Digital Transformation Patterns

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Nowadays “digital” is everywhere and is impacting the society and the economy. To stay competitive in the digital era, companies have to be innovative to adapt to the change that comes along with the proliferation of new technologies. One of the most important things to take into account is the business model. It has to be scalable to ensure the development and success of the company in the long term. Depending on the nature of the company and on the types of product a company brings on the market, the transformation will be a different one.

In this article the focus lies on understanding, through the identification of patterns, the transformation classical industrial companies mainly developing material products are going through. For example car manufacturers who a few years ago focused on building products for transporting people from A to B today invest in mobility services. Further, we describe patterns for companies like the GAFA (Google, Amazon, Facebook, and Apple) and other tech companies undergoing an opposite transformation. These companies, to enhance and extend their business models, are interested in the business of classical industrial companies, such as the music, media, health, mobility, finance and energy industry. This interest from both types of companies (the classical industries and the digital challengers) in the business of the other fosters innovation. That is probably one of the reasons why in the last years we have seen the rise of the buzz word “digital transformation”. Are there best practices that can help companies to transform and adapt to the digital era of today’s society? The set of patterns described in this article tries to identify good solutions that can be used by companies which have or are in the process of undergoing a digital transformation.

Key Words: Digital transformation, business model, innovation, integral industry, digitalization

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1. INTRODUCTION

Nowadays "digital" is a key element in people's lives. We wake up and look at the news on our smartphone through the internet and we go to bed after checking our emails or social media account. But the digital phenomenon is not only having an impact in the private area but also for companies. It is transforming industries in an unexpected and partially disruptive way. In fact digital technologies help companies to be more efficient, having more proximity to the customer and thus be more competitive.

Trying to understand the transformation that is impacting the companies who want to perform and/or survive in this era, we develop patterns to explain it.

The patterns given here are intended for those who are guiding companies in this transformation. This group includes executive people from business and IT, decision makers, strategic peoples and staff or support of decision makers.

1.1 Definition of key elements and concepts

Before deep-diving into the patterns, let us define the key elements and concepts for understanding the digital transformation patterns. The following definitions will help to better understand the patterns and their context (the one of digital transformation). We define different terminology, starting with the central concept of what "digital" means. We then will define the different industries that are evolving in the digital era (i.e. classical industries, digital industries/challengers and integral industries). Finally, the business model and capability concepts are explained as they are considered in our research as cornerstones for the success in the digital world.

- What "digital" means in this paper:

The meaning of "digital" in this paper is different than "immaterial". Etymologically the term digital is derived from the Latin "digitus" which means finger and "digit" which stays for number. Originally it means a technical term relating to computer coding for the transition from an analog signal to a digital signal. In our paper we take a broader definition of digital as it is becoming more and more important and becomes a major concept/issue in our society (Füller et al., 2010; Lucas et al., 2013). It refers by metonymy for us to everything related to the "digital" mindset, which we define as follows: the use of new technologies like social media, mobile computing and devices, analytics, cloud, internet of things, all connected to the world wide web and the information technologies are changing the way we act and live (in the private and professional/business world), bringing us more and more to a network society where people and things are in the "always-on" modus.

- Classical industries:

With the term "classical industries" we refer to traditional companies, considered as being companies that are mainly present in the physical world and whose products and/or services have little or no presence on the digital world. Such companies have different types of goods like physical or tangible products, or intangible products (such as banking, farming, administration, insurance, cleaning, transportation…), i.e. services or software.
Depending on the nature of the goods, the digitalization will be more or less easy to do. We have to make a distinction between different types of existing products:

- the one that could be completely transferred in the digital world and thus have a 100% digital version like for example newspaper (where information was typically available on paper) or music (where information was typically on CDs). Most of them are physical product used as data/information carrier.

- and the one that will always have a physical part like for example transporting physical goods or consumables (like for example oil or food). Those ones can be supported by digital services (e.g.: online ordering, booking and reservation).

- Digital industries/challengers[1]:

Digital companies know the rules of the digital world and they succeed in immaterial business models based on the digital product. Digital products are products that once they are engineered, can be almost arbitrarily scaled, due for example to the "infinite" computing resource in the cloud. Such products can be software, algorithms, data,… It's a mixture of all products that you can easily have in the digital world or that through their immaterial propriety can be transferred from the physical through the digital world. Those products are often supported by services.

- Integral industries:

Here the name of the concept of integral industries echoes to avant-garde thinkers like Edgar Morin (Morin, 1999), Ken Wilber (Wilber, 2000), Jean Gebser (Gebser, 1986), Sri Aurobindo (Aurobindo, 2006), Ervin Laszlo (Laszlo, 2004) and Basarab Nicolescu (Nicolescu, 1996) who develop several integral approaches. We consider here that companies and industries tend to have a holistic approach to be successful. An integral industry has both competences of the classical industries and those of the digital industries/challengers. Those integral industries are also strong in the combination and connection of both, making such industries stronger than others. It is like Edgar Morin explains "la première leçon systémique est que "le tout est plus que la somme des parties". Cela signifie qu'il existe des qualités émergentes, c'est-à-dire qui naissent de l'organisation d'un tout, et qui peuvent rétroagir sur les parties. […] Par ailleurs, le tout est également moins que la somme des parties car les parties peuvent avoir des qualités qui sont inhibées par l'organisation de l'ensemble" (Morin, 1996). ("The first systemic lesson is that "the whole is more than the sum of its parts"[2]. This means that there are emergent qualities, that is to say, arising from the organization of a whole, and that can feed back on the parties. [...] Moreover, the whole is also less than the sum of parts because the parties may have qualities that are inhibited by the organization of all")[3].
This is the case when the parties ignore themselves. To illustrate this point, imagine this example of an everyday situation: the actual crowdsourcing platforms, like for example Hypios[4] who use open innovation and bring together companies who have a problem, named "the seekers" and researchers from all over the world prone to come up with a solution, named "the solvers". The power of such PLATFORM[5] is the collaborative work between all "the solvers", the linkage between "the seekers" and "the solvers" and the interactions that are thus made possible.

- Business model:

The term business model remains vaguely defined despite the wide variety of definitions in the literature with so far still no consensus on a universal definition of the term(Weil et al., 2011; Rusnjak, 2014). For example considering different definitions of business model, we will found different component on which the scholars focus their work (cf. fig. 1).

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1 Taking in consideration the definition done by David L. Rogers about "asymmetric competitors" (Rogers,2016), we can consider that what we call the "digital industries/challengers" are the digital part of those "asymmetric competitors".

2 Aristotle, Metaphysics http://www.newworldencyclopedia.org/entry/Holism

3 Own translation

4 https://www.hypios-ci.com

5 This pattern will be explain later in this paper

Researchers	Focus components in the definition of business model
Osterwalder and Pigneur (Osterwalder et al., 2010)	Processes and workflow Value creation and proposition
Porter (Porter, 2001)	Strategy, Vision, Objective Value creation and proposition Competitive environment
Österle (Österle, 1996)	Growth Critical success factors

Fig. 1. The different definitions'components of business models (Krcmar et al., 2011; Scheer et al., 2003; Weil et al., 2011)

Krcmar et al. (Krcmar et al., 2011) point out in their research the presence of different schools of thought regarding business models. First of all we can observe the "E-commerce" school of thought which is in the line with the work of Timmers who defines "the business model is an architecture for the product, service and information flows, including a description of the various business actors and their roles; a description of the potential benefits for the various business actors; a description of the sources of revenues" (Timmers, 1998). Then there is consistent with the definition of Osterwalder and Pigneur school of thought "Strategy" whose definition is "a business model describes the rationale of how an organization creates, delivers and captures value" (Osterwalder et al., 2010). Finally there is the "Technology & Innovation management" school of thought with Chesbrough and Rosenbloom who approach business model from the following perspective: "The business model is the heuristic logic that connects technical potential with the realization of economic value" (Chesbrough et al., 2002). In this work the business model is considered as a combination of those three schools of thought.

The next term that we will define is a special dimension, as it is an enabler for the digitalization and thus we decided to integrate it in our pattern language. In fact, taking in consideration the capabilities that will help us to measure and evaluate the transformation „maturity" of the company (cf. fig.3 and 4).

- Capabilities:

In the literature we can find different concepts of capability. U. Homann introduces the concept of business capability as "a particular ability or capacity that a business may possess or exchange to achieve a specific purpose or outcome" (Homann, 2006) and I. Barreto speaks about dynamic capabilities as "the firm's potential to systematically solve problems, formed by its propensity to sense opportunities and threats, to make timely and market oriented decisions, and to change its resource base" (Barreto 2010). Those are just two examples of capabilities concepts. In our case, when we speak about capabilities, we consider it as strengths that enterprises can use to conceive and implement their strategies. Capabilities represent the competences, resources, etc. that are available or that are missing to support a business model and to enable the digital era transformations.

1.2 Digital Era/Integral Transformations

In the digital era that we are living in, the competition between the different types of industries is very difficult. To stay competitive, the industries have to be more and more innovative to adapt to the change that comes along with the proliferation of new technologies. However, how to ensure that this adaption takes place in a visible, effective and fast way? In fact a very important element to take into account is the business model. It has, like Osterwalder and Pigneur explain it, a strategic dimension that we have to take into account in the context of digital transformation (Osterwalder et al. 2010). With the digitalization, business models have to be scalable to make possible the development and success of companies in the long term. The combination of material and immaterial dimensions in their ecosystems helps to optimize the business model. A very interesting phenomenon observed in this context is that there is no player in the economy that can escape from the evolution and transformation that are necessary to stay a successful company. Depending on the nature of the company and on the nature of the product a company brings on the market, the transformation will be a different one. Being both challenge and opportunity, those transformations open new ways for industries and organizations to be successful in the future.

In fact, as we can see in the fig.2, three very important sorts of transformations appear:

- T_{PH}: The transformation performed by companies from classical industries who develop physical products, like for example car manufacturers. It is a transformation from a company with a business model based on physical/material products to a company with a business model based on hybrid products, combining hardware and software. In this case hardware is expanded by software.
- T_{DH}: The transformation performed by digital/challenger companies whose products and/or services are mostly immaterial or digital, like for example major software companies. It is a transformation from a company with a business model based on digital/immaterial products to a company with a business model based on hybrid products. In this case the software needs hardware to perform.
- T_{PD}: The transformation performed by companies from classical industries who decide to abandon the development of material products to focus on the development of digital products. It is a transformation from a company with a business model based on physical/material products to a company with a business model based on digital products and/or services[6].

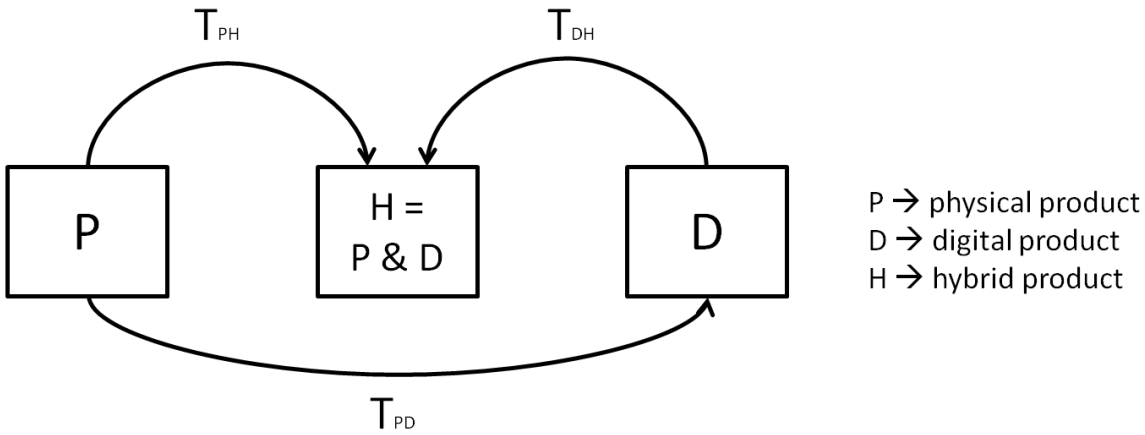

Fig. 2. Digital era transformations.

Both industries try with those transformations to become integral industries which mastered both, the development and manufacturing of a physical product as well as the development of a digital/immaterial product. Through successful transformation the integral industries become the specialist of hybrid products. Those products are at the junction of physical and digital products and worlds.

By both transformations, there is a common element: every type of industry tries to acquire the capabilities of the other (cf fig. 3).

[6] We have to notice that such a transformation is not just taking in consideration the product transformation but also the underlying organizational transformation.

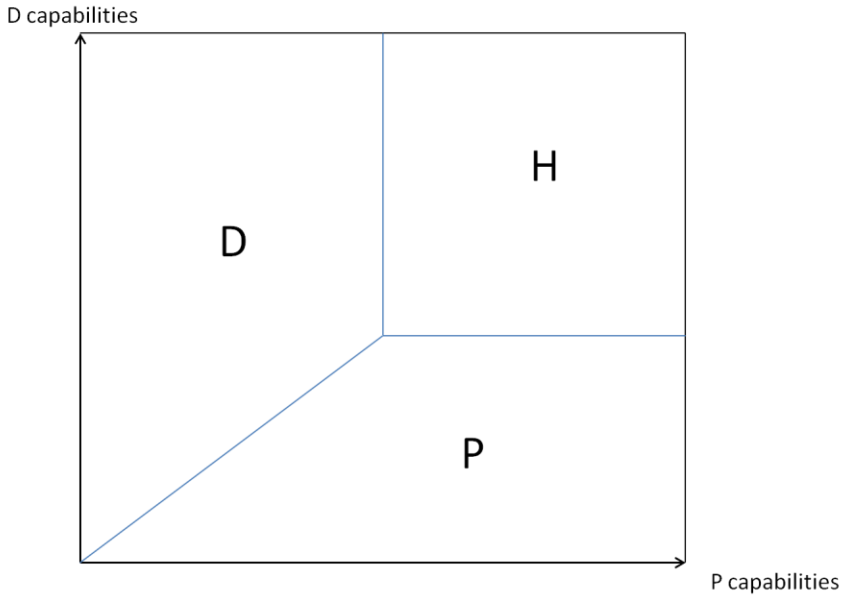

Fig. 3. Evolution of capabilities through the transformations

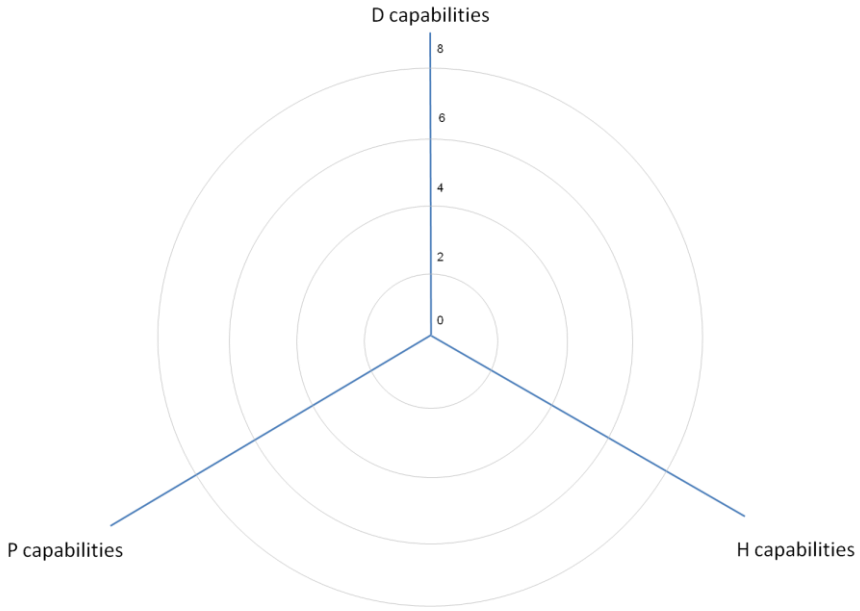

Fig. 4. Maturity model for the evolution of capabilities through the transformations

Considering these transformations, there is a common element: every type of industry tries to acquire the capabilities enabling an integral industry and thus mastering in the digital world.

Let's have an initial look at the transformation maturity model based on capabilities we are currently developing (cf. fig. 4). It is a model based on three dimensions: physical capabilities, digital capabilities and hybrid capabilities. For each dimension we take into account to the following four core elements: people, technology & innovation, organization and ecosystem. We take in consideration for our maturity model the level of commitment and change in the digitalization context. [7]

[7] In the appendices, we present an example of usage for the evolution of capabilities and the maturity model.

1.3 Pattern format and identification

Since the creation of the PLOP conference, several papers have explained how to write patterns, described the patterns format and how to identify patterns (Harrison, 1999; Harrisson, 2003; Meszaros et al., 1996; Wellhausen et al., 2012). The following patterns were found and written based on this literature.

We added the section skills/capabilities inside of our pattern to draw which capability we needed in a company to make the implementation of the pattern possible. Those are the required capabilities to achieve a solution.

2. DIGITAL ERA TRANSFORMATION PATTERNS

In the following part, we describe digital era transformation patterns. At first, we provide the PHYSICAL – DIGITAL-HYBRID TRANSFORMATION pattern which refers to the T_{PH} transformation and then the FROM DATA TO DIGITAL ASSETS[8] patterns which refer to the T_{DH} transformation.

2.1 Pattern language

The following pattern language presents different levels of consideration. To give a global view on the concept we used the Unified Modeling Language (UML). First developed in 1994 at Rational Software (Booch et al., 1996 and 2005) and the adopted as standard by the Object Management Group (OMG) (in 1997) and then by the International Organization for Standardization (ISO) (in 2005) (ISO/IEC, 2005), this modeling language helps us through the use of a UML class diagram (OMG, 2011) enriched with additional marking of semantic relationships to represent a conceptual model for Digital Transformation patterns (cf. Fig 5). This conceptual model represented in figure 5 describes how the different elements are linked to each other. The *Transformation pattern* and the *basic pattern* are enabled by *capabilities* that are realized by: (1) *people*, (2) *technology & innovation*, (3) *organization* and (4) *ecosystem*. Moreover, each *basic pattern* relates to other *basic patterns* and they stay in relation with the *transformation patterns* to enable them.

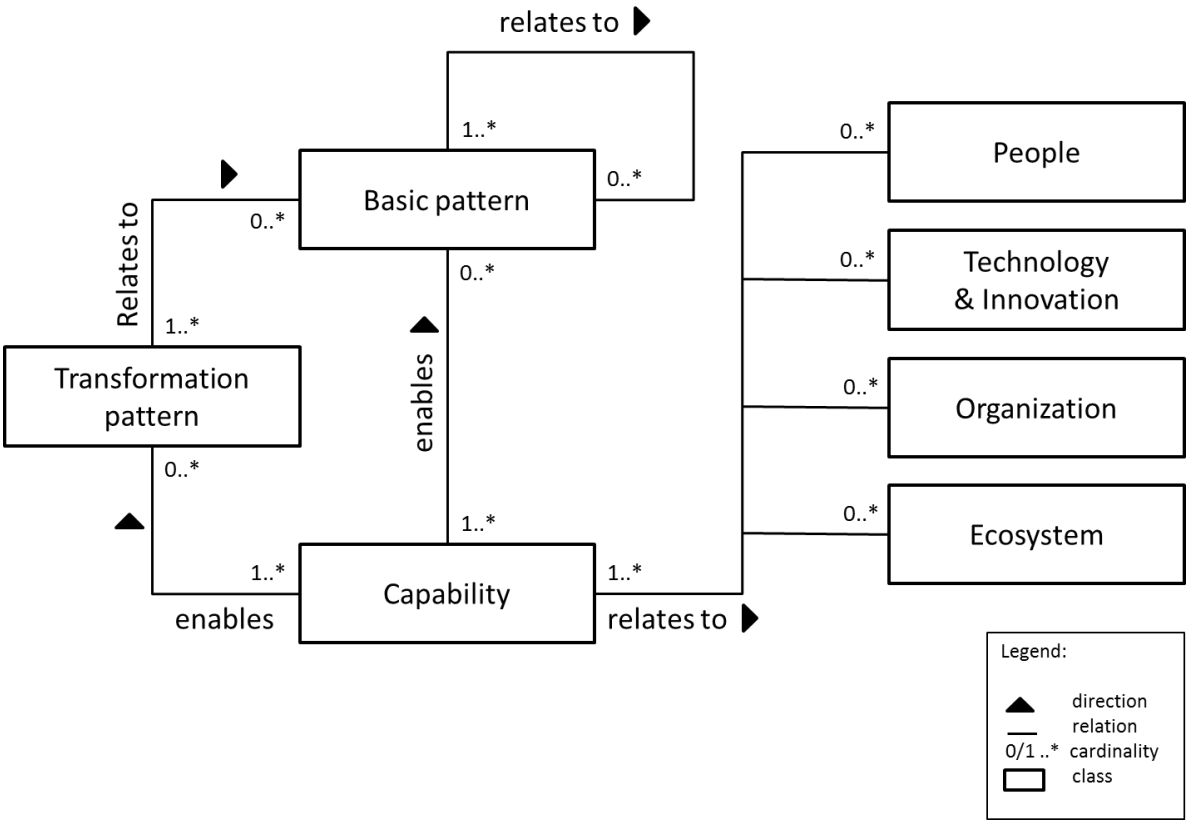

Fig. 5. Conceptual model for Digital transformation pattern

[8] An asset is defined by A. Bounfour as follow: "an asset is a resource controlled by a company via specific property rights" (Bounfour, 2015)

To better understand these patterns and their interrelations let's have a look at the pattern language for supporting the core/entry pattern, also named Transformations Patterns or Digital Era Transformation Patterns (in its long version) (cf. Fig. 6 and Fig. 7). We have to keep in mind that the others patterns, also named basic patterns[9] are there to enable the first ones but could also be part of other pattern languages.

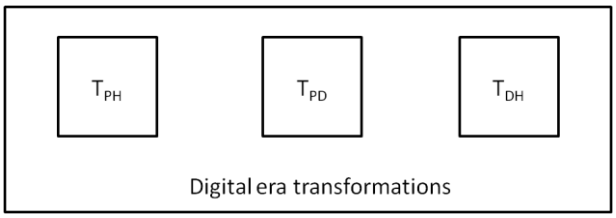

Fig. 6. The Digital era transformations

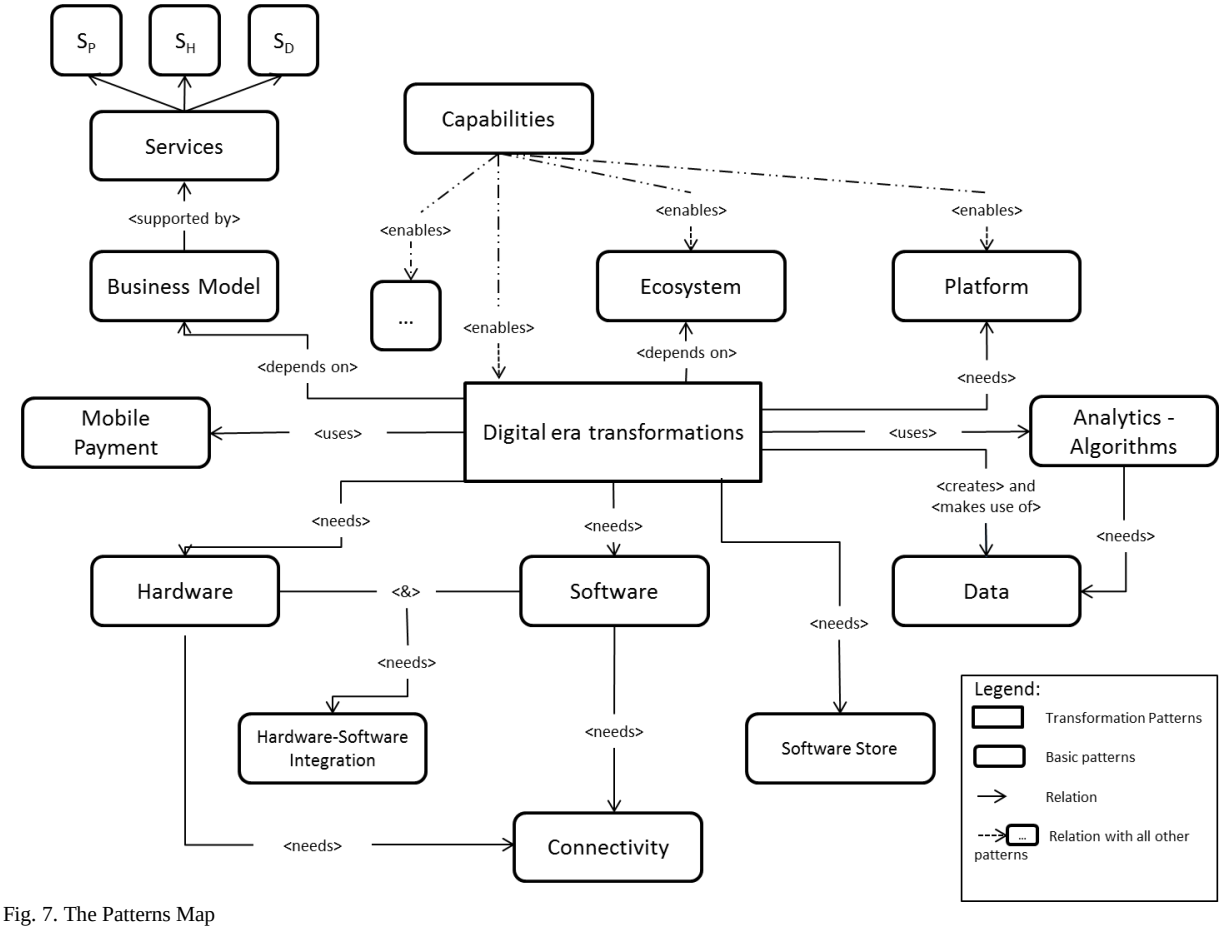

Fig. 7. The Patterns Map

This patterns map shows the relation between the patterns and how they support and depend on each other. In this paper we will only present some patterns, like for example the entry pattern PHYSICAL – DIGITAL-HYBRID TRANSFORMATION which refers to the T_{PH} transformation, the others will be presented in future publications.

[9] As we are doing research on digital transformation, we use here the term basic patterns to refer to all patterns that are not transformation patterns but that are relates to those patterns.

2.2 Physical – Digital-Hybrid Transformation Pattern

Name: Physical – Digital-Hybrid Transformation

Aliases: from physical business to digital business/integral business

Context: You are working in a traditional company, whose core product is a physical product. Physical products are complex to produce and require a lot of capital and long term planning. Such companies, through their mature structures often lack flexibility and agility. In the current digital era, where competiveness is very high, classical industries have new competitors which are not the traditional ones but which are start-up and/or digital challenger companies. Companies from the digital era have amassed huge amounts of capital with their easily scalable digital services and are now threatening classical companies (for example, they can buy them, build a better product etc.).

Problem: Digital companies are threatening your business because they are more agile, flexible and thus evolving faster and dynamic to the ecosystem changes and needs. You need to stay competitive in this new digital era and thus perform the transformation or you might vanish. Some other companies can take your place and get your share.

Forces:

- Scalability: you want to scale your business but your core product is a physical product. Even if you would have 1 billion customers who want to buy your product it would be difficult to satisfy them.
- Sustainability/duration of use: depending on the nature of the product, the duration of use /sustainability differs/varies. For example by buying a car or a computer a customer will keep it for some time; for apps or services, the customer can subscribe or pay again and again.
- New competitors: your business attracts new competitors issued of tech-companies and start ups
- Physical need: your product has a functionality which implies that a physical part will be always needed and cannot be completely replaced through software.
- Physical requirement: your physical product requires a more complex production system in the way that it has a long period of development, needs more testing and certification (as it could have a direct and material impact in the real world), …
- Limited flexibility: building a physical product in a traditional way (not with 3D printers) with production lines make the flexibility to change your product limited in comparison to software which could be updated and changed over the air.
- High investment: the development of a physical product requires a high investment in term of humans, production materials and machines, production lines, logistics …
- Personalization: reaching the customer needs is not so easy when the functions of your product are frozen in the start of production.
- Agility: a digital product is more agile and allows to make hot fixes anytime

Solution: integrate in your physical product a digital part through a software platform to obtain a more/better scalable business. The first thing you need is a hardware or physical part (being the material component of the hybrid product). Then you need a software part (being the immaterial component of the hybrid product). Combine software and hardware parts by using a back-end, which is separated in two elements: the back-end software system and the back-end ecosystem. The backend interface supports IP communication with hybrid products through e.g. WIFI, Ethernet or mobile networks.

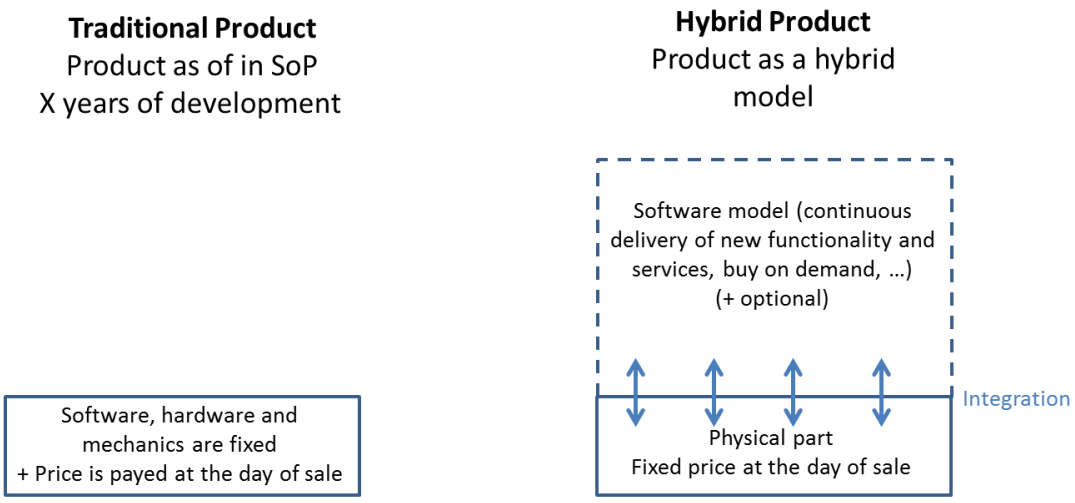

Fig. 8. Context of the PHYSICAL – DIGITAL-HYBRID TRANSFORMATION Pattern

For example a classical car manufacturer company sells a car with a fixed options package that the customer can chose at the reservation. If a new option comes that the customer didn't book, like for example a possibility to have a self-park system inside of the car, the customer will have to do without it or to buy a new car from the new generation. The idea is that with the hybrid product, the customer can upload a new option over the air and thus to upgrade his product as it is needed and wanted. PHYSICAL – DIGITAL-HYBRID TRANSFORMATION makes this possible. Such concept opens completely new possibilities and added flexibility. We can imagine for example that in the future people can pay extra fees to avoid traffic jam and arrive on time when other receive money as they use small streets and thus make the fast track free for people having a meeting and willing to pay for arriving on time. All thus possibilities will be available on-demand and reachable through an over the air update on the hybrid product. If we go even further, we can consider that the car will be as product part of the internet of things.

Result: the hybrid product is a product that has a physical functionality but to be capable of development, to be scalable and customer friendly, it also contains a digital part. The hybrid product spreads the value chain and enables the provisioning of new functions and services for the customer. The hardware and the connected software compose the hybrid product. The Backend – Support bides/boosts the business model by answering on demand, 24/24hours and 7/7days (24/7), the customer needs through new functionalities and services, made available via a software store or other platform and payable via mobile payment.
The PHYSICAL – DIGITAL-HYBRID TRANSFORMATION is a complex meta-pattern made possible with the interaction of different actions. Being and staying competitive depends on the business model you will develop supporting thus a sustainable income model. Grassmann et al. describe 55 business model patterns (Gassmann et al., 2014) that can be used here to support the transformation. To make this possible it is essential to establish an ecosystem. This will be supported by a platform allowing your company to collaborate/team up with third parties if necessary and thus create the best goods and services for your customers. You can integrate in your ecosystem a software store (it could be for example an app store) to provide update over the air or via cable.

If we consider that the share economy trend will take more influence in our society, we can say that part of a sustainable business model supported by the PHYSICAL – DIGITAL-HYBRID TRANSFORMATION for a digital car company will be the following:

To make the PHYSICAL – DIGITAL-HYBRID TRANSFORMATION possible, a traditional company will need to develop new capabilities and combine them with its classical core capabilities. For example it will have to understand and masters in the integration of software and hardware to make the hybrid product a successful

product for the customer; another example is the comprehension of the value of data, how to use them and how to collect them.
To make this work we need different building blocks that interact together. The ground system is composed of a connected hardware that support software stacks and thus compose the hybrid product, to which you have to provide connectivity. This product makes possible new business models based on a sustainable income model. To be sustainable, you have to be aware of the ecosystem where you evolve and you have to establish dynamic network in this ecosystem. Make use of information assets and thus create additional value will offer you new possibilities of business model.
In fact the typical digital business models generate benefit through the use of two levers: Initial Public Offering (IPO) and selling personalized advertisement (directly or through selling collected users' data to third parties). However, not every IPO generates a lot of money, this is in most cases a one-time income and does not apply to traditional companies willing to transform for the digital age. Furthermore those companies mostly build on their reputation and have another business philosophy in general. Same for selling advertisements, this is not a customer offering that every company may use for income generation when selling premium products, or having a strong reputation base on the customer trust and strictly obeying the European data protection rules (or de-facto culture). But what could be a good income model in this context? Take the example of car manufacturer; since almost everyone has a smartphone and internet is available almost everywhere new income models are possible like car sharing. For business model supported by services, you can use a software store. This one could be your own one (that you create and operate) or one of a third party that you use to bring new services to your customer. It is a part of the ecosystem in which you are active. Part of this new services could be composed by update over the air or cable making your products more dynamic and attractive for customers and users.

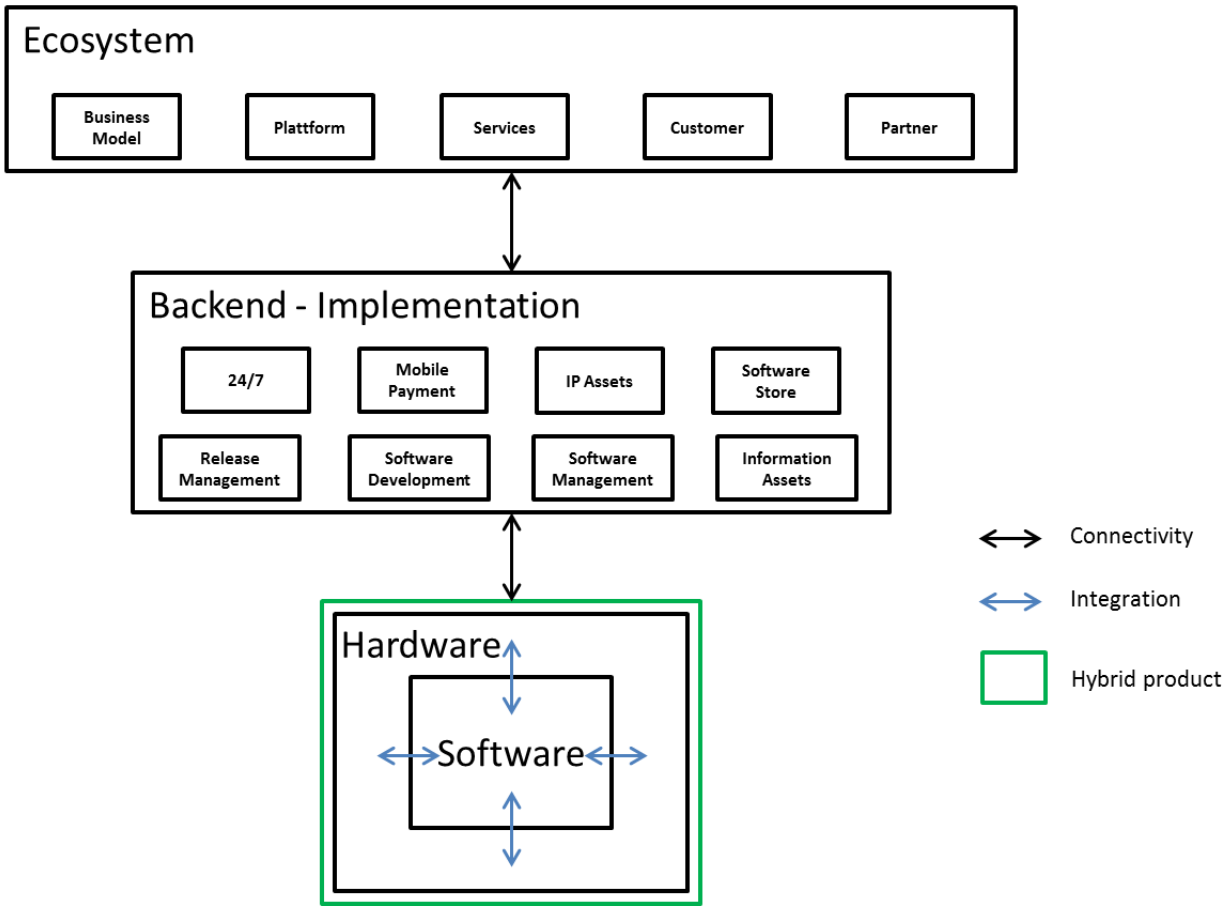

Fig. 9. Sketch of the PHYSICAL – DIGITAL-HYBRID TRANSFORMATION Pattern

Benefit:
Scalability: digital products and services are immaterial, they are scalable and changeable.
New Services: you can offer new digital products and services to your customers and to new customers.
Improvement: through the uses of generated data you can have a better insight on your product and thus improve your services and products.
New competitors: you are pushed to innovate faster.

Liability/drawbacks:
New competitors: because your competitors are tech companies they are comfortable/mastered the software part and thus the scalability issue.
Scalability: because you have a hybrid product it is difficult to scale the complete product.
Physical limit: because you have a physical part, it will be difficult to scale indefinitely.
Missing capabilities: how to obtain data? How to make value of data?

Capabilities:

- People:

Adaptation: be able to work on new assumptions.
Fears: like in every change process you have to deal with the fear of your employees dealing with new things out of their comfort zone.
Support: through understanding and qualification.

- Technology & Innovation:

Speed: technology evolves very fast and you have to be able to identify which new technology could support your business model and maybe think about integrating third parties.
Master in the software, hardware and hybrid skills.

- Organization:

Waterfall vs agile vs lean: use a mix of waterfall process, agile process and lean process (e.g. two-speed IT (Bossert et al., 2014) or bimodal IT (Gartner, 2014; Golden, 2015)).
Hardware vs software: be aware of fundamental difference between software and hardware as it has impact on process.
Platform: make use of platform to connect with the ecosystem and create value through network effect

- Ecosystem:

Integration: be able to integrate in your ecosystem, every stakeholder needed to master the PHYSICAL – DIGITAL-HYBRID TRANSFORMATION.
Two side market.
Customer: be able to build the best experience for your customer, which is an actor and a central piece of your ecosystem.
Legal: be able to adapt to the legislation present in the region you develop and/or commercialize your hybrid product.

Examples:

- Tesla with its over the air software update to add new functions to Tesla cars (like for example their autopilot option/add-in kit) (Reed, 2015; Tesla, 2016; Zhang, 2016).
- John Deer: this traditional company, which makes value in building and selling high quality machinery (principally tractors) to facilitate intensive farming, is moving from a pure hardware company to a key player in the agriculture ecosystem through the use of digital technology (integration of software, network connectivity, sensors for data collection, … into its machines) allowing them to become a personal assistant of farmers giving them the information about their farm when and where they need it and thus allowing them to increase the productivity (John Deere, 2012).

- Samsung with their Smart TV concept combine the classical TV concept with the apps concept, allowing people to see the program they want to see at the moment they want but also to play on their TV or to hear music (Tappert, 2015).

In the above section we focused on the *Physical – Digital-Hybrid Transformation* pattern, a pattern related to the *digital era transformations* patterns and thus being rather linked to the meta level of the digital transformation. In the following section, conversely, we now will concentrate on a specific micro level of the digital transformation by analyzing patterns related to the *data basic pattern*.

2.3 From Data to Digital Assets[10] Patterns

In this section, we will present patterns related to the T_{DH} transformation, which is having a strong link with the Big Data trend (Chen et al., 2012; Lohr et al., 2012 ; Mayer-Schöngerger et al., 2013). In fact, the knowledge on how to produce/obtain and make use of data and thus create value is becoming a key element of the digital era transformations. The famous statement "Data is the Next Intel Inside" from Tim O'Reilly (O'REILLY, 2005), showing that IT will become a very strategic element of every organization is strengthened by Peter Sondergaard who said "Information is the oil of the 21st century, and analytics is the combustion engine" (Sondergaard, 2011). As A. Bounfour, we will consider that "data is a digital resource that can be seen as a joint asset (i.e. something that is, or can be shared with others); hence the importance of analyzing its status in terms of control, potential value creation, and risk" (Bounfour, 2015). In the digital era, data is becoming an important source for growth in companies as it allows completely new business models.

When trying to generate value of data, industries are facing several problems:

- How to get access to valuable data?
- How to bring additional value to the customer?
- How to collect data?
- When you have data, how to create value out of it and how to use it?
- How to deal with unstructured data?
- How to integrate data coming from several stakeholders and generate new offer/good/service?
- How to deal with privacy?
- Who owns the data?

Let's have a look at patterns supporting this change.

[10] An asset is defined by A. Bounfour as follow: "an asset is a resource controlled by a company via specific property rights."

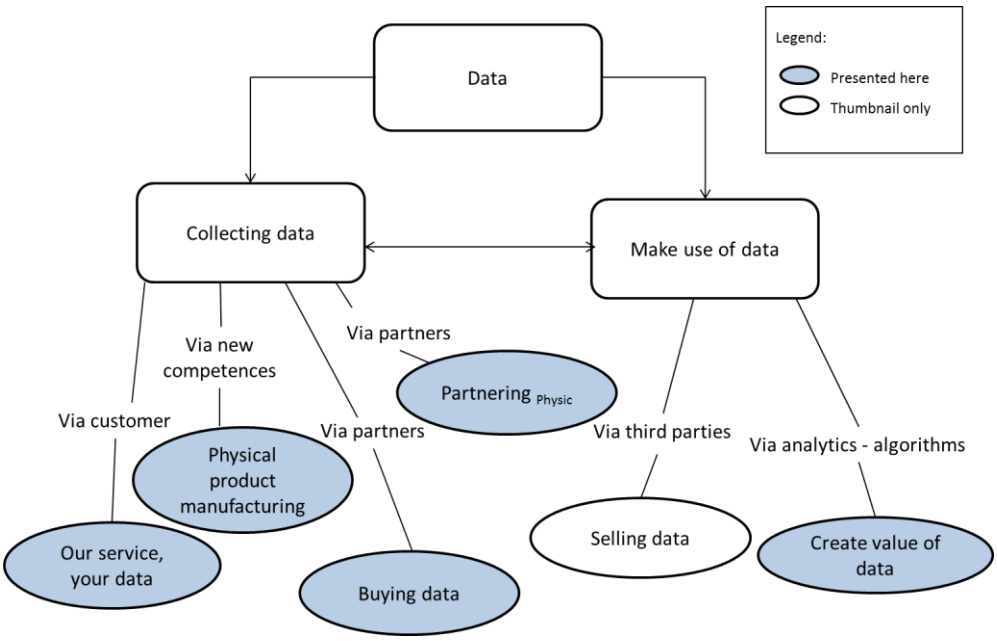

Fig. 10. From Data to Digital assets Patterns Map

2.3.1. Thumbnails

OUR SERVICE, YOUR DATA Page 15	By offering free services you can get access to data generated by the customer and thus offer them a more seamless experience and/or new services.
BUYING DATA Page 17	Data is a very important element for your business as you create value out of it. However you do not collect this data. By buying the data from a third party you get access to it.
CREATE VALUE OF DATA Page 18	Data alone has no value, but using analytics will allow you to build data as an asset and thus create value out of it.
SELLING DATA Future publication	You produce data which could be valuable for third parties or their customers. By selling this data you will generate both values for you and for the third party which is going to use it.
PARTNERING PHYSIC Page 20	Cooperate with third parties to build the physical product needed to get access to the relevant data for your business.
PHYSICAL PRODUCT MANUFACTURING Page 21	You want to obtain data related to a physical product. Integrate the manufacturing of this product in your business and thus build the competences needed.

2.3.2. Collecting Data Patterns

Every company wanting to succeed in the digital era through the use of data, has to start by collecting data (as data is not a natural good but a produced good). To do this there are different levers and ways.
Before we discuss the patterns, we want to take in consideration the analysis made by A. Bounfour who explain that the data is an asset that can be of three different types/kind/nature:
• Digital Asset Owner (e.g. loyalty card)

• Joint Digital Asset (partnerships and alliances/cooperations)
• Digital Asset non-proprietary on which the company has no control (or external digital asset non-proprietary) (Cigref, 2014).

The following patterns present solutions how we can perform this step, which is one of a cornerstone/linchpin for the digital transformation of organizations.

2.3.2.1. Our service, your data

Name: Our service, your data

Aliases: data vs. free services, freemium model to obtain data, customer-organization collaboration, the data "consom-acteur"

Context: Using data to generate value and seamless experience for customers/users is important for your company.

Problem: Your company creates value out of data (personal, behavior, mobility…) but the access to this data is not reachable without third party.

Forces:

- Data as value: most of the data could be of use.
- Access: the access to data coming from customers is essential but not an option without third party.
- Trust: accepting the term of use for a free service or platform is a prerequisite of trust on the company.
- Quality: make your free platform or service used presuppose that it is recognized as bringing value for the customer and thus a good quality one.
- Sensibility of data
- The willingness to provide data.

Solution: Offering a free service or a free platform to your customers in exchange of getting access to their information/data and thus you can collect them.

Result: By offering a good free service through the digital world, you can reach a very important amount of people. These people will, if you are recognizing as bringing them through your service value, in exchange to the "free" access to your service or platform, "pay" with their data. You can thus collect all the data you need (personal, behavior, mobility, etc.) for your company business model (it could be to bring new services to your customer or to sell the collected data to third parties, using them for example for personalized advertisement). To make this work you need a good service or platform idea, you need to have a good back-end system with a good storage capacity for the data collected. You need for this database systems and servers. You also have to build a strong trust relation with your customer, allowing you to have access to their data via accepting the legal term of use.

Benefit:
Mass: if your offer is recognized by the customer community, you will have access to a mass of data.
Generate value: all the data collected can be turned into assets.

Liability/drawbacks:
Reputation: if you do not bring a value to your customer and/or misuse their data, you will lose your reputation.
Rules: creating and maintaining rules acceptable for customer can afford a lot of work.
Dependence: the business you develop is linked to your partner.

Capabilities:

- People:

User engagement: ability to engage people to use your platform or service and thus generate data
Data base specialist: ability to manage database systems and servers.
Ability to put the customer experience in the center.
Coding ability.

- Technology & Innovation:

Collecting data: ability to search, collect and store data.
Matching data to person: ability to match available data to a specific person.
Make use of cloud technology.
Ability to use of Customer Relationship Management.

- Organization:

Crowd management: ability to manage the organization of a grouping of interest.
Data management: ability to define the ownership and how to use the collected data.
Legal and compliance: ability to manage evolving legal and compliance regulation.
Security: ability to provide an acceptable level of security and protection.

- Ecosystem:

Network: ability to act in a network for bringing the best service or platform for the customer and generate value out of the data collected.

Examples:

- Google offers a free search engine and free email services to their customers (they also sell their search engine too). In exchange, they can collect the data/information of their customers and use them for applying the SELLING DATA pattern. Another use of data by Google is the use of users' information to predict the traffic and arrival time but also to calculate the fastest route in Google maps. In fact they have so many users using their services that they can make a very precise prediction, which motivates the customers to continue using these services.
- Facebook offers to their customer a free social media platform in exchange for the collection and use of their data for leveraging advertising and other targeted and/or personalized services.
- Zynga offers its users to play free online games with friends. It collects in exchange like Facebook and Google, personal users' data.

Other variants of this pattern are:

- The topic loyalty program which allows companies and organizations to have access to data through the free loyalty card. The customer can thus collect points and receive presents and the companies have access to personal customers' data but also to their preference. For example, it is a very good way to access information for companies who do not sell their product directly to the customers. Coca-Cola creates for example the MyCokeRewards loyalty program, helped Coca-Cola to have access to data of more than 20 million of its customers (Rogers, 2016).
- The third party marketing providers: those companies, like for example Acxiom, Equifax, KBM collaborate with other companies to build consumers database by collecting through diverse channels. They then apply the SELLING DATA pattern as they sell this data to other companies wanting to know their customer behaviors, or get more insight about their customers.

If you decide not to use free model, you can also find other ways to collect data. You have the use of connected devices that allow companies to collect data about their consumers' behavior. A good example are the fitness

band like the Nike+ Fuelband which helps you monitoring and sharing sport, lifestyle and health data and thus collect it [11]. In this case Nike make use of data sensors.

2.3.2.2. Buying data

Name: Buying data

Aliases: obtain data from third party/partner

Context: Data is created in real-time on different channels like social media, apps, connected devices, mailbox, phone, mobility, etc. Because the core of your business is to bring a personal, intelligent, seamless and relevant experience to your customer, you do not collect data.

Problem: Your company creates value out of data (personal, behavior, mobility…) but the access to this data is either not reachable without partner/third party or it is not your core business. Possibly your company does not build the physical products that may produce the data needed to run your services, or your company does not have the direct contact to the customer. This direct contact is named "digital customer access" in "The digital transformation of industry Study" (BDI, 2016).

Forces:

- Data as value: most of the data can be bought.
- Production: you want to obtain this data but you do not have the physical entity that produce them and thus you have no skill in the data manufacturing area/domain.
- Collection: the data is being collected by entities willing to sell it.
- Access: the access to data coming from physical product is essential but not easy as non-data manufacturing company.

Solution: Buy data from third party or partner

Result: By buying data from a third party, you build with your partner a complementary business. The partnership company collects data, sells this data to you (it could be in different form: unstructured, semi-unstructured or structured data) and you make value out of it. To do this you have to build up new capabilities like for example having a good network and being the best in data analytic.

Benefit:
Flexibility: you have access to new data without engaging in a new business field.
Skills: you do not need new skills for data collection but you do need to use it, store it and make sense of it.

Liability/drawbacks:
The access to data could be very expensive depending on the sensitivity of the data needed. In this case you can get the data but with parts removed as it may still be valuable.
Skills: you need new skills to make use of data.
Dependence: the business you develop is linked to your partner.

Capabilities:

- People:

Be able to build a competitive data analytics team.
Recruit and qualify data scientists.
Hire people with strong mathematical, statistical and analytical competences.

- Technology & Innovation:

Be able to generate new idea, for new business based on using data to generate assets.

[11] http://www.nike.com/us/en_us/c/nike-plus

- Organization:

Be able to build a strong partnership and collaboration.

- Ecosystem:

Be able to build a strong network.

Examples:
Insurance company trying to buy data to adapt their contract to the consumer. It is the same with a bank when a consumer wants to contract a credit, e.g. credits services offer data to banks.

Another variant of this pattern is instead of buying the data to share the data with partners though for example a data-sharing agreement like Caterpillar does with their dealers.

2.3.3. Make use of Data Patterns

2.3.3.1. Create value of data

Name: Create value of data

Aliases: build data as an asset

Context: Data is everywhere and thus is becoming essential for the development of a company. Your company have already data or could potentially collect data.

Problem: Data just to have data doesn't bring more value for your company. How to create value out of it?

Forces:
- Data as an asset: having only data without creating value is not an option.
- You do not want to lose data that could be valuable.
- Collection and generation: collect and /or generate data does not help you create value alone.
- Methods and tools like for example statistics can help to structure and analyze data.
- Trust: not every data is valuable and liable.
- Combine: using only one type of data is often not enough.
- Customer expectation: your customers would not expect if you charge for some extra services (based on the data); but they may be willing to pay for services provided by third parties even if these services are based on your data/tools.
- Legal aspects.

Solution: use analytics and predictive algorithms to generate assets from your data.

Result: It is made possible by the exploitation and valuation of the data you have collected or generated. In fact, once your data is collected, you have to store it in database and will be accessible through the use of digital technologies. Then organize it via arrangement or categorization in different type of data (structured, unstructured, semi-unstructured).You can thus valuate your data, use visualization tools; better know your customer; improve the research and development inside of your company; create new products and services by using data; personalize; improve the leadership and the organization of the company; optimize your marketing; optimize your manufacturing process[12].

[12] For example we currently analyze the impact of using data to improve energy efficiency inside of the plants, generating thus value by reducing cost.

Benefit:
Digital asset: through valuation of data you generate digital asset.

Liability/drawbacks:
Silos: it avoids the transparency and the possibility to make use of data coming from other part of the company to generate value.
Quality: without quality of data, generate value is difficult.
Speed: you want a seamless experience and have to deal with time to analyze data, volumes and reliability of the data and making sense of data.

Capabilities:

- People:

Ability to recruit and qualify data scientists (i.e. people able to search data, collect data, analyze data, store data, clean raw/unstructured data, curios and willing to do experiments but also able to programming, dealing with algorithms and understanding business needs).
Having people with strong mathematical, statistical and analytical competences.
Ability to create and generate a strong culture inside of the company of dealing with data and understanding the systemic connection this has for a company's strategy and business model.
Having people able to manage metadata.
Having people able to manage unstructured data.

- Technology & Innovation:

Make use of cloud computing.
Be able to identify key trends and do future studies.
Be able to have vision.
Be able to FAIL AND LEARN[13] from it.
Be able to generate new idea, for new business based on using data to generate assets.
Be able to use open data.
Make use of database.
Ability to manage geo-localization.

- Organization:

Ability to build a bridge between traditional industry world and data driven mindset/people/culture.
Be able to build transparency inside of the organization, in a cross divisional way, allowing thus the sharing of data inside of the organization.

- Ecosystem:

Be able to understand consumer needs and thus having a 360° view on customer.
Build a strong communication inside and outside the company.
Ability to manage legal security (privacy/data rights)

Examples:

- Analyzing the impact of using data to improve energy efficiency inside of the plants, generating thus value by reducing cost (on which traditional plants currently work on).
- Through the use of data collected by the use of connected sensors on the rails, wheels and engines of trains; Eurotunnel with the TTSA Project succeed to remove technical failure by anticipating wear and thus improve customer satisfaction (Cap Digital et al., 2014).

Another variant of this pattern is FROM MIXED DATA TO ASSET[14], which allows company to create value out of data by combining and mixing different data (part self generated and part issue from third parties).

[13] It's a pattern on which we are currently working
[14] It's a pattern on which we are currently working

2.3.3.2. Selling data

SELLING DATA is the second patterns issued of the MAKE USE OF DATA patterns, under development, will be included in future work.

2.3.4. Partnering $_{Physic}$

Name: Partnering $_{Physic}$

Aliases: Cooperation $_{Physic}$

Context: You are a company whose business model is based on the use of data to generate value and you want to obtain data that are generated from traditional physical products.

Problem: Your company does not build the physical products that may produce the data needed to run your services. How do you obtain data coming from physical product?

Forces:

- Material link: most of the data are linked to a material/physical entity or to their digital twins'[15] representation.
- Production: you want to obtain this data but you do not have the physical entity that produces them.
- Access: the access to data coming from physical product is essential but not easy as non-manufacturing company.

Solution: Find a partner that builds the physical part (depending on the case it could be the physical product itself or/and the sensors that the product have) for you.

Result: a partner, in the context of "Partnering $_{Physic}$", is the company to cooperate with. Together, you build a complementary business. The partnership company builds for you the hardware part and you build the software part through which you will obtain the data and bring additional value and services to your customer.

Benefit:
Flexibility: you have access to new data without engaging in a new business field and with low cost.
Get to know manufacturing to slowly build up skill for future.
You benefit from the knowledge of your partner.
You do not need new skills for manufacturing.
Low cost.
Different partners for different products, each has his strengths (TV, smartphone).

Liability/drawbacks:
Dependence: The businesses you develop are linked to your partner.
Meetings, communication, exchanges, same understanding…
You have to do some compromise (for example on the topic design, material…).
Insecurity regarding the mark image (which will be also linked with the partner).

Capabilities:

- People:

Be able to have employees understanding physical, digital and hybrid products.
Ability to deal with connected devices (internet of everything).

[15] You can find a definition of the digital twins also known as cyber physical twins in Benzerga et al. 2015.

- Technology & Innovation:

Be able to make use of data.
Be able to deal with sensor technology.

- Organization:

Make use of API.
Ability to manage and defined the ownership of generated data.

- Ecosystem:

Be able to integrate the physical part of the partner.
Be able to deal and manage a relation with partners/third parties.

Examples:

- Google lets other company produce the product for them. Thus the Nexus One was produce by HTC, the Nexus S by Samsung, the Nexus 4 and 5 by LG, the Nexus 6 by Motorola and the Nexus 6P by Huawei (Boral, 2016). Google has partnered with specialist smartphone and hardware companies.

2.3.5. Physical Product Manufacturing

Name: Physical product manufacturing

Aliases: build the physical product

Context: you are a company whose business model is based on the use of data to generate value. More and more physical products are now generating data.

Problem: Data is used by digital companies to generate new business models and create value for companies but also for customers. If classical industries, seeing this evolution, become interested in collecting data and make a use of it, the access of data issued from physical products becomes more complicated/harder for digital industries who are interested on those data.

Forces:

- Material link: most of the data are linked to a material/physical entity or to their digital twins'[16] representation.
- Production: you want to obtain this data but you do not have the physical entity that produces them
- 360°: being dependent of other to capture the key value of your business is not an option
- Logistic

Solution: integrate in your business the manufacturing of the physical product from where you want to obtain the data. To do this you have to build up the manufacturing competences inside of your company (new department(s) or new team(s)) or in a subsidiary of your company which will be responsible for building the physical product.

Benefit:

Skills: you will acquire new skills to build and develop the physical product.
Diversification: your business will be enriched (manufacturing, logistic, etc.).
Full control over the product.
No problems with partners.

[16] You can find a definition of the digital twins also known as cyber physical twins in Benzerga et al. 2015.

Liability/drawbacks:
Skills: depending on the complexity of a physical product, the skills needed to build and develop it are different than the skills you already have as a digital industry company.
Scalable limit: the physical product production has a scalability limit.
Time paradox: the lifecycle and development of the material and immaterial part are different.
Risk of failure.
Established competition with many years of experience.
You will be no more only focusing on your core business/competences.

Capabilities:

- People:

Ability to work with a mix of agile and classical methods.

- Technology & Innovation:

Connected device management.
Ability to develop and use open architecture.

- Organization:

Matching know how: ability to match the digital, physical and hybrid know how.
Logistic management.
Manufacturing and inventory management.
Ability to manage and take in consideration different type of development lifecycle between the physical and the digital part allowing thus companies to master in hybrid.

- Ecosystem:

Ability to use open innovation and collaboration with third parties.
Ability to manage the work with partners.

Examples:

- Amazon used its subsidiary Lab126 to build it's hardware product (like for example Kindle or Echo personal assistant)[17],
- Alphabet with the Google Car built by X, the moonshot factory of Alphabet[18].

2.4 Platform Pattern

The PLATFORM is becoming the linchpin of the digital era (Rochet et al., 2003; De Rosnay, 2016; Rogers, 2016). That's why it is interesting to better understand it.

Name: Platform

Aliases: the state companies[19], online marketplace, two-sided platform, multi-sided platform (Rogers, 2016; Gassmann et al., 2014).

Context: digitalization is a sort of industry revolution which brings on itself disruptions. One of them is the new company form that has emerged.

Problem: How to create value and make this scale without having huge cost and thus become a key player in the area?

17 http://www.lab126.com/ - http://www.bloomberg.com/features/2016-amazon-echo/
18 https://www.solveforx.com/
19 Translates from the French "enterprises états" name giving to such companies by Joel de Rosnay

Forces:

- Network effect: your PLATFORM depend on the other users (Shapiro et al., 1999) (the more you have user, more you have providers and vice versa; the different stakeholders of the platform attract each other)
- Speed: you need to develop yourself fast as one of the first platforms established in the market will likely get/attract the majority of users (the one who achieve first a critical mass).
- Scalability: you have to manage a possible quick growth by using cloud architecture and low operating cost.
- Openness: you have to open your platform to third party and customers to receive, generate and exchange value.

Solution: through the use of a platform, you bring together two or more parties to receive, generate and exchange value. You are the interface that sticks to the big production and distribution systems (which cost money) and become the intermediary between them and people (where money is).

Result: through the combination of the platform and the use of algorithms and enabling digital technologies (like Internet, APIs (Application Program Interface), cloud computing, mobile devices, social media, cognitive science, …) you are able to bring supply and demand together. You are the direct link between all the stakeholders who act on your platform. The art is to become the owner of the user interface and put a software layer on top of a service layer (De Rosnay, 2016).

Benefit:
Dependence: as a centerpiece of the system, other stakeholders plug to your system to generate a win-win situation.
Win-win: you generate win-win situation between all the counterparts of the platform.
Resilience: you have to be able to reinvent yourself continuously and to adapt to every situation.

Liability/drawbacks:
Monopole: if your platform works well it will be the reference for an area and you will have the risk/chance to become in a monopole situation as the ONE TAKES ALL[20] pattern apply here.
Strong competition: you compete with classical but also with other PLATFORM company.
Security

Capabilities:

- People:

Seamless: Make the platform easy to use
User interface
Be able to have a 360° view on your customers to bring them the best experience

- Technology & Innovation:

Make use of API
Make use of mobile payment system
Make use of cloud computing
Make use of mobile devices

- Organization:

Be flexible and "fluid"[21]
Ability to deal with data (authenticity, legal aspect, analytics)
Ability to build and deal with networks

[20] This pattern will be explain in future paper
[21] This pattern will be explain in future paper

- Ecosystem:

Ability to build links between all the actors
Co-opetition: ability to cooperate with business rivals

Examples:

- Airbnb is the biggest provider/supplier of flat/room/accommodation in the world without having any property/real estate.
- Through the use of PLATFORM Uber is the biggest taxi company in the world without owning any vehicle. They are the interface connecting the drivers owning a vehicle and the people searching a taxi/mobility services.
- Alibaba is the biggest marketplace worldwide without having any stocks/inventory. It brings together buyers and sellers of every sort/type of goods.
- YouTube is the biggest Video provider in the world without producing any video. It bring together consumer of video, producer of video and publicists.
- Paypal is the biggest finance platform (digital payment systems) in the world, through is online payment system bringing together banks, shoppers and vendors. It is like the digital substitute of credit cards.

3. CONCLUSION

In this paper we presented patterns which are linked to the digital transformation phenomenon. In future we want to present further patterns related to this pattern language, like for example the ACCELUCTION [22](the new system of production for the digital age). In fact there are three pattern language linked to each other, which map the different transformations that we can observe in the actual digital era context and that can help to achieve the position of an integral industry.

Not only in the transformations are causes by digitalization at the core of our research but also the complex ecosystem and new rules that are emerging in this context. In the future, this pattern language will guide organization, companies, and industries to recognize, understand and evaluate different solution to master the digital transformations.

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22 This pattern will be explain in future paper

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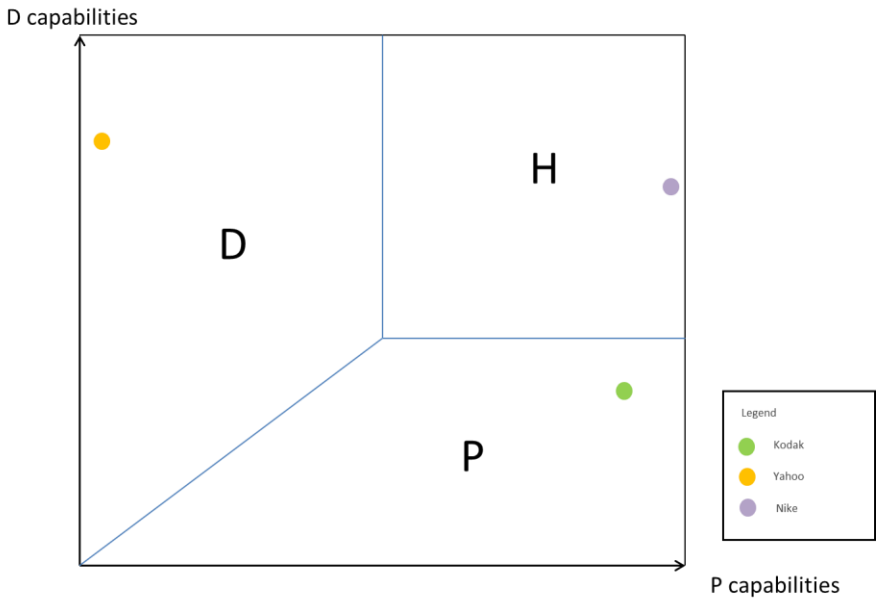
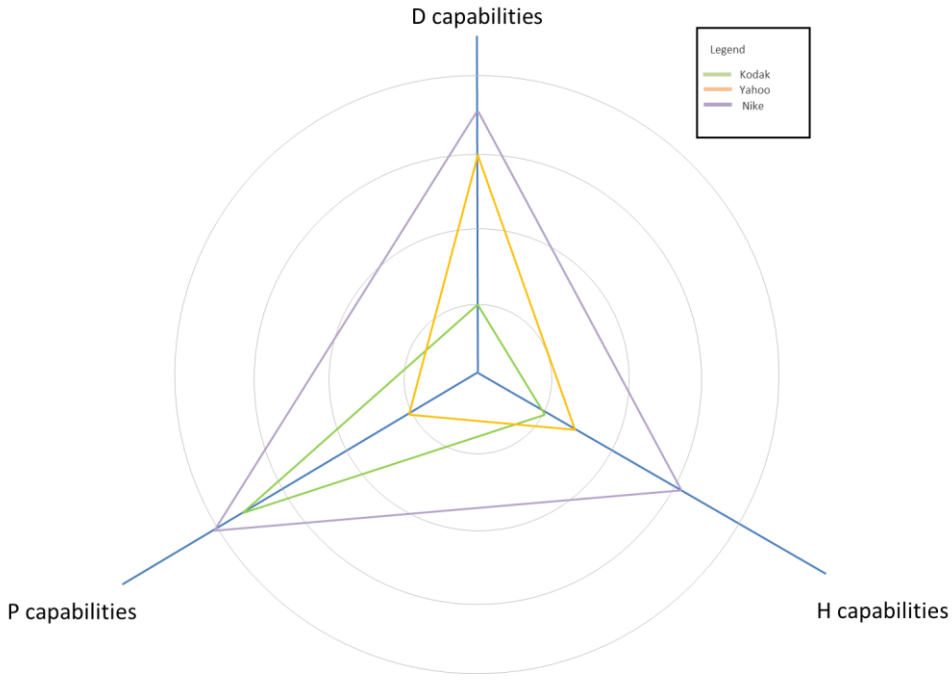
APPENDICES

- Appendix 1: usage model for evolution of capabilities through the transformations



- Appendix 2: Example of usage for the maturity model



In the appendix 1 and appendix 2, examples of usage are presented. This helps to better understand how combinations of the capabilities impact the success of a companies' transformation. To do this, we

focused on three different types of companies:

- Kodak, having been one of the most successful camera companies at its time, but having failed to take the path of digitalization. They even were pioneers in the development of digital cameras but nevertheless didn't believe in this new technology and later on had to file for bankruptcy protection. From the two appendices it can be seen that this company did focus on its physical capabilities only at that time.
- Yahoo, one of the first big search engine and email platform providers. This internet company focused mainly on digital products and technology and thus was rather based on digital capabilities. Its main competitor Google, in turn, combines both digital and physical capabilities under the head of its parent company Alphabet.
- Nike, which seems to be on its way to succeed in its digital transformation, combines both digital and physical capabilities and thus will likely prevail in the hybrid modus. Having started as a pure sports goods company, from the scratch Nike developed new digital products and hybrid products that support its vision. It created the new brand "Nike +" and thus expanded its business model by connecting more and more the customer to the brand to further improve the user experience (e.g. Nike+ running: adding gaming elements to the running experience or Nike+ personal trainer).