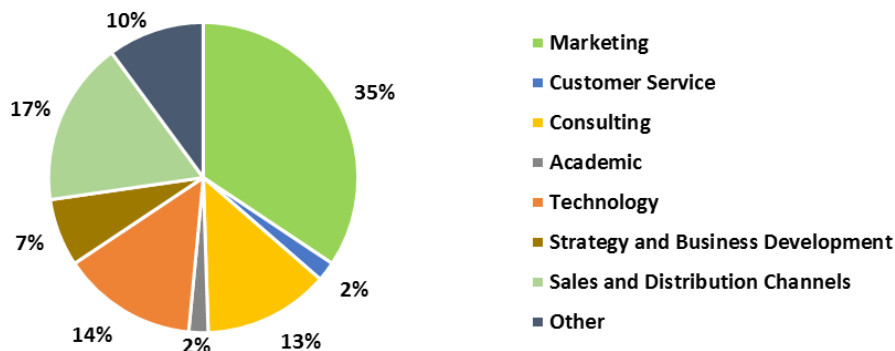


Figure 7 – Background of a Chief Digital Officer.

Ariker et al. (2014) specify that the CDO should possess both the skills and competences of the CIO and the CMO. For the CMO, these are (i) a strong data oriented perspective through KPI and big data competences, and (ii) a clear vision of the business strategy.

For the CIO, these are (Milovich, 2015) (i) the exploitation of technological infrastructure to allow a fast acceleration on revenue improvement, (ii) a deep knowledge of the ultimate digital trends and for the data analysis techniques in order to generate strategic information for the management, (iii) agile project management competences (Cameron et al. 2015), and (iv) data analytic skills.

According to Horlacher and Hess, the CDO must possess the “Spokeperson”, “Entrepreneur”, and “Leader” capabilities among those configurations theorized by Mintzberg (1973).

Managerial role	Description
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<i>Informational</i>	
Spokesperson	This role includes communication and cooperation skills, as well as relational skills in order to maintain good dialogue with the other departments.
Monitor	The managers of this category search and receive information on the organization orientation in its context market and on the available innovation technologies.
<i>Decisional</i>	
Entrepreneur	This role is characterized by the identification of the business needs of the organization and by the development of change management solutions. It is a pioneer role, with high propensity for risk and influence.
Resource Allocator	This role is in charge of human, financial and informational resources inside the enterprise.
<i>Interpersonal</i>	
Leader	This role is responsible for surveying, monitoring and motivating people.
Liaison	This role is characterized by the capacity to create personal relations and develop useful contacts besides his department.

Table 4 – Managerial roles

Standing the above configurations, the CDO should not disregard the following soft skills capabilities:

- Collaboration. This capability is crucial to allow the communication with other divisions and c-level executives. “Digital Transformation” is indeed a process involving the whole enterprise and the cooperation among all the involved department is vital.
- Propensity to risk. The CDO should possess initiative and braveness in order to begin very risky projects. Without these capabilities a CDO would not be ready to grasp the opportunities of innovation.
- Communication. Being able to communicate at the best level allows to obtain the best results, especially that of creating a shared enterprise vision of the digital strategy.
- Leadership. A CDO is a guide for his team towards the digital transformation.

### CDO typologies

The research by Kim (2014) detects the following CDO typologies.

- Product-focused. In this category CDOs focus their attention on the development of core products innovation, as well as on the improvement of tangible and intangible assets that the enterprise owns. As traditional business models are losing profits, the CDO should also be able to detect new solutions to allow the enterprise to generate profit based on the new digital technologies. Usually this CDO role is played in those fields relate to Internet, such as that of entertainment and media. Also in the education and learning field CDOs are of this kind.



- Capabilities-focused. This CDO category is found in service provision fields, e.g., advertising and communication. In this role the CDO focuses on the enterprise staff in order to improve their digital knowledge and innovate the service provision. The CDO moves the digital competences that people already has towards new competences in their work.
- Experience-focused. The CDO of this kind are those active in the fields where physical assets should co-live with digital assets. Fashion, financial services, food and beverages are all examples of sectors where a CDO can improve the customer journey with the integration of multi-channel communication.

Deloitte (Huges 2015) proposes an alternative classification. This is based on three CDO typologies: “ex-agency”, “digital transformation strategist” and “technologist”. The first two roles are focused on customer experience and discovery of innovations and new business models in order to revamp the enterprise success. The last category focuses on digital seen only as a mere tool to be used in the enterprise to improve production processes.

Product focused	Capabilities focused	Experience focused
<ul style="list-style-type: none"> <li>• Information management fields</li> <li>• Core products innovation and new business models development</li> </ul>	<ul style="list-style-type: none"> <li>• Service provider fields</li> <li>• Competences improvement</li> </ul>	<ul style="list-style-type: none"> <li>• Physical stores</li> <li>• Intergration between physical and digital world</li> </ul>

Figure 8 – Typologies of Chief Digital Officer.

Another classification is relate to an organizational form based on business units (the silos) where there is diversity of products and big dimensions (Rebora 2001). In this scenario the organizational schemas are four: “Silo”, “Central coordination”, “Digital hub” e “Global” (Westerman et al. 2011).

### C-levels interplay

The interplay between the CIO and the CMO has always been problematic, due to the competence differences between the two roles. However, in the new digital context their relationship is ever necessary in order to grasp the opportunities of the innovation-based market.

The CMO is responsible to improve the revenues and he needs the CIO to transform customer data into better services and hence better sales. On the other hand, the CIO needs the CMO to detect better functional and technical requirements. None of the two can succeed in transforming the business autonomously and the cooperation among the two has to be created and reinforced properly (Ariker et al. 2014). Based on the study of Willmott et al. (2013) it is demonstrated that enterprises using data in a meaningful way are more productive and rich of 5% and 6% respectively. The reasons for a better alignment between IT and marketing are also reported in a study by Hartman et al. (2014). CMO and CIO agree to many of the reasons for towards their alignment. In particular, they agree on data analysis and collaborations to face Digital Transformation with success. The knowledge exchange between these two operative functions may be mediated by the CDO (Anh et al. 2013). Also a better cooperation between CDO and CIO has been proposed in



Horlacher and Hess in order to drive the digital transformation process. The CDO role focuses more on the strategy and the communication phases, whereas the CIO focuses on the infrastructure and the technical part of the process. It is important to clarify the different competences since the beginning, considering that in small enterprises the CDO can also have the role of CIO and vice versa (Westerman 2013). The choice to hire a figure devoted to the Digital Transformation depends on five questions, as reported in Westerman:

- is the CIO currently able to manage effectively the IT function from the point of view of the costs, of the fast reaction and of other relevant business parameters?
- is the CIO ready to assume other responsibilities besides his specialization areas?
- has the CIO been already involved in experiences outside of the IT environment and, if yes, how did he behave?
- is the CIO able to understand the opportunities offered by the digital technologies and the menaces represented by the digital disruption?
- is the CIO able to collaborate and communicate proficuously with the other enterprise functions and with external people?

In case the answers to all these questions are positive, then the CIO could be unified with the CDO without the need of extra roles, people and supplementary consultants. Moreover, this role would have a wider vision of the enterprise and as a consequence a potential improved efficiency.

## **4.2 Definition of the main RQs**

### **4.2.1 Analysis of the CIO role**

- RQ1: how the work of a knowledge worker will be reshaped in 2020, due to the influence of DiDIY? how will it change in relation with the evolution of other organizational roles in her firm?
- RQ2: how the IS function will evolve due to the influence of DiDIY? How the structure of the function will be affected? Which organizational roles will be reshaped, and which competences will be required?
- RQ2.1: how the work of the CIO will be reshaped in 2020, due to the influence of DiDIY? how will it change in relation – with the evolution of other CxO roles?

### **4.2.2 Analysis of the CDO role**

- RQ1: what skills are needed in organizations to face the evolution enacted by digital technologies?
- RQ2: how are those skills configured today. Are they centralized or distributed in multiple roles?
- RQ2.1: hypothesizing that they are centralized, within 5 years from now, will they remain centralized in a unique role and, if yes, which role?



## **4.3 Research design**

### **4.3.1 Analysis of the CIO role**

The empirical part of this study consists of the collection of qualitative data through several interviews. The research started with the selection of the topic considered relevant on the basis of a systematic literature review that was useful to formulate interesting and suitable interview questions.

The approach used is a semi structured one, i.e., the interviews were conducted according to a predetermined structure which is composed of four main topics which are to be faced during the discussion. Moreover, in order to collect as much information as possible, and not to put too many restrictions in advance, the survey guidelines have been followed in an extensive manner.

The analysis aims at addressing four macro themes that are the same as the ones previously discussed in the literature review, namely, the effect of the digital transformation on strategy, how the companies' organizational profiles are changing, what are the main technological trends and an overview on the main socio economical implications brought by the widespread of digital solutions. The main purpose of the survey is to give a shape to the new phenomenon of digital transformation and to understand the direction to be undertaken in order to drive these new trends in a most effective and efficient way.

In collaboration with AUSED (the Italian Association of Users and Technology Systems Information), ten "champions" have been identified and further surveyed to understand the ways and thoughts of the companies about the digital transformation that is taking place in all the organizations, how it is perceived and what is the degree of maturity of these topics within specific organizations. In order to have a complete understanding of this topic, also the vendors of IT solutions were interviewed. A total of ten interviews have been collected in the time range that goes from November 2015 to January 2016. Most of the interviews were audio recorded, transcribed and successively analysed the others were just noted down and further analysed.

### **4.3.2 Analysis of the CDO role**

We have analysed 58 interviews and codified questions and answer according to Grounded Theory methodology (Corbin, Strauss 1990). First, the interviews were transcribed and analysed carefully, each question has been extracted so that a list of questions was created. As a second phase, the most frequent questions were kept, and the questions asked only once were discarded. The most frequent questions are reported in the next section.

## **4.4 Research method**

The analysis of the data has been performed with Nvivo, a program for handling qualitative data. The program allowed to organize, classify and sort the data thus working as a data-structuring and organizational program. Nvivo software has been realized by Richards (1999) and it is widely used with particular reference to the Grounded Theory elaborated by Glaser and Strauss (1967). Although it is generally considered a qualitative method, the Grounded theory is a method that implies the systematic generation of theory from systematic research. The basic idea of the theory is to read a textual database and discover or label variables and their interrelationships. The data collection procedures involve interviews and observation but also any other documents, video, images and everything that may shed light on question under study (Corbin, Strauss 1990).



The first methodological stage is the *data collection and analysis*. According to J. Corbin and A. Strauss (1990), the two processes are interrelated since the analysis begins as soon as the first bit of data is collected. This enables to capture all potentially relevant aspects of the topic as soon as they are perceived. In this specific case the interviews have been recorded and transcribed right after, to make sure not to lose many important pieces of information captured through non-verbal communications, pauses and body language.

The second stage is the *open coding*, the process by which data is divided into segments and then scrutinized for commonalities that reflect categories and themes. Concepts that pertain to the same phenomenon may be grouped to form categories (Corbin, Strauss 1990).

The third step is called *axial coding*, where categories are related to their subcategories. According to Strauss and Corbin the axial coding reflects the idea of clustering the open codes around specific axes or points of intersection.

Then the *selective coding* has to be addressed. Here the researcher has to treat the various codes clusters in a selective way and decide how they are related to one another (Corbin, Strauss 1990).

The last step involves integrating, refining and writing up theories. After having coded categories, they have to be linked together in theoretical models around a central category that hold everything together.

## 4.5 Definition of the questionnaire for the empirical investigation

### 4.5.1 The CIO role

The questionnaire has been the principal instrument used for the data collection and it has been expressly created for the specific scope of the research.

THEMES	SUBTHEMES
Introduction	Introduction of both parties Purpose of the research
Digital Business Strategy	The respondent's own definition Does the specific company have a digital business strategy? Standardization vs diversification Collaboration vs competition Startups as an R&D outsourcer
Organization	DiDIY phenomenon inside the organization The CIO role and CIO/CEO Alignment Start-ups as an organizational model

Table 5 – Interview themes.

The same scheme has been used for the vendor's meeting.

### 4.5.2 The CDO role

The total of questions in the 58 interviews that were analysed is 26.

1. What are the main "tech trends"?





2. Which skills are necessary to a CDO?
3. How do you define “digital transformation”?
4. What opportunities / obstacles characterize “digital disruption”?
5. How do you effectively deal with digital transformation?
6. What are the main responsibilities of a Chief Digital Officer?
7. How is it important to have an enterprise culture able to accept / appreciate digitalization?
8. What are the main activities of a Chief Digital Officer?
9. How do you rate the importance of the customer experience in the digital transformation?
10. What is your advice for a successful business digital strategy?
11. How much are social media important in digital transformation?
12. On which projects are you working and on which projects will you work in the future?
13. How much are data and data analytics important in the digital transformation?
14. Which kind of relationship exists between you and the CIO? And you and the CMO?
15. What will be the future of CDO?
16. What are the roles with whom the CDO should deal with?
17. How important is the collaboration in your work?
18. To whom is the CDO reporting and how much this factor is important?
19. Which are the KPI that can be used to measure the CDO performance?
20. Does a CDO is really needed and why there is the need to introduce such role?
21. Who should be in charge of the digital transformation?
22. How do you use social media for sales?
23. What do you do to guarantee a successful customer Engagement?
24. How important is to reconcile the two different speeds of IT and digitalization?
25. How important is the “agile” approach in your work?
26. Once the digital transformation has been accomplished, will CDO be still needed?

As shown in the list above, the questions cover a wide range of topics, that inevitably overlaps only partially with the aim of our study. We extracted from the interviews the contents which were pertinent with the aim to identify the profile of the CDO as an emerging organizational role compliant with the principles of DiDIY.

## ***4.6 Selection of the empirical domain***

### **4.6.1 The CIO role**

Considering the specific topic of the research, the individuals inside organizations that most likely possess the appropriate knowledge to answer the survey questions, are supposed to be the CIO, the IT director, the information system director and in general whoever is acknowledged about IT issues and IS inside the company. In this specific case the sample is composed by eight CIOs and two HR Directors that are going to be listed in the table below.



#	Position	Company
1	Global CIO	Bracco
2	IS Director	Sapio
3	Head of Group	Italcementi
4	HR Director	Italian Institute of Technology IIT
5	ICT Manager	Carl Zeiss Vision
6	ICT Director ICT Manager	Fiera Milano
7	IT Director	Guzzini
8	CIO	Ariston Thermo Group
9	Global Demand Manager	Angelini
10	CIO	Artsana
11	CIO	Ariston Thermo Group

Table 6 – The list of the people interviewed and their companies.

All these interviews were held through different channels due to geographical differences and the duration of the interviews was more or less of an hour and half.

For the vendors it has been used a different methodology. Instead of the singular interview, they have been called to attend a meeting where, after explaining them the purpose of the survey, they were asked to answer the same questions from the vendors' point of view. Three IT vendors participated to the meeting: Elmec Informatica S.p.A., Sopra Steria Group, and Atlantic Technologies S.p.A.

#### 4.6.2 The CDO role

The interviews found online are ported in the table below. The main theme of the interviews is the digital transformation and the role of the interviewee in the enterprise where he works.

#	Name	Role	Company
1	David Mathison	Founder	CDO Summit
2	Jonathan Reichental	CIO	City of Palo Alto
3	Sree Sreenivasan	CDO	Metropolitan Museum of Art of New York
4	Ganesh Bell	CDO	General Electrics Power
5	Jay Ferro	CIO	American Cancer Society
6	Matt Preschern	CMO	HCL Technologies
7	Tien Tzuo	CEO	Zuora
8	Esteban Kolsky Graham Hill	Founder CIO	ThinkJar & Optima Partners
9	Chris Hjelm	CIO	Kroger Co.



10	Chris Curran	CTO	PwC
11	Lee Congdon	CIO	Red Hat
12	Robert Tas	CMO	Pegasystems
13	Sanjay Poonen	EVP & GM	Vmware
14	Lew Cirne	CEO & Founder	New Relic
15	Jonathan Becher	CDO	SAP
16	Barry Libert	CEO	OpenMatters
17	George Westerman	Research Scientist	MIT Center for Digital Business
18	Lisa Davis	CIO	Georgetown University
19	Dion Hinchcliffe	CSO	7Summits
20	Larry Augustin	CEO	SugarCRM
21	Jill Rowley	Social Selling Evangelist	--
22	Phil Fersht	CEO	HFS Research
23	Rizwan Khalfan	CDO	TD Bank Group
24	Adam Brotman	CDO	Starbucks
25	Rachel Haot	CDO	New York City
26	Jason Goldman	CDO	White House
27	Tanya Cordrey	Director of Digital Development	The Guardian
28	Mike Germano	CDO	Vice Media Inc.
29	Paul Gill	Head of Digital Engagement	Oxfam
30	Blake Cahill	Head of Digital and Social Marketing	Philips
31	Robin Thurston	CDO	Under Armour
32	Brian Tilzer	CDO	CVS Health
33	Joe Bilman	CDO	American Media
34	James Keady	Head of Digital	Samsung
35	Simon Miles	Digital Director	Coca-Cola Enterprise
36	Amanda Neylon	Head of Digital	Macmillan Cancer Support
37	David Parkinson	Head of Digital	Nissan
38	Teddy Goff	Digital Director	Obama Campaign '12
39	Gary Ellis	CDO	Hearst Magazines International
40	Julie Bornstein	CMO & CDO	Sephora
41	Baron Concors	CDO	Pizza Hut
42	Peter Longo	CEO & CDO	IDG



43	Jeff Misenti	CDO	Fox News
44	Dave Aron	VP – Digital Analyst	Gartner
45	Chantal Restivo-Alessi	CDO	HarperCollins
46	Patou Nuytemans	CDO	Ogilvy & Mather
47	Chris Miller	CDO	Drafftcb Chicago
48	Michael Menis	SVP Digital & Voice Channels	IHG – Intercontinental Hotels Group
49	Carlo Cagliardi	Partner on Digital Strategy	PwC
50	Allen Wyke	CTO & CDO	CNN
51	Patrick Hoffstetter	CDO	Renault

Table 7 – List of the interviews collected and analysed.

## 4.7 Analysis and discussion of the results

### 4.7.1 The CIO role

What emerged from the interviews’ results is that DiDIY is an issue of big interest that sometimes flows into the fear of not being able to handle it. Besides, each of the interviewee gave a different connotation based on his/hers personal experience or opinion.

Starting from interviewee 1, he thinks about DiDIY as a really interesting phenomenon from one side, but very dangerous from the other side. This trend, indeed, brings with it the big opportunity to make the customers more sensible and careful about the new proposals and the digitalization. The dangerous thing, however, is that some initiatives start outside of each control and this becomes devastating when these activities take a certain shape and must be integrated inside companies. Moreover, interviewee 1 added: “simplicity wins, but to ignore the complexity is dramatic; so who generally becomes a consumer of these aspects, i.e., marketing, strategy, production, etc, tends to buy the marketing simplicity of those who sell it to them, ignoring that there is an infrastructure that does not forgive them”. This is evident from the testimony of interviewees 6 who told about a person of the business of Fiera Milano who decided to acquire the right skills to use, even in a technical manner, complex tools such as SharePoint, since in that way he could enhance his activities. They explained that this person has built by himself what he needed for his interlocutors and now Milano Fiera is thinking if and how bring him home because, as usually happens in DiDIY, the object has become increasingly complicated. He lacks a vision of the overall architecture in terms of data and information, as well as in the choice of instrument and he begins to have management difficulties.

Speaking about infrastructure, interviewee 8 has brought to the light a fundamental point, namely that, previously the infrastructure was linked to IT due to the fact that for doing whatever, the contribution of the machine was needed. Nowadays, with the several cloud solutions, in certain situations, it may not happens. “I think the role that needs to change is the IT, not so much the business. I am the first saying that many skills, especially the most used before, like the old IT analyst, will lose value over time in some respects. Instead, what it will increase IT ability to take on the technological advisor. What will increase it is the IT ability to do advisor on the technological part”.



Accordingly, interviewee 9 also put the focus on the governance claiming that the loss of this aspect leads the company to lose sight of the added value of IT management that is exactly in the governance of the various initiatives.

An important point stressed by interviewee 4, is that of DiDIY in terms of adequacy of management, specifying that the CIO role is going to change. “What is used to be a garrison of power becomes something totally different and I do not know how this generation of CIOs is ready in terms of culture and skills”. According to his vision “on the one hand there is a growing number of suppliers of these opportunities, on the other hand there is a market that has antibodies, creates resistance, and in that sense there is potentially a conflict, but, sooner or later we will be overwhelmed by this phenomenon”.

Due to the specific competences required by the sector of lenses, interviewee 5 believes that is unlikely for such a phenomenon to grow. In general terms, however, he confirmed that DiDIY exists and it may be relevant only if companies are able to read and monitor it, like the other respondents said. He added also that “if it is done by an expert who has been doing it for decade, it is clear that evolution comes out in a more structured way, so I give you the opportunity to make you something at home in a professional manner. If it is self-managed, it is clear that even in the long term also comes to a professional level, but the first who uses it will find something totally unprofessional which can alter the evolution immediately. If what you get is not a professional result, the system does not go forward”.

In Artsana, instead, there is not a great sensibility for DiDIY since the focus is rather on the collaboration between IT and Business people interested in IT issues.

Interviewee 3 and interviewee 2 used some practical examples to explain how DiDIY can take shape inside the organizations. interviewee 3 affirmed that although for Italcementi is nearly impossible to identify new activities generated by DiDIY technologies, the latter strongly empowered pre-existing activities and role. For example, 3D technologies enable Italcementi R&D department to make in-depth studies in order to generate new form of concrete. She mentioned also the Internet of things and the linked usage of Big Data analytics, as an interesting perspective to improve the velocity, precision and effectiveness of their systems.

Sapio Group is developing the home haemodialysis that is can be seen as an example of DiDIY since the patients would be provided with the specific machine and they will be able to do the haemodialysis by themselves. Moreover, by means of a high-quality video conference system, the patient would be assisted by a nurse, who in turn is able to simultaneously monitor other patients.

DiDIY can also be a potential means of disintermediation and reduction of barriers between sectors through enabling technologies. Mr Provini showed a very strong awareness about it thus explaining that all the initiatives are born to avoid that something would happen outside their control. To give an example he said: “if someone invents an RX machine that does not need to be read with contrast liquid, I’m dead. The contrast liquid is however a risk for the patient, therefore an invention of this kind would be devastating”.

Interviewee 8 claimed that in Ariston they are experiencing a massive use of the technology on the entire supply chain, and then on the suppliers of components, as well as on the logistics providers. The main problem concerns the communication standards that have still not been established and therefore the interplay is not so trivial.

Interviewee 5, finally, provided a broader view of this topic arguing that if the digitalization will surely bring the market to a disintermediated approach, jumping the no added value for the



consumer, the company efforts should be focused on actions able to increase the traffic and deals opportunities on the customers' point of sales. He also added that most of the technical figures requiring specific skills, especially in IT, is not excluded that can remain for a long time, if not forever, external. Surely the customers' way of buying will change as a consequence of the huge amount of information they are provided. At the end, companies that do not adapt to the new trends are doomed to disappear.

The other crucial topic faced during the interviews concerns the impact of the digital transformation on the organizational roles, especially the CIO one.

Interviewee 2 believes that the Chief Digital Officer is the natural evolution of the CIO, since it combines the traditional world of IT with the new technologies of evolution. Looking the organization chart of Sapio, he asserted that none of those present, including himself, is able to cover that role, because they are contaminated by the daily experience and, more widely, by the culture of how they have managed Information Systems up to date. According to interviewee 2 there is the need of someone who "thinks out of the box"; people working for years in the same industry no longer has the ability and the mental flexibility to be able to change the working model. Regarding the CIO, he added: "I think it must be a triptych because there is also the communication and image component that could be seen as marketing. In our case is a bit different, since we have a communication and image management that responds to human resources. Marketing for us is purely commercial marketing. So it is dealing purely to promote the products".

Interviewee 4 also, as stated above, spoke about management adequacy and the changes in the CIO role in terms of garrison of power. Conversely to Mr Salierno, he sees the establishment of the CDO role as a way to solve the problem by giving a role, a label, but not following a tool. This means channelling the old scheme on a new ones and in interviewee 4 view is not a great solution, due to the fact that we have been experiencing a change of paradigms on these issues that is leading to shared responsibility, shared power, collaboration and interaction matter. Interviewee 1 also agreed with it. So according to interviewee 2, interviewee 4, and interviewee 1 also believe in the inadequacy of the management.

Interviewee 6a and 6b have shown to be aware of the need of having people of business that can become more competent about IT issues in order to carry out this role of "bridge" between the IT and the other department. In their opinion, the CIO should have a good knowledge of IT, an excellent knowledge of the business and they must be extremely flexible people with extraordinary negotiation skills. Of the same view seemed to be interviewee 5 that argued: "We have the ERP in outsourcing because inside the company I need people that understand the business, not just technicians. Progressively as I see the evolution of IT, it will be only a function of "bridge" between the technology and the business aspects, where is important to know the technological aspect, but it is essential to know the business. All those functions where there is only technological aspects, with evolving technologies and standards, it makes no sense to have them in the company because you have no technical time to train them". Interviewee 5 has further highlighted the relatively new figure of Data Scientist claiming that is a person who needs to know the business as well as being a good statistical and having technical skills.

Interviewee 10 gave an overview of the future IT competences specifying that anything that becomes a commodity should be left outside. He believes that the IT will be composed of three classes of activities that are: the outsourcing area where are required few IT skills and more administrative competences; the services area including unconsolidated applications that in the long



term will be outsourced; the innovation area, in which new themes and ideas will be created and developed.

Interviewee 10 further added that IT people are “people of method”, the IT department, thus, have a methodology that can be transferred to other areas. In Artsana the IT sits at the tables of the steering committees as well as in GUZZINI where, as stated by interviewee 7, there is a strong collaboration between CIO and CEO.

According to interviewee 7 the CIO should acquire the necessary skills from an administrative and management point of view to be able to identify the costs, the driver that lead to a choice and it is also important to be acknowledged of fiscal and legal issues.

Talking about how the information systems are changing in terms of interaction with other entities, he said: “Until a few years ago there was a much more pragmatic approach in the sense that for computing procedure the IT had the responsibility of sending information. Today, the compass should be moved not so much on the ways in which you interact with the function, that now are quite simple, but on the process behind. So, is it right that this process behind is explained by the IT, or is right that there is a mix of IT and submitting authorities? I can’t answer this question.”

In Bracco Imaging the Chief Strategy Officer does not leave much room for the CIO and the IT in general that have a marginal role. According to interviewee 1, the reason is rooted in the fact that who deals with business and strategy considers the IT as an internal service. He believes that the traditional business organizations makes difficult the relationship between the CIO and the TMT and that it does not enable the CIO to become crucial in the digital transformation process. In the companies he lived and attended, most of the time, the IT is under the CFO or the HR director responsibility, therefore, in the strategic decision making process, the IT is often interpolated and consequently it fails to be decisive. If the CIO does not sit on that strategic table, he should be able to find unstructured moment in which he can propose innovative ideas and be incisive. In Ariston, for example, it has been established an innovation committee where the issues concerning all those initiatives that will affect innovation are discussed, including also the digital innovation. Interviewee 11 pointed out how important was to take part to this committee, together with the CMO, the CEO and the R&D director, since, at least, he is assigned a role. As explained above, the problem in Ariston is the lack of a unified vision and the silos approach.

However, according to interviewee 1, although the trends tend to highlight a general loss of vertical competences, the CIO will continue to be responsible for the company’s backbone and to be an integration expert of each type of information system. The changes should happen in terms of having clear strategic vision, a strong commitment and leadership, a team motivated, skilled and strong in shared values.

As far as the topic of start-up as an organizational model is concerned, what came out is that in most cases the respondents talked about innovations committees rather than start-ups. These “innovation lab” can be considered similar to the start-up because of the way of working and the activities carried out.

Interviewee 7, interviewee 2, and interviewee 11 confirmed the presence of innovation committee or innovation labs inside their companies. Interviewee 1 is also trying to establish these innovation circles, based on Open Innovation concept that may include start-ups as participants. Mr Ingletti and Interviewee 6 talked about “task forces” inside their organizations, rather than start-ups, but the purpose is the same of the innovation committees or lab, namely, the generation and development of new innovative projects.



## 4.7.2 The CDO role

### CDO responsibilities

The CDO Summit founder, David Mathison, claims that CDOs have as responsibilities those of “driving the digital transformation”, and the creation of profit centres, of new sources of revenue and new businesses. Also the CDO working in SAP shares this vision, and adds that another important responsibility of the CDO role is related to the cultural change. “Each transformation, in particular the digital one, requires a change and this also implies a change in enterprise culture and mindset”.

One different goal is advocated by the White House CDO, for whom the final goal of this new role should be that of “connecting among them people of different departments to reach a common goal”. Another CDO, that of the Metropolitan Museum of New York, sees the CDO role as capable of producing a “virtuous cycle, i.e., by connecting the real and the digital, the physical presence and the online presence. If the latter has been positive the digital user will want to see what the museum has to offer in presence.”.

A last point of view is that of Drafftcb Chicago CDO, Chris Miller, as one of his objectives is that of “spreading inside the organization the digital skills”. His responsibility can be summarized as “being an expert in the digital field, so as to increase, manage and define the organization itself”. From the analysis of the interviews many different visions are emerging for what concerns the responsibilities of a CDO, standing that one of the main goal is dictated by the need to “digitally transform” an organization.

### The activities of a CDO

The Head of the Digital Department in Philips claims that a CDO should be able to “transform a set of numbers in one story to tell”. For this reason, data analytics capabilities and data visual representation are crucial in the new digital era. It is then of paramount importance to understand what data are important and what should be ignored.

For the Header of the Digital Department in Macmillan Cancer Support the enterprise activities are related to the “realization of new solutions, products or services, to supply customers towards a personalized experience”. Finally, the CDO of Renault, declares to be in charge of “controlling the digital strategy and its achievement through the use of “benchmarking”, “dashboard” and KPI”.

Hoffstetter and his team are in charge of the operative part, and for this reason they should execute all the activities related to the development of the different digital platforms.

### The competences of a CDO

CDO and CTO of CNN, Allen Wyke, claims that “agile, as an adjective, is a fundamental competence in the digital era”.it is necessary to move fast, to change direction suddenly, and to be reactive. Wyke adds that “Agile”, as a name, is another competence, which “allows two things: first, it can solve problems of bad communication inside the diverse teams; second, it can motivate people to innovate through their ideas. Also the Head of the Digital Department in Philips agrees with the claim that an “agile” culture is crucial to face a successful digital transformation.

The customer is another term emerging from the analysis of interviews and, as claimed from the CDO Summit founder, the CDO “must have an obsession for the customer, through a deep analysis of data and information related to him”. The CDO should possess, among his soft skills, the





capability to reason for the customer and take diverse decisions by posing a great attention to this aspect.

Another transversal competence that a CDO should possess should be to have leadership skills. This ability may assume different characteristics based on the interlocutor. According to Sanjay Poonen, General Manager of VMware, leadership should not be confused with the capability of a manager. According to her interpretation, leadership means to “be able to let people do what you want them to do and make them love to do it”.

Poonen exposes his concept of “servant leadership”, highlighting that it is vital for his job. This notion identifies a typology of leaders that enables people to be transformed into leaders by developing their potential, rather than putting them in a position of control which limits their growth.

Aslo George Westerman agrees with the importance of this ability to be a successful CDO, by remarking that enterprises investing in this competence are able to transform really their company. One last characteristic is that of experience. The CTO and CDO of CNN, Allen Wyke, highlights the importance of having a long career in agile projects. CDO of SAP, Jonathan Becher, says that an important experience should be that of “customer experience”. The customer should always be at the centre of attention and the CDO should understand what is the best method to improve the experience on a product, that should become able to attract the most part of one’s customers.

### **Collocation of the CDO in the organizational chart**

The CDO of SAP, Jonathan Becher, has indeed declared to respond directly to the CEO. Becher comments that the trend of some enterprises is to put the CDO under the CMO, by defining this choice as the first step towards the digital transformation. A CDO under a CMO will be in charge of activities related to a “digital marketing” in the first stance, and then he will grow to a major scope towards tasks related to the digital transformation for the whole enterprise.

The CDO of Renault, Patrick Hoffstetter, was initially reporting to the CMO, but this has changed after an internal re-organization where a new functional area has been created besides those of the marketing and sales, and now Hoffstetter is reporting directly to the responsible of this new division, and continues to work with the marketing department.

### **Relations between the CDO and the other C-levels**

One of the most important relations is that between CDO and CEO. David Mathison affirms that, a great number of CDO reports directly to the CEO so as to assure a high lever of collaboration.

Another strong relation is between the CDO and the CMO, as seen before. The CDO of Sephora, Julie Bornstein, declares that “the marketing and the digital department must work hand by hand”. The cooperation between these two departments is crucial to “reach the best customer experience” and enables a major effectiveness, a major impact and a faster pace of innovation. And this can make the difference.

Even if in an indirect manner, the CDO should pose many attention to his relationship with the final customers. As remarked by the CDO of TD Bank Group, Rizwan Khalfan, it is “responsibility of the CDO to guarantee that all the customer receive the same level of satisfaction with each interaction with the enterprise, independently of which channel is used”.



A very important relationship is finally that between CDO and CIO. In PizzaHut the CDO and CIO are dependent from each other. Also the CDO of SAP confirms the importance of this collaboration. He and the CIO of General Electrics “work side by side so that the digital platform really work with the aid of the IT infrastructures”.

As the CDO should connect to a wide range of roles, he should be able to connect and relate with different personalities by understanding their needs, by using the right techniques to obtain what he wants from them in order to reach his goals.

### **KPIs to evaluate a CDO**

What emerges from the KPI analysis is that they are used more frequently to monitor the digital products and services towards the customer. As declared by the CTO of PwC, Carlo Cagliardi, companies usually use KPI for three purposes: to increase business thanks to the digital; to improve the customer experience through digital products; to measure the degree of change of the market where the company operates. George Westerman, MIT researcher, focuses on real metrics used by the most part of companies and he claims that one of the most important KPI is the ratio between digital sales and physical sales. The researcher adds that many organizations are using this metric as they want to become 75% digital by the next 5 years. Finally, Westerman declares that there are some KPI focused on the digital but “the metrics that are used for other processes can be also useful to the purpose of digital transformation assessment”.

### **Current and future project of a CDO**

The CDO of Starbucks, Adam Brotman, says that he is in his first phases of the digital strategy of his organization. The goal of the next years is to “continue and innovate to expand the digital platforms currently developed and create new ones that are relevant for the customer”. To do so, it is necessary to listen to customers, either through physical channels or through digital channels so that one can grasp what is really important from a digital point of view. In the same direction, the CDO of VICE Media Inc. is posing a certain attention to the most correct integration between advertising inside the application, so that these are not interrupting or damaging the brand experience. The CDO of Under Armour, Robin Thurston, has instead integrated the social aspect inside their platform so that customer are solicited to play sports and “the more the sports they play, the more are the benefits they gain” and this creates a trust in the organization.

The CDO of PizzaHut is focusing on the cultural aspect that in the last years he tried to improve through the creation of a digital mindset that can generate simplicity for the user.

The CMO of Pegasystems, Rober Tas, thinks that a CDO is not necessary, however he claims that it is crucial to possess an equivalent role, as it is important that his responsibilities are given to a C-level role in order to take the change ahead.

A different opinion is that of David Mathison, founder of the CDO Summit, who says that CDOs are innovation generators. In the new digital era, companies are obliged to change, and the CDO is the crucial role to assist the CEO and the board in the organization management during the process of digital transformation.



## 5. Research Topic 3: Networkers

A recent study by Price Waterhouse Coopers International Limited (PwC 2014) describes the Orange World – one of three emerging organizational models – as networks of autonomous, specialized operations. The orange company model lays the foundation for its success on operational flexibility, lean staffing, collaborative partnerships and minimal fixed costs. This kind of organization makes extensive use of technology to run the business, coordinate a largely external workforce and support its relationships with third parties. PwC consultants show how the adoption of disruptive technologies increases speed and favours employee recruitment. Moreover, technology itself “keeps these networks together, often on a task-by-task basis, with social media heightening the connectivity upon which the Orange world depends” (PwC 2014).

Some local academic contributors underline long since that enterprise and distribution models – such as direct selling network marketing companies (NMDSO) – represent (network) organizations coordinating large amounts of autonomous sales force. They underline that in NMDSO people have come to realize that they can enjoy more flexibility and varied challenges by working independently, supported by knowledge sharing. In fact, networkers base their careers on the collaboration with the up-lines, and benefit in various ways from the support given by the company itself. As such, NMDSO represents an (old) example of the present and future Orange organization, and probably one of the most interesting research objectives where the connection of autonomous salespersons generates knowledge sharing and creation, thus enabling performance and success (Guerini 2003; Guerini 2013; Gross 2008).

More specifically, network marketing is largely based on personal interaction and embedded knowledge, whereas technology offers the means to enable and support knowledge-related activities (Cabitza, Locoro 2014).

On the basis of the described features NMDSO and especially the web-enabled type of collaboration within downlines can be analysed with the aim to find out the nature of the interchange, the goals and preferred applications. Due to the lack of literature on this peculiar kind of organization, a possible research path includes a preliminary research of exploratory nature, with the aim of verifying, NMDSOs’ membership in the Orange world, and the nature and goals of knowledge sharing and creation within downlines.

### 5.1 Background

Though academic literature includes a huge number of publications referred to the impact of technology on sales activities and performance, none of these studies directly refers to NMDSO. At the same time, there are no publications that explicitly refers to the issue of knowledge oriented technologies, and their different capability in supporting the different core and peripheral activities of direct sales (for a review of the main contributions see (Groza et al. 2012)).

Network marketers and their downlines, represent also a peculiar example where the analysis of the technology-mediated relation between salespeople and customers and the analysis of the intra-organizational aspects merge, as networkers and downlines components represent both customers and distributors of the products.

A recent survey (Guerini, Minelli, forthcoming 2017) aims at acquiring knowledge about the digital support used and developed by Italian networkers. It directly addresses DiDIY that is an activity for the creation, modification or maintenance of objects or services in the digital domain, which



develops a mindset as well (Mari, 2014). Based on the hypothesis of a potential reshape of the networker’s role due to the impact of DiDIY, the above mentioned research will also investigate how coordination and control mechanisms are going to change within NMDSO and networker’s downlines as a consequence of digital knowledge sharing and creation.

The cited survey is a part of a research program. Prior to the launch of a survey, intended to acquire knowledge on the use of digital technologies by networkers and to identify DiDYers, the same research project addressed the issue of knowledge sharing and creation, thus verifying the nature and the objectives of knowledge sharing within network marketers communities. This paper illustrates the results obtained in the first research phase.

**5.2 Methodology and Research Questions**

The importance of informal networks or communities of practice emerged in the nineties. By way of definition, Wenger et al. (2002) have defined a community of practice as “a group of people informally bound together by shared expertise and passion for a joint enterprise”. While communities of practice are pervasive in society and organisations, more recently organisations have recognised the central role that these communities play in managing knowledge.

Starting from the observation of virtual communities of practice comprised of networker marketers – highly frequent on social media such as FB, YouTube and Twitter in Italy – this work extends the sales and organization literature by moving beyond salespeople’s role as knowledge gatherers to their role as knowledge sharers with the staff belonging to the personal downline. Following Kaplan and Haenlein (2010), we define social media as “a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content” (p. 61).

Frequent interactions and communication exchanges with networker’s downlines also promote new knowledge and this is “recreated in the interaction within communities of practice, that is in the message exchanges of their members and in the free flows of content and narratives that the KITAs host and help accumulate” (Cabitza, Locoro 2014).

Because of the poor literature on this topic, the issue of knowledge sharing in the virtual communities of networkers was addressed with an exploratory research, intended to analyse the nature and the goals of knowledge sharing within downlines.

Two focus groups (Liamputtong 2011) were organized in July 2016, involving eight networkers each, with the aim of analysing that situated knowledge artefact, not yet investigated so far.

<b>What is your main activity?</b>	<b>First focus group</b>	<b>Second focus group</b>
Only/mainly network Marketing	4	5
Mainly other activities	4	3

Table 8 – Main activities of the participants in the focus groups.

Both were composed of homogeneous salespeople in terms of career path (all having achieved remarkable steps in the network career path), whereas gender and age varied, as per the universe of network marketers in Italy and worldwide.

<b>How long have you been in practice?</b>	<b>First focus group</b>	<b>Second focus group</b>
--	--------------------------	---------------------------



Less than 3 years	3	2
Between 3-5 years	2	3
More than 5	3	3

Table 9 – Experience of the participants in the focus groups.

Gender	First focus group	Second focus group
Male	5	4
Female	3	4

Table 10 – Composition by gender of the focus groups.

Age	First focus group	Second focus group
18-30	2	1
31-50	4	5
Over 50	2	2

Table 11 – Composition by age of the focus groups.

All networkers worked for Lyonesse, they came from different Italian towns, knew each other and took part comfortably in the focus groups.

The objectives of the two focus groups were: a) to verify the (perceived) importance of virtual knowledge sharing and creation within networkers downlines; b) to classify the nature of knowledge sharing and /or creation within those types of communities; c) to pinpoint the main benefits obtained thanks to technology in a typical high touch activity, i.e. previously based on personal interaction. The organization of the second focus group aimed at confirming the results collected during the first one and allowed a more immediate categorization of the answers and comments given.

### 5.3 Research Questions

- How will the activities of a Network Marketer be reshaped in 2020, due to the influence of DiDIY?
- What is the actual and expected utility of these technologies?
- How will the different digital technologies affect the different activities done by a Network Marketer?
- How will the different digital technologies affect the different stages of the selling process?
- How will DiDY impact on the selling process?
- How does DiDIY actually impact the selling process?
- How does DiDIY impact on the other activities?
- How will it impact in the near future?
- How will coordination and control mechanisms within the NMDSO be impacted by DiDIY?



## **5.4 Research results and discussion**

As far as the findings are concerned, both groups underlined – first of all – the engagement in knowledge sharing/creating of networkers. As such NMDSO marketing firms can be definitely considered learning organizations (Guerini 2013; Nonaka et al. 2006; Argyris, Schon 1978) and knowledge sharing is a fundamental activity of every networker engaged in continuous learning, via frequent interactions with his up-line and its downline, and with the firm.

At the same time, in the case of network marketing activities, this seems far more important than in pure direct selling activities. Networkers confirm the extensive use of technology to run the various core activities, coordinate workforce and support its relationships with third parties and prospects. Networkers also affirm they use different applications depending on the type of relationships, clearly distinguishing between their collaboration with the company, or with the downlines. Though there was not full agreement (60%), most of them stated that nowadays digital technology keeps networks together, with social media heightening the connectivity. The latter capability is strictly reduced to intra-downline relations, whereas it doesn't fit for horizontal relationships between different networkers teams, and within vertical relationships with the headquarter.

The main findings about the nature of the knowledge shared in social media groups suggest a distinction between the sharing of information about the activity and the ideological considerations.

Downlines share, on a daily basis, huge quantities of information about the company, its marketing and compensation plan, the role of the team or persons involved, as well as their status and upgrade, sharing also verbal information, links and/or photos (Kaplan, Haenlein 2010).

Information technology is increasingly used by personnel engaged in network marketing activities also as a means to encourage collective action in support of the advancement of an ideology or idea (Oh et al. 2013). In this sense the analysed types of organizations rely heavily on information, whereas community-building, and action-oriented messages, using the taxonomy of Lovejoy and Saxton (Lovejoy, Saxton 2012) seems to merge in an “ideology-sharing” category.

For them, this is considered part of the sales activity, frequently communicated (by the NMDSO as well) much more as a typical way of life rather than as an alternative distribution model for goods and services. In this case the downlines interact frequently to share contributions by bestseller Authors in the field of network marketing, videos and posts that lay the foundation of the network marketing ideology. The ideology-sharing concretely occurs, on the basis of the narration done during the focus groups, by researching, analysing and diffusing interesting contributions or by generating new contents by commenting them, and posting the results in all the social networks in which they are active (FB personal page and group, Youtube, personal site if existing).

Referring to the goals that motivate the sharing of information, economic benefits are mostly cited. Being compensation plans in network marketing activities structured so as to reward collaboration between people, sharing appears a rational, utility maximizing behaviour. Furthermore, there are signs of both positive and negative influences of economic incentives on sharing behaviour (Davenport, Prusak 1998; Bock et al. 2005; Kankanhalli et al. 2005) as networkers underline, during the conversations within the focus groups, that “economic benefits are the reason for avoiding knowledge sharing with different downlines” (horizontal relationships). This behaviour has a potential negative impact on the network as a whole in terms of coordination and success.

It is interesting to underline that discussion converged, as the focus group components stressed, that knowledge sharing is considered by owners also as a way of “helping people”, thus solving them “problems” and favouring a “better future of all people involved”. More clearly, networkers add to



economic benefits personal gratification as an important by-product of knowledge sharing, collaboration and networking. In this case, the interaction via FB and Whatsup allows networkers to keep in contact continuously with recently engaged workforce and favour their motivation, training and the appraisal of the ideology.

Moreover, in the context of network marketing, sharing through social networks serves as an incentive for saving economic resources (Luchs et al. 2011). In network marketing activities the organization of events is frequent and common (and will persist in future). At the events all downline components participate actively by accompanying new members, potential customers and future networkers. Nevertheless, if the knowledge sharing occurs via social networks, instead of vis-à-vis, the speediness and the advantage of cost-saving become the main reasons for non-personal interaction.

At the same time, both focus groups confirm that a fundamental dimension of virtual interactions via social networks is represented by the enjoyment derived from the activity itself. Social networks appear to be “a way of handling life”. Being the contents of information shared multimedia, and thanks to the variety of stand-alone and built-in social media services currently available, networkers underline the fact that entertainment and joy are part of their lives, and “entertainment an important reason for interacting via social networks”. On the basis of what networkers mention during the focus groups, conversation mediated by technology include every aspect of the networkers’ lives. Photos and videos regarding their private sphere are part of the information sharing. Nevertheless, frequent interchange includes posts, videos, texts dealing about aspects of our “existence as human beings” that encourage, through emotional arousal, also the likelihood of sharing news (Berger 2011).

Enjoyment has been regarded as an important factor in sharing-related activities, such as information system use (van der Heijden 2004), and information sharing on the internet (Nov 2007; Nov et al. 2010). A study on the continued use of social networking services established that enjoyment is a primary factor, followed by the number of peers and usefulness (Lin & Lu, 2011). Social networking services and similar service design used elsewhere can be seen to especially promote relatedness – see (Hamari, Koivisto 2015), and, e.g. (Deci, Ryan 1985; Ryan, Deci 2000), on relatedness –, which is a major determinant for intrinsically motivated use such as enjoyment.

Finally, some questions were addressed to the impact of knowledge sharing in network marketing activities fostered by social media. Within downlines, knowledge sharing has been defined as the main source of knowledge, its impact judged as ‘very high’, its value defined as “incomparable”; with the words of the interviewees: “without interaction, collaboration and knowledge sharing, network marketing wouldn’t be network marketing”; “social media modify the way we share knowledge and information by rendering that all much easier, faster and more agreeable”; “the continuity allowed by cheap technology in interaction and collaboration makes it possible to reach 1 billion clients worldwide in a limited number of years, which is our network’s goal.”

## **5.5 Conclusions and limitations**

This study has several limitations. They include issues related to: (a) sampling, (b) possible researcher influence, and (c) participants’ level of honesty and accuracy. The study was also limited to one network and networkers came all from one country.

Nevertheless, we contributed to the elimination of the general lack of context regarding knowledge sharing in social media, as indicated by Kümpel et al. (Kümpel et al. 2015) in reference to



qualitative and situation-related research about news sharing. Respondents had the opportunity to further develop their thoughts and provide reasons for their individual and collective sharing behaviour.

The qualitative approach was suitable and appropriate to the study for the richness of the information obtained allowing researchers to gain preliminary insights into the research problems and to develop propositions to be validated quantitatively (Creswell 2005). As clarified in the Introduction, the research project is comprised of a series of steps. The results of the preliminary focus groups encourage the launch of a survey intended to acquire knowledge on the use of digital technologies by networkers and identify DiDYers. This study offers some preliminary insights on the relation between knowledge-oriented technologies and NMDSO by analysing the nature and the objectives of the web-enabled collaboration.

The “social web” (Stroulia 2013) offers the means of socializing the advantages of the network marketing model, considered primarily a “way of life”, in which autonomy, joy and amusement, but also altruism, generosity and personal gratification pay a great role. Through the means of the social web, network marketers benefit from cost-reduction, increased efficiency and personal gratification as well.

At the same time, the study seems to offer also some preliminary insights into the “knowledge artefact” construct as well, and can be useful both to inform the design and to evaluate the impact of knowledge-oriented technologies in the communities of practice that adopt them and adapt them to their ever-evolving bodies of knowledge. In details, knowledge artefacts appear to be embedded in culture: in this case the network marketing culture, being the research results highly homogeneous.

Besides networkers found some difficulties in defining clearly the correlation between applicative used/objectives and outcome. A further effort by the authors will be, thus, directed to the investigation of the knowledge oriented platforms that best support knowledge sharing and creation in NMDSO, depending on the complexity of their aims. Nevertheless, it is apparent that the above mentioned social media represent the main application used so far for virtual knowledge sharing and creation. Networker marketers have also proved to be knowledge sharing agents highly active within their personal and professional network.

Thus, the general recommendation to focus more on theory building could be combined with the suggestion to subdivide theory building about knowledge exchange via social media, not only considering organizations and individuals but also persona/professional networks.

Thirdly, this culture-bound, context related research results deductively sustain the call for a theory based on a multidisciplinary approach that could positively be impacted from advances in information technology, economics, marketing, organization and psychology.





## 6. Research Topic 4: Healthcare professionals

This Research Topic investigates the phenomenon of DiDIY in the medical domain. In particular, the main contribution is a conceptual framework based on the notion of DiDIY in healthcare. To help focus on the main actors and assets composing the 3D printing innovation roles in healthcare we model: the DiDIYer as the main initiator of the practice innovation; the available technology allowing the envisioning of new practices; the specific activities gaining benefits from the innovative techniques introduced; and the knowledge community continuously supporting and evolving knowledge practices. A general introduction on the notion of knowledge artefacts (KAs) and on the use of 3D printing in medicine will be followed by our research questions and by a more detailed analysis of diagnostic, training and surgical planning activities for clinicians and patients. Observations carried out in a hospital in Italy are reported to exemplify activities based on 3DP bone models in the radiological and orthopaedic fields. These observations can be considered a second contribution of the work, although secondary with respect to the conceptual framework. They also help proof how knowledge sharing and circulation in the community of healthcare professionals may be improved by the introduction of tangible and intangible KAs around the practice of DiDIY. Our framework is then presented in the end.

A KA has been defined (Cabitza et al. 2014c) as *any artefact that is purposely designed to support knowledge-related activities* in any practice. Although this is an (intentionally) broad definition, it allows to exclude most of the tools that are used in the human activities where users do not rely on these tools to take decisions, access a body of notions that are useful to interpret or understand a situation, or to solve a problem and complete a task relying on past experiences and solutions.

After a comprehensive survey of the varied literature available on this matter, Cabitza and Locoro (2014a) identified two main perspectives along which to conceive this class of artefacts: *objectivity* and *situativity*. These are seen as two extremes of a broad spectrum of application solutions, which often offer functionalities that cannot be traced back to only one extreme but rather lie in between. What do these two terms refer to? At the former extreme, there lies the idea that knowledge can be expressed in explicit and linguistic forms, in terms of guidelines, procedures, rules and notions. As such, knowledge is somehow quantifiable (e.g., in terms of how many statements, rules, notions constitute it); it exists independently of any possible consumers, like a book on a library shelf; and it can be transferred from one place to another, e.g., by email or a courier. Therefore knowledge is seen as if it were an *object* for any practical purpose (hence the name of the approach). At the situativist extreme, instead, knowledge is assimilated to a *knowledgeable behaviour* that competent people exhibit *during a specific situation and within a social practice*. This latter is seen as a set of activities where more or less explicit rules and conventions that are shared within a social group stipulate and normate the right way to have things done, and where an often totally ineffable know-how allows the practitioners to accomplish their tasks. In the situativist case, KAs are those artefacts that enable the sharing of ideas, the learning process and the mediation of collective activities of problem framing, agreement reaching and decision making, without knowledge being objectified in any form (neither as written facts nor written rules) as above.

This objective-situative spectrum regards the *degree of specification* (high in objective KAs and low in situative KAs – Cabitza et al. 2013) and the very way in which knowledge is conceived (cf. objectivism vs constructivism – Vrasidas, 2000). In this contribution, to this dimension we add two further dimensions regarding *interactivity*, and *tangibility*. KAs can be either passive or interactive. And they can be either tangible or intangible.



The latter dipole allows us to distinguish, quite sharply, between software applications and physical, tangible objects. The former KAs are certainly “physical” (and often even material) in that their users can perceive them, but their way to show themselves is through patterns of energy and matter that could hardly be touched (in this light a mouse is just a tangible controller to move a pointer on the screen, but the real application regards bit of energy in memory modules or pixel grids). Tangible objects, which we all are very familiar with, are usually passive, but this is not necessarily always the case: a washing machine, for instance, can be touched (indeed, it is even quite heavy) but through some controllers it can also respond to the users’ commands and settings and through sensors can “take decisions” on how to proceed in carrying out its washing programs. On the other hand, not all of the intangible (software) objects are interactive in the same way, nor necessarily so their level of interaction matters. For instance, the Wikipedia, although it is a very comprehensive and convenient source of knowledge (in an objectivist viewpoint), responds to the user’s textual query and allows just to open new pages from the links of another one, that is a sort of basic interaction; but it is not proactive in its provision of knowledge nuggets, facts, taxonomies and procedures, as an expert system would be; rather it is reactive. To the other extreme, there are decision support systems, that is software systems that, once been fed in with the available information about a case, suggest ways to classify, treat or manage it (e.g., in the healthcare domain, in the legal one and in Customer Relationship Management). These are very interactive intangible KAs, which can even surprise its users (and indeed rightly so they consult it to get indications they still ignore).

In our studies, we identified two extreme examples of KA: shapes produced with 3D printing technology, in particular bones and anatomical parts printed by radiologists and orthopaedic surgeons. And social media that support the practices of the professional roles mentioned above, by providing videos, blog articles, guides and a place for DiDIYers, makers and 3DP enthusiasts in the orthopaedic surgery domain to ask questions and exchange advice. This latter case also regards the increasing use of intangible and interactive KAs that can support (in a more less objectivist/situativist manner) the pioneers and early-adopters of 3DP technologies for their delicate and often very difficult work (consisting in very complex surgery aimed at correcting important deformities and alleviating multiple pathological conditions).

Although both cases are important and worthy of further research, in this worker we will focus on the former case, 3DP, in order to both keep the scope of the paper circumscribed, and also to acknowledge the increasing relevance of the literature contributions on embodiment (Dourish 2001; Lakoff, Johnson 1999; Varela et al. 1991), which argues for a close link between physical activity and cognition and on the role of physical manipulative materials in supporting learning (Rybarczyk, Fonseca 2012; Hornecker, Buur 2006; Pernin et al. 2012). In the same vein, we observed how relying on situativist, tangible and passive KAs, rather than only 2D representations, improved planning, communication and decision making in the orthopaedic settings we studied. In what follows, we will interpret these observations referring to the concept of DiDIY, in which either an *amateur* or a *professional*, which we call DiDIYer, builds up material artefacts by herself with 3D printing technologies *for her job and daily work, without the aid of specialists*.

## **6.1 Research questions**

Our research topic focuses on the impact of DiDIY and 3D printing on the healthcare practices, training and communication processes. All of these contexts have in common the exploitation of knowledge and knowledge artefacts in different forms (Cabitza et al. 2014c). Healthcare



practitioners rely most of the time on a kind of tacit knowledge based on their training, “situation specific wisdom”, and narrative exchange of real cases with their peers (Greenhalgh, Wieringa 2011). Traditional training techniques in health education are mostly based on human cadavers dissection and inspection, either for school teaching or pre-operative simulations (McMenamin et al. 2014; Regier et al. 2010). Finally, pre-surgical, intra-operative and patient-specific communication are well known to be delicate moments where improving the awareness for patient consenting (de Mel 2016; Starosolski et al., 2014; Regier et al., 2010), the shared understanding in surgical rehearsal (Mitsouras et al. 2015) and the rapid decision-making during the ongoing operation may be of vital importance.

Consequently, our research questions regard whether and how DiDIY processes and artefacts may influence, enhance and guide the mechanisms of knowledge circulation (Cabitza et al. 2014b) in medical settings, and in particular in radiological practice either by single doctors or in cooperation with other clinicians. In summary, they are the following:

- do 3D printing artefacts modify diagnostic and therapeutic decision making?
- do 3D printing artefacts modify training and teaching in radiology?
- what are the dynamics of knowledge circulation between members of hybrid communities and the hospitals where they work?

Some preliminary answers can be found in this study, where we elaborate a DiDIY framework tailored on the specific healthcare domain that should help focus on the main actors, technologies, activities and communities involved.

We report in this study some early reflections, on the basis of the specialistic literature and of the existing online communities, mentioned in section 6.2, and in observational studies carried out in an Italian hospital, from which some vignettes have being extracted and are reported in section 6.3 and discussed in section 6.4 where we introduce our framework; section 6.5 draws some conclusions on our study.

## **6.2 Background**

### **6.2.1 The technology at hand**

In the healthcare literature, 3D printing is finding its place in different facets of the professionals practice. We will shed light in particular on the practice of surgery, orthopaedics and radiologists, starting from the technical process of medical 3D printing.

For reproducing patient-specific anatomy, 3D printing objects are generated from medical imaging acquired through either Computer Tomography (CT) in its several variants (e.g., Multidetector Computer Tomography (MDCT), Single Photo Emission Computer Tomography (SPECT), and so on) and Magnetic Resonance Imaging (MRI). A second step of this elaborate acquisition is the saving of imaging data into Digital Imaging and Communication in Medicine (DICOM) format. A further step consists in the 3D rendering of the image, by segmentation techniques, which can be manual, automatic or semi-automatic (Auricchio, Marconi 2016), depending on the complexity of the data managed. Segmentation allows to place regions of interests on the images for further volumetric refinement (Mitsouras et al. 2015). During segmentation, a 3D model of the acquired image is rendered as a geometrical transformation into a set of triangles (called mesh), which allows the data to be readable by a 3D printer. One of the most common 3D files format for 3D object printing is the Standard Tessellation Language (STL), which refers to the property of the image to



be represented as a set of triangles, at different degree of precision (or smoothing). Commonly, a 3D model is then virtually cut into equally-thin horizontal slices, and each slice can be printed in various materials (e.g., “powder, resins, filaments and hydrogels” – see de Mel 2016 and Mitsouras et al. 2015) and laid down as a layer of the 3D object. Each slice is then fused together with the just printed layers, according to disparate techniques using chemical and physics processes (e.g., photopolymerization, material jetting, material extrusion, powder bed fusion, sheet lamination, direct energy deposition, and so on – Auricchio, Marconi 2016; Rengier et al. 2010; Malik et al. 2015).

### 6.2.2 A quick glimpse at the literature

A 3D printed object is very different from a 3D virtual object. Recent comparative studies of 3D virtual and material objects in manipulation tasks have shown that “performance during the activities was significantly higher when using tangible representations” (Cuendet et al. 2012). In healthcare domain, this has proven to give a pre-operative visuo-haptic capability to physicians of unprecedented flexibility and precision (de Mel, 2016). 3DP objects can be exploited to gain a huge amount of patient-specific detailed and clear information before a complex surgery takes place, for example in case of deformities correction. Obviously, not all the activities need the use of 3D printing, and this is especially evident in diagnostics and classification tasks (Mitsouras et al. 2015). A literature survey (Malik et al. 2015) on around 500 papers retrieved from Medline, Embase, and PsychInfo databases, helps detect the three main areas where 3D printing is currently exploited in surgery.

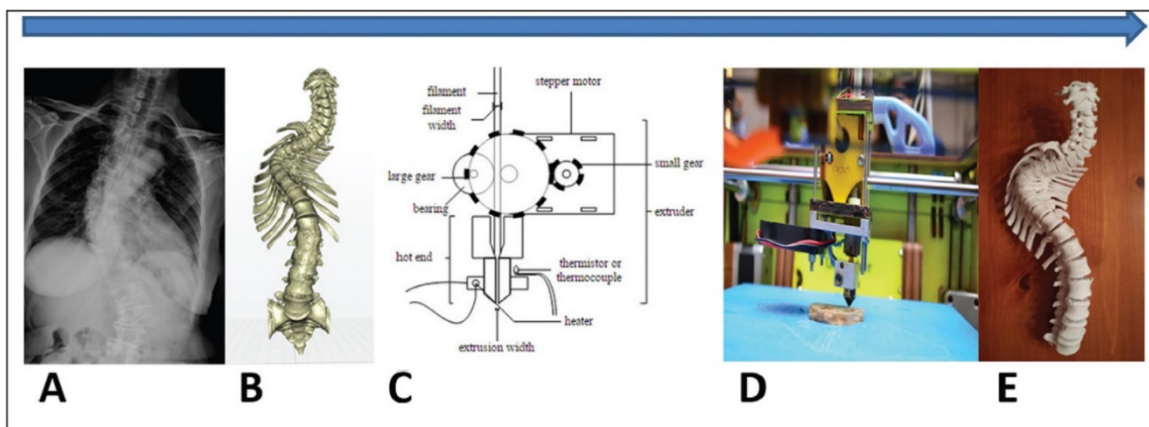


Figure 9 – The process from the virtual image to the printed object, taken from Eltorai et al. (2015).

They are: anatomic models, medical devices like surgical instruments and implants, and prostheses. Anatomic models are used by doctors to familiarize with the patient anatomy in surgery planning, and help them reflect on the challenging and risky passages of an operation well in advance. This patient-specific appreciation overcomes traditional simulations (see, for example Malik et al. 2015; Rengier et al. 2015). In some cases, for example cardiothoracic surgery, bespoke heart models are exploited either for planning and for intra-operation activities. Young surgeons can be trained (Malik et al. 2015) through the manipulation of these objects besides traditional virtual patients environments (Cabitza et al. 2016), which help “simulate in vivo conditions and real tissues without any risk of patient complications” (Rengier et al. 2015). Also patients and their family may be better informed on the pathology at hand and the necessary therapy, and this helps the psychological



conditions under which a surgery can be understood, accepted and perceived as satisfactory (Malik et al. 2015).

In orthopaedic surgery, where “radiographs are used routinely [...] yet they provide inadequate information on the precise 3D extent of bone defects” (Auricchio, Marconi 2016), 3D models are exploited to assess tools trajectories, to measure and prepare materials for fixing bone fractures and placing plates and screws in advance (e.g., assessing surgical manoeuvres for the placement of pedicle screws in spinal surgery). Patient-specific guides and templates are also printed in 3D and used during the operation as supportive devices that are removed at the end. In the maxillofacial reconstruction or in the implants placement, for example, these kind of devices have reduced the time of operation and improved the efficacy of the outcomes (Malik et al. 2015).

In low error-tolerance scenarios, such as for example in neurosurgery, the 3D reproduction of the skull or of the tumours may help understand the exact resection boundaries and provide a level of accuracy that reduce risks, operation time and the number of errors and adverse events (Mitsouras et al. 2015).

A pivotal factor in favour of the manipulation of medical imaging for 3D printing technology adoption is that radiologists and radiographers, as more and more “image guided surgeries call for radiology to become strongly integrated in a therapeutic team together with different surgical specialists” (Rengier et al. 2010) are acquiring prominent roles. However, open issues rise in the passage from data images into 3D prototypes as this encompasses “a multidisciplinary array of fields involving knowledge ranging from data acquisition, image post-processing and manufacturing of the prototype by various techniques” (*ibidem*). The authors contend that although radiologists may facilitate the introduction of additive manufacturing in healthcare, this integration would result difficult, if feasible at all, without a close cooperation with other roles such as computer scientists, material experts, clinicians and other healthcare professionals.

At the frontier of 3D printing technologies we also mention bioprinting, i.e., the reproduction of cellular tissues and the related organs for implantation in human bodies. Since research studies are still preliminary, we do not treat them here and refer the interested reader to the overview by Mok et al. (2016).

### **6.2.3 Online communities in the medical field**

Communities in the field are those of physicians who meet periodically with 3DP professionals in their universities, institutions and research centres, where a broad spectrum of experimental activities takes place. This aspect is witnessed for example by our observational studies reported in Section 3.

Virtual communities of makers exist and gather around online platforms such as 3D Slicer (Fedorov et al. 2015), an MIT initiative, which provides a mature, open source, and fully-fledged software platform specialized in “image guided therapy”. Intelligent online platforms such as POIGO (Popescu et al. 2015) aim to integrate medical expertise with the manufacturing of tools for the so called personalized surgical templates, an increasing popular range of tools for helping surgeons customize their operations around their patients, and reduce costs, risks and adverse events.

Other kind of tools are online blogs and reference websites that help gain knowledge on specific health topics and techniques, and are tailored for specialists of different kind; for example: the Italian blog “Fermononrespiri” (<http://fermononrespiri.com>) where discussions on MRI, CT, and diagnostic by images are the main topics discussed by the participants to the online forum that the



website provides; “Embodi3D” (<http://www.embodi3d.com>), where a virtual community gathers around virtual spaces such as blogs, forums, textual tutorial and “how-tos” for 3D printing, a marketplace where to buy and sell biomedical models, and a training section with training models, realized with the aid of health professionals (e.g., 3D vascular models such as venous models and arterial models).

### **6.3 Research Design**

In our study, we had the opportunity to carry out two observational studies in the Marino hospital in Cagliari, Italy. This hospital is near to be dismissed, since the recent regional policy making decision of cutting administrative costs. However, currently the hospital hosts healthcare figures of both professional and academic kind, in the two local specializations of traumatology and emergency surgery. The hospital is one of the only two hospitals in the Sardinia Island equipped with hyperbaric chambers. Its main areas of orthopaedic expertise are hip and knee surgery, upon which we will focus our investigation. In particular, we will examine a case where the introduction of additive manufacturing (3DP) has been used to support the planning and pre-operative training of a knee prosthetic surgery.

This is not the case of an ex-novo, patient-specific 3D printing of a knee prosthesis (re)production, but of a traditional bone-prosthesis replacement, with the support of an anatomic model of the patient bones, exploited to support and enhance the outcome of a traditional surgical practice.

We depict in the following two vignettes on how 3D printing is used to inform and educate the patient to know more of his pathology and of the subsequent therapy, as well as for surgical rehearsal.

#### **6.3.1 The patient informed consent**

It is Monday morning. Today Prof. Bones will explain the pros and cons of the procedure of knee replacement surgery that Marco Poli (male, 58 years old) will decide to undertake or not. In case he decides to do it, he will sign the informed consent form.

Prof. Bones, the orthopaedic surgeon, met Mr. Poli previously and, during that occasion, he prescribed to him routinely examination tests such as blood, urine, drugs intolerance, and a radiography. By reporting the radiologist report of this last exam Prof. Bones realized the morphological deformities and damages affecting the patient’s knee joint and the need for Mr. Poli to undergo a surgery.

For this reason, once the surgeon analysed the report, he prescribed to Mr. Poli a second and more complete diagnostic examination: a CT, with the aim to obtain from it a 3D dataset in DICOM format and, hence, to use additive manufacturing to create a patient-specific anatomical model before the meeting with him during the day hospital session. In so doing, Prof. Bones could further investigate the patient-specific problem and let Mr. Poli see and touch first hand the tangible representation of his condition, through the replica of his irreversibly injured articulation.

Monday it’s the day where other tests are done, more extensive and specific, to gather information about the patient’s anamnesis. In particular, physical examinations are aiming at assessing movement, stability, strength, and alignment of the patient’s joint, and a more specific test (an MRI) was aimed to better analyse the anatomy of his soft tissue (muscles, tendons, and cartilage).



Figure 10 – A 3D printing spine with implanted nails for pre-surgical rehearsal.

The study of Mr. Poli’s anamnesis already showed a compound fracture dating back to when he was 32, which involved the femur to come closer to the same left knee region now under examination. In addition, during these last exams, Prof. Bones evaluates the condition of the damage caused by post-traumatic arthritis, which severely limits the patient in articular functionality by afflicting him with persistent pain, and pronounce himself in favour of the joint replacement as a treatment of election.

Now Prof. Bones is ready to talk to Mr. Poli, who may appreciate his own case also with the aid of anatomic models reproducing his articulations, and that the surgeon made ready before their meeting. Thanks to them, the surgeon can show with precision to the patient which parts of his knee are irreducibly deteriorated, which operation Mr. Poli should undergo to his bottom femur and top tibia to let the articulation work out again, and to hypothesize with him the exploitation of the proper traditional prosthesis having the best dimensions similar to his original bones.

In so doing, Mr. Poli understands vividly his case, and is able to integrate these information with those reported in the informed consent form. Mr. Poli, under a mood of psychological relief for the awareness gained during the meeting with the surgeon, agrees to the operation.

### 6.3.2 The surgical planning

The Friday before, the orthopaedic surgeon met the radiologist to discuss in more details the case at hand and asked him whether he recommended to run a further test in order to use additive manufacturing with the case at hand. The radiologist proposed to do an MRI scan, and to call Dr. Bolt, who is a professional consultant in the field of additive manufacturing and 3D technologies applied to prosthetic surgery, with the aim to print a 3D model of the patient’s joint bones. In particular, the radiologist asked Dr. Bolt to do an evaluation of the most appropriate acquisition parameters, in order to optimize the effectiveness of the dataset for later use with additive manufacturing technologies.

Both MRI and CT results are exploited in order to obtain the most accurate reproduction of both the hard and soft tissues of the patient-specific anatomical model.



The surgeon then calls the professional consultant, with whom he agrees upon which are most appropriate materials and processes to be used. An anatomical replica of the patient's hard tissues should be produced by using Fused Deposition Modeling (FDM) technology and Polyethylene terephthalate glycol-modified (PETG) material, as this can be submitted to antibacterial sanitizing processes, if necessary. An anatomical replica of soft tissues should be produced by stereolithography (SLA) and photosensible resin, which is a soft and flexible material that could be also compatible with some sanitizing procedures.

Thanks to the 3D printing custom-made models the surgeon and his team may start the surgical planning. The surgeon studies the osteotomy planes, performs measures of trajectories and lengths of the necessary perforations by simulating them directly in the anatomical models.

In so doing, the surgeon may transfer all the necessary data to the consultant, so that he can in his turn create the anatomic replicas, the surgical guides and all the supporting material for the operation. For example, he may prepare the osteotomy planes in the custom-made models with the cuts and the holes already performed on them, through FDM and SLA technologies, and under the direct supervision of the surgeon, who can simulate the operation moments in minute detail.

The software used in this phase allows the application of osteotomy planes and holes, the creation of scaffolds for dimes and the 3D models availability of virtual existing surgery environments.

Furthermore, in case that a prostheses has undergone a 3D scanning process or simply its 3D models are available from the manufacturer, it is possible to pre-operatively overlap 3D prosthesis models with custom-made anatomical models, so that the prostheses fitting the patient's bones size can be easily selected. After this surgical rehearsal, some comparisons and verifications of the obtained results are still possible. In this sense, the surgeon verifies all the pre-operative process details by applying a real prosthesis of the same size of the one used in the surgical planning phase.

### **6.3.3 Some cost-effort data and lessons learnt**

3D printing is not cost nor effort free. In the specific cases, different phases before the printing were carried out, namely: image of bones acquisition; DICOM data storage and transfer (after the clinicians' decision on what to print); rendering, segmentation and triangulation for the generation of the 3D model; further editing and preparation (with the aid of the clinicians); slicing and G-code generation (for programming the printer). These pre-printing activities takes on average from 4 to 20 working hours. The printing of the patient-specific bones took around 50 hours. The costs depend on the printing technologies (e.g., either Stratasys or MakerBot printers, whose costs vary from 60.000 to 4.000 euros, respectively), on the materials used, and on the level of standardisation of these materials with respect to standards such as ISO and so on. For the case at hand, these may vary from an average of 50 to 250 euros per kilo. In the specific case, the 3D printed bones were accurate enough to guarantee similar material characteristics (e.g., density and resistance).

The most critical and error-prone passage was the activity of conversion from ERM raw data into DICOM data. In general, this is the most delicate passage and the one where both radiologists, engineers and other experts are requested to cooperate and coordinate their work and competences. As a general lesson from our experience, we may report that costs and efforts were considered affordable and the exploitation of the cheapest printer (the MakerBot one) did not compromise the quality of the work and the satisfaction of both the patient and the clinicians in manipulating the 3D printed bones.





## 6.4 A DiDIY framework for healthcare professionals

We have defined DiDIY as a human-centered phenomenon characterized by the diffusion of:

- a mindset among individuals, the DiDIYers;
- a set of activities enacted by DiDIYers.

Such activities are intended as pragmatically translating in a context the abstraction of mindset of an individual and, as a consequence, natively overcoming the level of analysis of the single individual. In DiDIY digital technology is an “enabler”, but the very existence of DiDIY does not depend on the presence of digital technology, as its core properties are human-centric, thus related to individuals’ mindsets and activities. In short, according to this approach an individual can be defined as a DiDIYer when, due to her mindset: (i) she uses to “do things” on her own that had been previously carried out by experts or specialized companies (this aspect deals with the traditional notion of Do It Yourself, or DIY), and (ii) these “things” could not be “done” without digital technology (“Di”DIY).

Under this premise, and elaborating from a previous characterisation, an operational definition which enables the identification of DiDIY activities is the following:

- a DiDIYer, i.e., certain organizational roles,
- carries out on their own certain activities,
- by exploiting certain digital technologies,
- possibly exploiting the knowledge sharing within a certain *knowledge* community (Cabitza et al. 2014c).

According to this definition and to our preliminary research, we instantiate its four dimensions in the medical domain, as follows.

**DiDIYers:** are the healthcare professional whose skills are those of a digital craftsman. This role can be played for example by doctors, surgeons, nurses, technical clinicians (e.g., radiographers).

In particular our research focused on two main roles and activities:

- the *Radiologist*, in her diagnostic and prognostic activities, who runs examinations with proper technologies and acts directly or highlights to her colleagues actions to be taken, based on all the medical information gathered during the analysis of examinations results. State-of-the-art information are bi-dimensional representations (axial, coronal and sagittal planes) of the analysed anatomical parts or, at last, 3D visualizations available thanks to 3D dashboards provided by the ultimate diagnostic tools. Whenever there are strong interpretation misalignments of diagnostic examinations, for example in case of congenital deformities, the radiologist joins the surgeon (or her collaborators) in order to analyse the examination together, so as to reconcile meaning and proceed the activity with the aid of a complex however complete set of information;
- the *Surgeon*, in her therapeutic activities, who applies her surgical speciality methodologies. She needs to collect the most part of information before taking decisions and actions that are neither diagnostic nor prognostic, hence they are not at all repeatable. For this reason, the surgeon needs the support from her colleagues, and in most complex scenarios, even from other healthcare professionals, such as for example clinical engineers, other specialists, consultants and so on.



**Technology:** is the elective tool of the DiDIYer to improve her activities or to face them in innovative ways and under unusual perspectives. The technologies involved in the healthcare domain encompass: 3D datasets from physical objects through scanning and diagnostic image acquisition; 2D visualizations of physical objects, through DICOM files or CAD software; 3D manufacturing of physical objects. In this sense, 3DP amplifies the capabilities to go from bits to atoms back and forth (*blinded reference*).

**Activity:** is the (knowledge) practice of the DiDIYer; it is the daily routine that a professional carries out alone or as a part of a community. The use of technology should improve and innovate her daily activities, so that a virtuous circle can be triggered, and creativity and new skills can emerge and flow freely, also thanks to her network community. Medical practice is peculiarly “practical”, and tangible and intangible information concur to define the logic of “knowing how to do it” or DIY. In the words of an orthopaedic surgeon (Malik et al. 2015) that we adapted to emphasize the importance of tools that improve the situated awareness and support more critical scenarios during surgical operations: “Having the chance to perform on a 3D model all the necessary steps preoperatively, valuable time is saved and surgeons have more time to focus on the present moments: *you have more time for the doing, having made the thinking*”.

**Community:** can be offline, online or both, and encompasses individuals who are either contextualized in physical meetings and workshops or in the virtual spaces of an online environment. In communities people can find inspiration for new ways of doing things while exchanging and sharing knowledge. The community is the vehicle to share experiences, results and open new ways and directions to practical problems. In the medical domain, cross-fertilization has a pivotal role: during conferences or pre-operative meetings, surgeon together with radiologists, biomedical engineers, and other medical team members may share heterogeneous knowledge and competences and find a synergy to solve problems, propose solutions or simply hypothesize new healthcare trajectories and allies.

## 6.5 Concluding remarks

Hence healthcare professionals may be helped in sharing knowledge and cooperating thanks to 3D printing resources and 3D objects, seen as either intangible and tangible (respectively) KAs. In this view, we have illustrated as the printing of virtual 3D objects into tangible material artefacts does not regard only the transition “from bits to atoms” (Bull, Garofalo 2009). Rather it also pertains the transition from digital objects to “matters of fact” (i.e., physical objects) and eventually to “matters of concerns” (Latour 2004), that is *things*, to discuss both *about* and *around*. The physical availability in an increasing number of work settings of this kind of *things*, through a making-oriented and DIY attitude, creates opportunities also for other kinds of *social* making, like sense making and decision making (in our case, among health practitioners) and enrich these activities in ways that are still to be explored. In particular, we illustrated this phenomenon in two vignettes taken from our observational study:

- 1) the orthopaedic surgeon talks with the patient, who is going to undergo a surgery for the replacement of his knee joints, by showing him details of his injury and the necessary operation details with the aid of a custom-made 3D anatomical model. This KA helps the patient “see” his situation more clearly and take a more informed decision on the surgical operation;
- 2) the orthopaedic surgeon talks with his team members to discuss the details of the surgical operation and to test in advance the prosthesis against the patient-specific 3D reproduction of the



knee joint articulation (the KA). In so doing, a relevant amount of time can be saved for settings and measurements, and the KA can help reduce the operation time, improve safety and lead to better outcome.

As purported in the specialist literature and confirmed in our observational studies, 3D printing has got a potential to change the work of surgeons, both in regard to surgery planning, and in educational activities with novices, as well as in the communication with the patient. In this sense, medical 3D printed objects represent a new toolkit of KAs available to prosthetic practitioners, as these artefacts allow for the patient-specific configuration and setting of the main parameters and measurements that can be tested before the surgery takes place. In this light, further research should be aimed at understanding whether prototype replicas can help practitioners replace the more traditional “diagnostics by imaging” paradigm with a complementary, if not alternative, one: a “diagnostics by volumes”, which would enable the emergence of new knowledge circulation practices and habits.

As to future research development, a questionnaire will be administered to physicians of at least 2 hospitals in Lombardy, under the form of a semi-structured interview, and of an online questionnaire.



## 7. Research Topic 5: Shoppers

In this Research Topic we shift the point of view of the analysis from inside to outside the organization. The subject of the RT is the client of a retailing company, a consumer whose behaviour has shown relevant changes in the last decade, also due to the exploitation of digital tools. The consumer's decision process has been increasingly been informed with the support of web platforms and mobile apps. As a result, the shopping process has profoundly changed, and retailers are now facing the challenge to interact with a shopper who shows several of the traits of who we call in this project a DiDIYer. The aim of this RT5 is to identify the impact of this change on retailers organization and work.

This RT has been only recently identified and therefore only the first steps of the research have been carried out: the following sections describe the theoretical background about consumer behaviour and the main characteristics of the shopping process.

### ***7.1 Theoretical background: consumer behaviour and consumer decision making: multidisciplinary contributes***

Consumer behaviour and decision making have long been of interest to many authors. Only since the 1950's the notion of consumer behaviour has responded to the conception and growth of modern marketing to understand the impact upon the consumer decision (Blackwell, Miniardet 2001). This is evident in a recent definition of *consumer behaviour*: "consumer behaviour [...] is the study of the processes involved when individuals or groups select, purchase, use or dispose of products, services, ideas or experiences to satisfy needs and desires." (Solomon, Bamossy et al. 2006, p.6).

This approach, far from being considered a monolithic theoretical model, represents a fundamental issue to investigate the structures and the opportunities within the consumer behaviour, that under the sociologist point of view, is considered and analysed as a collective act, where the deciding factor of the purchasing decision must be found in the area of social influence: class, culture and reference groups, that sometimes force the consumer to look for items functional to achieve social status and sense of belonging or to differentiate from other consumers.

Veblen (1934) analyses the consumer choice and the diffusion of consuming patterns under the social variables influence. Social classes consider wealth as the foundation for reputation and respect, forcing individuals to demonstrate and show their status in terms of flashy affluence and consume. Under Veblen's point of view items play a role of social distinction, based on wealth possession and, most importantly, wealth exhibition. Emulation is the motivational engine of consumer behaviour: assets are used to demonstrate superiority to lower social classes. Veblen's analysis of conspicuous consumption that is consumption that signals wealth is the first contribution to the economic literature.

Duesenberry (1949) and Leibenstein (1950) provide a second sociologic approach to the definition a comprehension of the consume pattern, that is a social issue with strong demonstrative intent.

The consumer behaviour is based on interdependent selections, influenced by the chooses of other individuals in the same environment. The most significant consequence of this interdependence is the "demonstrative effect": the satisfaction an individual can achieve trough his/her purchases depends mostly from the comparison between his/her level of life and the level of other social group.



Within psychology, one of the most famous theory is Maslow hierarchy scheme, that explains the identification of consumer needs. The author sees motivation as an internal pressure that drives the individual to the needs satisfaction goal.

This means that motivation is an internal force that originates from an unsatisfied need. Maslow theory explains that human beings have needs both social and psychological that must be classified in terms of priority. When the basic needs have been satisfied, the attention of the individual is redirected to the next level needs.

The hierarchical order of needs groups several steps, ordered in the sequence of individual satisfaction effort.

1) Basic or physiological needs: known as physiological pulses, are the starting point of motivational theory. They are primal needs triggered by scarcity of food and they are the easiest needs that can be satisfied. They represent the daily need of food in order to grant the individual survival, expressed in terms of calories.

2) Security and protection needs, related to the individual activity (job availability, social security, medical security).

3) Social acceptance, related to a group of friends, relatives and neighbours.

4) Esteem and approval, developed by means of social relations and economic life. They could be identified in social status, power, prestige and social reputations. The approval need could be summarized in the desire to be in the same time accepted and respected.

5) Self achievement: this needs emerges when all the other needs on the scale have been satisfied and respond to the desire to achieve the most important and deep goals of the individual, in terms of personal, professional and social life.

Psychology is an important starting point in order to investigate on the consumer behaviour under the marketing decision making perspective, that transformed, the consumer behaviour into a theoretical and empirical field of research.

Today, in marketing, learning theories, cognitive/experiential approach research, and investigation on attitude are the most important field of study.

The theoretical models that at the moment are the base for the consumer behavioural analysis are comportamental, cognitive, and experiential (Dalli Romano 2003). Comportamental and cognitive approach is related to the consumer purchase behaviour, the experiential are indeed related to the consume behaviour. The comportamental models, (Howards 1969; Rice 1993; Kotler 1991) even with different depth of approach on specific issues information evaluation, influences on the decision making process, purchasing role) are based on the assumption that the consumer is part of the environment and from the environment is influenced, receiving input in order to assume consequent decisional purchase attitude. This approach however denies individual cognitive processes of elaboration. This theoretical approach admitting that the consumer activates a reply every time he is exposed to an external input does not look for an explanation, the cognitive link, between the external stimulus and the consumer reaction. This models consider the consumer as a sort of “black box” (Kotler 1991) and concentrate on the environmental influence, on the elements composing the consumer cognitive system, instead of analysing the transformation process of the external input into the consumer decision making models. Cognitive models, otherwise, go deep in analysing the individual information processing modes in order to understand the purchasing attitude. In other words the consumer is an element of the environment, receives external inputs that



are processed inside mental structures and schemes that generate the final purchasing decisions. Under Bettman (1979) approach the consumer analysis should be based on the identification of the several roles that as an acting subject: individual, decision-maker, environment element. In opposition to comportamental models cognitive models try to understand and identify the processes into the “black box”, once it has been activated. The consumer is not considered as a passive receiver of external inputs but is an active subject: looks for information, that are processed in a proprietary perceptive and cognitive scheme, releasing on the other hand inputs directed to other individuals and corporations. The consumer reacts to external inputs with a behaviour based on economic experiential and psychosocial motivations, with recognisable causality links.

Experiential models differ from previous approaches: the consumer is not a mere “mechanism” nor a sole “problem solver” but acts guided by emotional flows that are the motivational thrust of the consumer behaviour and decision making (Solomon 2004). In the end the decision making process three different phases (pre-purchase evaluation, purchasing choice and post purchase evaluation) can be mostly influenced and motivated by the capability of goods and services to generate emotive and experiential reactions that could captivate the consumer.

These aspects, in modern economies and hypercompetitive environments, characterised by evolved consuming pattern are mostly linked to the symbolic, intangible and psychosocial components of the offering systems and, on the material side to the techno-functionals and tangible elements.

Experience in consuming processes is a new customer and shopper requirement in modern economic contexts and represent a new competition lever for commercial and service companies.

## ***7.2 Shopper involvement and experience***

Several authors from the psychology field has analysed the involvement concept but fewer and more recent are studies related to the customer involvement a behaviour inside the store. As a matter of fact, the experiences lived by consumers when they buy or consume products could be regarded as the most important purchase mover (Arnold, Price, Zinkhan 2002). At the moment, from the first approach (Holbrook, Hirshman 1982) to the experiential consumer behaviour, this developed rapidly and represent today one of the most important area of the marketing theory. (Arnouleid, Thompson 2005). Meanwhile other authors evidenced the importance of creating extraordinary experiences for the clients in order to compete in the market. This trend is definitively visible especially in the services and Retailing sectors that went through a radical transformation. The basic principle proposed by Pine and Gilmore (1999) is that every single product can be transformed in a memorable experience.

Schmidt, in 2003, wrote that managing corporation in order to create experiences is a clear market strategic orientation. Companies, to follow this orientation, must analyse in deep the mind and the hearth of their clients, and be able to understand which experience must be created in order to satisfy them (Zaltman 2003).

Three drivers must be identified in the analysis is the shopper involvement inside the selling area:

- range of product or assortment;
- brand;
- shopping activity.

Under the research conducted by Lockshin, Spawton, and MacIntosh (1997) the three drivers can help to define 5 different clusters:



- Choosy Shoppers, that show high degree of involvement with product, brand, and shopping activity;
- Brand-Conscious Shop Haters: they do not love shopping but are really aware of brand and of product evaluation;
- Uninvolved Shoppers: they are not interested in brand or product characteristics but look for the cheapest alternative;
- Interested Shoppers: they are really involved in the product and in the purchasing decision but not interested in the brand at all;
- Lazy Involved Shoppers: they are really interested and involved in the product but not interested in both brand and shopping activity.

It is crucial for the retailer the ability to segment consumer under the involvement level point of view, in order to evaluate specific retailing mix alternatives more suitable for the reference target, or better strategies more coherent with the consumer objectives, with more satisfaction even in the shopping behaviour until the final post-purchase moment.

### ***7.3 Shopping and shopper behaviour***

According to Putrevu and Lord (2001) no descriptive model can be considered complete without the analysis of the choice process previous to any eventual buying decision. Research and product choice decision are two important and inseparable stages: decisional objectives motivate and drive the choice process; meanwhile is the decision making to set the characteristics of the shopping decision and therefore outline the most effective communication strategies to be implemented in the shopping area. As from current literature, (Bloch 1986; Popkowsky, Timmerman 2001) Consumers act with different behaviours related to different variables like preventive planning, sought advantages, level of involvement, ability to outline differences between brands, money, available time, price sensitivity, store atmosphere.

Since these variables are different from consumer to consumer, it is clear that is crucial to identify different behaviours to the single stage. In a recent segmentation based on the grocery goods choice process (Putrevu, Lord 2001), several cluster of consumer (and shopper) are identified thanks to the observation of the moment of choice and the evaluation of the product/brand inside the shopping area. The result of the data gathering outlines the three following segments:

- high search segment;
- selective search segment;
- low search segment.

The first segment is constituted of consumers that spend a relevant amount of time checking and comparing different product and brands. These individuals often derive their satisfaction on this specific process even without finalizing the shopping act at all. The second cluster is composed by more selective individuals that tend to reduce at the minimum amount the time spent in comparing product, brands and store. The final group is the one less involved in the choice process.

The identified clusters are in the end very similar to those previously identified by Furse (1984), that after the analysis of the data acquired before the evaluation and the purchase of the product, was able to discover the existence of consumers that orient their choice on infos acquired only inside the shopping area. In other terms seems that the selective consumers introduced by Putrevu



and Lord could be further distinguished in “Store Based”, those that utilize mostly information available inside the selling area, and “non-store based, those that act primarily utilizing information like friends and relatives suggestions, or reports from several media.

In the recent past several technological innovations modified the relation with the consumer. Several retailers that are implementing in-store technology to improve the shopping experience, in order to be aligned on all channels (Zooz 2015). One notable example is the presence of Beacons, low energy sensors that interact, sending information via Bluetooth, with mobile devices in a predetermined range. Those devices constitute a typical example of integration between the digital and the off-line channel: beacons are strategically placed in order to technologically targets the shopper, as soon as he gets inside the store, with custom made offers and personalized promotions. Beacons are able to track the preferred areas where the shoppers walk and stops, the way they move, where do they stop inside or even outside the shop. In this way a special customized offer could be “fired” to persons looking to specific windows or the analysis of the data can be used to modify in- store configurations.

Until now retailers could gather these data from their eCommerce platform, but with the use of beacons those data can be utilized in store to create experiences with the highest possible degree of personalization. At the moment one of the most important trend is the in-store use of augmented reality. In the cosmetic sector Sephora allows several brands to utilize an augmented reality 3D mirror to test several products in real time with obvious savings in terms of less testers used and, of course, less personnel time for single operation. Ikea offers another example of augmented reality with the “place in your room” app, that enable the viewer to install the furniture in any given room of his/her house, with a quite accurate 360 degrees rendering.

Technical innovations imply physical modification of the stores and demand the need of different lay-out and display placement, that must be able to integrate innovations without an invasive approach. The digital revolution involves the role of the shop assistants that can interact with the consumer via devices like smartphones and tablets directly in the shopping point. In this way the shopping experience evolves in a more and more customized mode with higher and higher engagement levels because it is now possible to know the preferences of the single specific shopper in real time (Rigby 2011).

The consumer behaviour analysis is assuming new meanings: the chameleonic consumer (Cova 1997), the hedonistic consumer (Hiirschmann, Hollbrook 1982), the growing importance in shopping choices of subjective and emotional benefits, compared to rational and objective benefits, experiential (Pine Gilmore 2002) and recreative dimensions of purchase and consuming processes are aspects that outline the real complexity of the field and consequently the difficulty of a single theoretical framing. In order to deeply understand the retail consumer behaviour it is really crucial to analyse the level of autonomy that the individual is gaining in any single stage of the process.





## Annex 1. The framework of the personal/environmental characteristics of a worker (RT1)

We transcribe below the detailed description of the characteristics of a DiDIYer and of a DiDIY-compliant organizational context, already presented in deliverable D3.2.

### Personal characteristics

- *Job attitude* – Workers usually have a production plan to follow and do not focus on the job they want. On the other hand, makers are free to focus on the task or job they like. This calls for a growth mindset, where, given effort and resources, anyone can learn the skills needed to complete any project they can imagine. In this light, digital technologies impact on the job allocation by granting a certain degree of flexibility (i.e., anticipation or delay of specific tasks) that can empower workers in prioritizing jobs according to their job saturation. The question to be addressed with the empirical investigation is: “how personal attitudes and motivations can be fostered in the working environment building on the case/experience of the makers generating innovation?” (Martin 2015).
- *Autonomy* – Within organizational settings usually most of the workers respond to a specific and fixed organizational structure. Making environments, instead, are typically characterized by autonomy and control of endeavours that create more motivation, support engagement and persistence, identity development, and growth of resourcefulness. We believe that digital technologies will allow coordinators of specific functional areas to be flexible in their activities and prioritize or postpone specific tasks (i.e., taking strategic decisions although being operative people). The question to be addressed with the empirical investigation is: “in which context or tasks the availability of higher levels of autonomy may increase employees’ commitment, creativity and innovation?” (Martin 2015).
- *Failure positive* – Workers in traditional organizations that fail to compute a task may have negative feedbacks from their superiors. Yet, within the maker mindset, failure is celebrated. Failure in making circles is seen as a productive possibility to better understand the structures and constraints of problems, so that they can learn better and try again. We believe that this mindset will allow improvements in the process of the organization (i.e., operative people learn better or faster methods to accomplish a task). The question to be addressed with the empirical investigation is: “how the process of facing and adapting to multiple sticking points may be important to the development of adaptive expertise?” (Martin 2015).
- *Multidisciplinary* – In traditional organizations workers have a task and they have to complete it more efficiently as possible, on the basis of their specialization. The maker movement welcomes all types of making. Typical interests enjoyed by the maker culture include engineering-oriented pursuits such as electronics, robotics, 3D printing, and the use of CNC tools, as well as more traditional activities such as metalworking, woodworking, and, mainly, its predecessor, the traditional arts and crafts. We believe that this characteristic could be beneficial in the organization in terms of motivation and new skills gained through interaction among others. The question to be addressed with the empirical investigation is: “how the collaboration between experts in a task and other workers is needed to help build bridges between the tacit knowledge cultivated through the act of doing and the explicit and abstracted formalisms valued in assessment?” (Peppler 2013).



- *Playfulness* – Workers in traditional organizations are characterized by an attitude of seriousness. Instead, the act of making is a playful one as makers are pushed to make by passion to discovery in a learning by doing way. Indeed, they are characterized by a critical engagement with technology often characterized by a sense of play around technological norms. We believe that this characteristic could bring new motivations for workers in organizations. The question to be addressed with the empirical investigation is: “how playfulness can be fostered within traditional organizational settings?” (Tanenbaum 2013).
- *Anti-consumerism behaviour* – Traditionally in organizations there is low environmental awareness and this is translated in waste of materials, energy, and money lastly. Makers, instead, are reported to support sustainability through an ethos of fixing and remaking. 3D printing and other technologies enable people to create the spare parts which will make something work again, or to develop innovative solutions to make things usable in new ways. These practices could be effective also in organizational context both with or without digital technologies. The question to be addressed with the empirical investigation is: “how a behaviour that pays attention to sustainability can be fostered in the working environment building on the experience of the makers’ serendipitous bricolage?” (Tanenbaum 2013).
- *Computational thinking* – In traditional organization when workers face a problem in completing a task they have to inform the supervisor that will handle it personally. Makers use instead computational thinking to overcome difficulties. Computational thinking aims at training people to think like computer scientists when facing a problem. This practice could be effective also in organizational contexts to spread problem solving and independence in the production line. The questions to be addressed with the empirical investigation are: “how the introduction of computational thinking could be efficient in a production line environment?” and: “which computational tools could be helpful in doing this?” (Wing 2010; Rode 2015).

### **Environmental characteristics**

- *Quality and availability of tools* – One of the most readily apparent features of the maker movement is the celebration and use of new and affordable digital tools. As these tools provide new ways of interacting with physical materials, they also offer new opportunities for learning so they are seen as enabler for the movement. Tools, like 3D printers or CNC mills, are all based on the same principle, using software to help guide the movements of a machine tool. These could have a huge impact in organizations and lead to a new industrial revolution. The question to be addressed with the empirical investigation is: “how these tools can improve productivity and pleasure to work of workers within the paradigm of Industry 4.0?” (Anderson 2012; Martin 2015).
- *Connected facilities* – Makers, rather than just be isolated, are stitched together in the larger maker movement through several events (like maker faires hosted locally, nationally, and internationally), periodical subscriptions like Make magazine, online communities like instructables.com or DIY.org, while maker adherents can connect through non-profit organizations like Maker Education. In this way knowledge is shared online and through social networks. The question to be addressed with the empirical investigation is: “how translating this characteristic (providing an online community within organization’s facilities) in an organizational context could improve communication and productivity at plant levels?” (Peppler 2013).



- *Gamification* – The maker movement leverages on online communities that extend offline collaboration and provide spaces of collaboration and knowledge sharing. User participation in an online innovation community seems to be fostered by game elements that relate to the gamification concept. Gamification in an organizational context could be a disruptive innovation, leading sharing platforms to take place, with the aim to motivate people through the use of game elements and dynamics in nongame contexts. Game design elements refer to game design principles, game mechanics and game dynamics, storytelling and other aspects typically incorporated into games. The question to be addressed with the empirical investigation is: “how gamification mechanisms, if adopted, can improve the knowledge sharing, motivation and participation in an organization’s online community?” (Hofferbert 2015).
- *Openness* – Closeness represents a typical trait of workers’ behaviour. Vice versa, sharing ideas, projects, helping others, making and connecting, characterize makers under the collaboration perspective. The presence of digital technologies enabling information sharing may generate a higher degree of openness. The question to be addressed with the empirical investigation is: “when is it possible to introduce higher levels of openness and collaboration in the working environment to foster team building and innovation?” (Martin 2015).
- *Learning as social interaction* – In traditional organization social interaction is a trait of the breaks (e.g., lunch time). Vice versa the environment of the makers encourages people who work in a common domain, through their participation in the community, to share knowledge and experiences. Learning in each of these spaces is deeply embedded in the experience of makers and an ongoing part of social interaction rather than a discrete activity. The question to be addressed with the empirical investigation is: “how it is possible, introducing in a traditional organizational context an ethos of learning within workmen as a social way of communication as the one of the community of practice (people who work in a common domain and through their participation in the community share knowledge and experiences), to expand skills, deepen knowledge, and tackle increasingly difficult problems?” (Sheridan et al. 2014).



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