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"KIBS, KNOWLEDGE MANAGEMENT AND DIGITAL PRODUCT-SERVICE SYSTEMS: AN EXPLORATIVE INVESTIGATION"

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Firma dello studente

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INTRODUCTION

Modern economy is approaching the fourth industrial revolution, a new paradigm which will radically transform the business landscape. Reshaping business models towards Servitization and exploit the potential of new digital technologies are the imperatives followed by manufacturing companies to achieve competitive advantage and deliver a new value proposition. The new upcoming changes highlight how knowledge is more and more representing a critical success factor for firms, occupying a central role in the innovation dynamics as well as in every day operational routine. Facing the complexity triggers a trade-off in the allocation of the limited resources of companies: on one side internal resources need to be allocated on the core-business activities to ensure revenue streams while, on the other side, firms need to take into consideration the innovation and changes in the business environment to sustain their revenues. Under those circumstances the business environment has seen raising in the last 30 years new firms focused on the delivery of knowledge to other economic entities, from private businesses to public companies. Those firms have been recognized as Knowledge Intensive Business Services (KIBS). The development of KIBS has radically changed the innovation dynamics, moving them out of the boundaries of single entities and fostering the creation of networks to support the complexity of innovation. KIBS rely heavily on knowledge and are primarily involved in its effective management to compete on the market and provide customers solutions that fulfill their required outcomes. From that point of view, Knowledge Management become even more crucial and affect the overall functioning of KIBS as facilitators and supporters of customers in firms' ecosystems. The following dissertation aims at analyzing the role played by KIBS companies in the innovation dynamics concerning digital servitization of manufacturing companies and exploring the main implications from a Knowledge Management perspective. The paper is divided into three main chapters, presenting the following contents:

1) Chapter 1 presents the changing paradigm due to the beginning of the so-called "Knowledge Economy" and the leading position acquired by knowledge in organization, considering both workers' and management's perspectives. The focus then turns to the introduction of KIBS phenomenon, their specific role in innovation's dynamics and their relationship with customers.

2) Chapter 2 introduces a theoretical overview on Knowledge Management. Beyond the definition and the general contribution of KM to strategy and competitive advantage,

the chapter analyzes the most important models of KM provided by the literature as well as the cycles undertaken in organizations for the effective employment of knowledge resources. Lastly, according to the different phases that interest the management, a series of widely used KM tools and practices are presented, taking into consideration also the introduction of new digital technologies and the potential benefits that it has been producing in KM.

3) Chapter 3 introduces the Digital Servitization paradigm and the new related challenges faced by manufacturers: from the radical change to a service-dominant logic affecting business models and delivery of the value proposition, to the resulting new offer of solutions embedding services and physical products supported by the application of new technologies, defined as Digital Product Service Systems (DPSS). Moreover, the chapter introduces the innovation dynamics contributing to the definition of DPSS solutions in the manufacturing sector and the multiple roles played by KIBS firms in the ecosystems of in which they are involved, focusing especially in the knowledge-specific aspects. This last topic is further investigated through an empirical analysis of the main findings resulted from interviews involving KIBS firms acting in the ecosystems of DPSS innovation.

CHAPTER 1: KNOWLEDGE ECONOMY AND KIBS

1.1: THE KNOWLEDGE ECONOMY

1.1.1: Knowledge Economy: a new paradigm

Economy in developed countries has been driven in the last 60 years by an increasing information and knowledge production. At the beginning of the 60s decade, a relevant number of industries that involved the application of science-based knowledge in the production of goods were born, guiding economy to the improvement of productivity by using knowledge as the main source of competitive advantage of their business. Economists started to look at this phenomenon and noticed how the exploitation of tangible goods for production purposes typical of the Fordist Economy (E.g. the assembly of a car) had been slightly governed by the application of science and the development of R&D in companies. This dynamic describes the first step of the global economy in the field of the so called "Knowledge Economy"; many academics and institutions have tried to give an interpretation and definition to the same economic shift, as for example English Economic and Social Research Council (ESRC) in 2005, which declared that the term is used to describe "a dynamic in which economic success is increasingly based upon the effective utilisation of intangible assets such as knowledge, skills and innovative potential as the key resource for competitive advantage." , while Kok Report stated in 2004 that "knowledge society is a larger concept that just an increased commitment to R&D. It covers every aspect of the contemporary economy where knowledge is at the heart of value added – from high tech manufacturing and ICTs through knowledge intensive services to the overtly creative industries such as media and architecture". In one of the most important works regarding research on Knowledge Economy, Powell W.W. (2004) defines it as "production and services based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance, as well as rapid obsolescence". Even if different sources gave different explanation to Knowledge Economy, suggesting how such a recent sociological and economical event is not yet precisely defined but is still subject to an open debate about its origin and development, it's commonly accepted that one of the main traits of Knowledge Economy is the use of knowledge as either a productive asset and business product, suggesting a change in the production paradigm of companies. These common elements work as a guiding light in the economic history to describe the main steps of the development of the Knowledge Economy: as it has been previously said, the first step of the path is defined by the concentration of companies in production of goods that were the result

of the scientific progress and breakthrough science-based innovation. In this first period knowledge itself wasn't considered as something that must be managed and governed but at the same time companies realized that the level of protection of their scientific discoveries was increasingly determining their competitive advantage in the market. This has been proven by an increasing number of scientific patents released between the 70s and 80s that testify an increasing relevance of the innovation process. In the last decade of the 20th century global competition exacerbated the role of scientific-based innovation as much as it became a perceived linear innovation, a companies' must-have to compete. The "commoditization" of the application of scientific research and R&D department reveals the narrow scope considered in the Knowledge Economy, opening it to the new platforms and companies related to the process of "servitization", recognizing, in addition to the intangible value of scientific-based research, the value of intangibles of services and consumer innovation. As noticed by Svarč J. and Dabić M. (2015), the reconceptualization of the Knowledge Economy in the servitization has shifted the economy to the contemporary business era, where innovation considers, on the base of Kline Rosenberg chain-linked model of innovation, also non technological aspects and the focus is shifted to service innovation, which is judged the primary source of economic growth of developed economies. Svarč J. and Dabić M. hypothesize a complete identification of the Knowledge Economy in the Service Economy: companies that use knowledge as the most relevant source for production of intangible goods and services, resulting in the dynamic of use of knowledge to create knowledge, supplying final consumers but also heavily industrialized sector (e.g. advisory services) in their path of incessant improvement to remain competitive. The Knowledge Economy corresponds to the wide recognition of knowledge as a strategic valuable asset for business activity by organizations and individuals, an asset that, on the contrary of tangible ones, doesn't have material limits in its application. But how is Knowledge declined as an asset in companies? Let's introduce the concept of Intellectual Capital.

1.1.2: Intellectual Capital

Klein's and Prouska's (1997) definition of Intellectual Capital is: "Intellectual material that has been formalized, captured, and leveraged to produce a higher-valued asset". The definition of the two authors emphasizes a fundamental trait of the Intellectual Capital: it doesn't consider all the information hold by the company and its individuals as relevant, but only the one that is relevant in terms of its contribution to create valuable assets, emphasizing that not all information is knowledge. The pyramid scheme below gives us a point of view of the subdivision: we have Data at the base, which are row numbers, "Information" that deals with the contextualization of knowledge, and "Knowledge" that consists of ideas and conclusions over data and information. Lastly, there is "Wisdom" that can be described as the human ability to understand something which was not understandable before.

Figure 1.1 The Pyramid Scheme , Source: Journal of Entrepreneurship, Management and Innovation

Company's Intellectual Capital identification starts from the pyramid scheme as a basis, but we need to answer to a further question to be able to select it: Which parts of the pyramid form Intellectual Capital? Giving an answer led us to consider that knowledge must always be considered as beneficial for the organization because it contributes to its scope. That's why Data, Information and Knowledge are useful only if they are considered in the context of company's strategy, as it nails down what they are exploited for. Edvinsson L., author of the famous Skandia Model, a framework in which Intellectual Capital reveals the "hidden value" of a company, points out 3 different levels in order to describe where to find out Intellectual resources: People (Human Capital), Organization's structure (Structural Capital) and customers (Customers Capital). Human capital deals with the ideas of individuals as part of the

organization. Stewart A.T. (1997) identifies Human Capital as the most important one, being the nest of ideas and at the same time one of the major threats for enterprises, as it can reveal itself as a total waste of money because of human resources that unfit with the organization's needs. As a consequence, companies are forced to understand which ones are more profitable in order to increase the quality level of their human capital. Moreover, Stewart identifies two different paths to enhance and grow Human Capital: the first one consists in "Using more of what people know", capturing and exploiting benefits and ideas which come from workers' minds and experience, while the other path consists in "getting more people to know more stuff that is useful to the organization", a work that is made by companies' leaders to focus and amass knowledge where it is needed. Smart individuals don't necessarily mean a smart enterprise, that's why a leveraging structure of knowledge is needed, identified in the Structural Capital, that deals with information systems, laboratories, competitive and market intelligence, knowledge of market channels and management focus which turn individual knowledge into group knowledge (Stewart. A.T., 1997). Structural Capital is the knowledge that an enterprise extrapolates from its individuals and makes its own reproducible and shared knowledge, e.g. patents and legal rights. The last valuable level of Intellectual Capital is Customer Capital, understood as the value of the customer relationship of the organization: even if an extensive part of the financial literature explored how to worth customer relationships, many enterprises doesn't manage them considering the possible source of competitive advantage created by them and their content. As a matter of fact, the value of these relationships is not fully captured by financial parameters such as Brand Equity, but also by non-financial signals as trust and loyalty, that become part of the evaluation of the company made by customers. The relevant importance of Intellectual Capital in the Knowledge Economy brings with it the necessity of understanding how the organization changes its nature and structure and what the challenges faced by companies in the management of the Knowledge resources are.

1.1.3: Management and workers in the Knowledge Era

We have previously understood that Knowledge Economy has redefined the multiplicity of organizations' assets by focusing on Intellectual Capital and Knowledge Resources. The shift to the new knowledge paradigm interested also a change in the organizational structures of the company and addressed new management issues to all levels, defining new actors and reshaping the role of the old ones. North K. and Gita K. (2014) identifies how, differently from the business era of the 90s, characterized by a new born "knowledge management" that represented an implementation issue for companies, the servitization economy era faces new external challenges for knowledge workers, as the impact of digitalization, automation and big data exchange phenomenon. Lehtiniemi et al. (2015) sustain that companies must also address new issues as a new norm of work, given by the rising practice of smart working and ICT-based work which have disrupted the boundaries of the company and require to rethink the work time and its content, as well as the ability to share and blend external and internal knowledge resources of very different nature in an crowdworking customer-oriented environment. Worker's self-management and company's shift from the "presence" culture to the "result" culture must be sustained by digital leadership in ICT technologies and workers' self-management skills. All those different variables affecting companies results in the redefinition of the roles of workers, in particular the so-called Knowledge Worker, defined as people primarily engaged in Knowledge Work that "think for living" (Davenport, 2005). The redefinition of work into the Knowledge paradigm leads to the development of new roles inside the firm (North K., Gita K., 2014): workers interested in the creation of knowledge contents as the result of creativity and scientific research, considered the main subjects of knowledge management in the 90s, are now flanked by knowledge communicators, entailed in structuring, preparing and communicating knowledge, while processors of knowledge routines are involved in the application of the created and shared knowledge, looking for "best practices" and bottom-up improvement. A specific role that has been distinguishing between knowledge workers is the one of Knowledge intensive providers, considered as workers which tailor specific solutions to direct or indirect customer on the base of their own expertise. Knowledge intensive providers have raised their relevance on the economic scenario during the Servitization Era thanks to their ability to represent an answer to the issues of enterprises and customers facing the increasing complexity of the business environment, a complexity which has forced the same service providers to share their own expertise to compete on the market and create organizations voted to the solution and service provision, as for example doctors, lawyers, consultants, and any working role which requires a certain level of knowledge and expertise to be performed; the

matching of these needs has resulted in the creation of the Knowledge Intensive Business Services, where knowledge intensive service providers organize their business in an economic way to maximize their ability to fill the required knowledge gap in the market and create companies that represent one of the most important fields of knowledge development and sharing. As well as focused categories of knowledge workers have been previously described, we also want to underline how knowledge work can be shaped into material work, as for example technicians and maintenance personnel, who are entrusted to solve daily issues which can generate new ideas and solutions at the base of efficient knowledge development.

1.2: KNOWLEDGE INTENSIVE BUSINESS SERVICES

1.2.1: Defining KIBS

Knowledge Intensive Business Services (KIBS) have been defined by Miles et al. (1995) as "services that involved economic activities which are intended to result in the creation, accumulation or dissemination of knowledge". Other authors tried to give a different definition of KIBS, as for example Toivonen (2004) which stated that KIBS are "those services provided by businesses to other businesses or to public sector in which expertise plays an especially important role", or Consoli and Elche-Hortelano (2010) who described them as "intermediary firms which specialize in knowledge screening, assessment and evaluation, and trade professional consultancy services". Battencourt (2002) specifies how KIBS are "enterprises whose primarly value-added activities consist of the accumulation, creation, or dissemination of knowledge for the purpose of developing a customized service or product solution to satisfy the client's needs". Miles et al. (1995) describes also three main characteristics which outline KIBS in their business activity: they rely heavily on professional knowledge, they are either primary sources of information and knowledge or they use knowledge to produce intermediate services for their clients' production processes. Den Hertog (2000) further specifies how those companies are usually privately held companies, while Pardos, Gomex-Loscos and Rubiera-Morollon (2007) underline how KIBS imply an important connection with information, new technologies, new management and new production/sales techniques. Some example of KIBS companies are given by legal and accounting services, ICT and marketing consultancies, practitioners of technological and technical change, but also services as design, photography and advertising activities. Even if KIBS definition by different authors can differ in many specified aspects, that are mainly connected to the implication of their business activity, the central role of Knowledge is a common thread; "Knowledge intensive" feature of KIBS underlines how knowledge represents the main input resource of these organizations, declined as expertise, the source of competitive advantage and the input of their activities. KIBS firms can act at the same time as "intermediaries" of knowledge, integrating external sources of knowledge with internal expertise and providing a final service useful for their clients (Zieba M., 2014). The absence of a standard approach in the literature concerning KIBS is due to the fact that it is a relatively new economic dynamic interesting the last 30 years, a trait that transfers also in the classification on KIBS organizations. Generally, KIBS are organized on the base of Miles and al. (1995) classification into new-technology-based services (T-KIBS), as ICT-related services, R&D and engineering consulting, and traditional professional services

(P-KIBS), as legal, business and management services. Miles and al.'s classification of KIBS firms rely only on the content of the activity but it's straightforward that, due to the nature of KIBS themselves, this classification appears rough and doesn't allow to investigate toward different sectors variety and to detect common patterns across them (Bolisani et al., 2014). Another classification that has become increasingly used to differentiate KIBS firms was proposed by Koch and Strotmann (2006) on the base of NACE, a European classification of economic sectors, identifying those activities in sectors N. 72,73 and 74 as KIBS, excluding some sub-sectors such as the one related to activities of holding companies. NACE classification, as T-KIBS and P-KIBS classification, fail to furnish a subdivision of KIBS sectors that can highlight effective differences between different companies and sub-sectors, creating heterogeneity in the categories in terms of type of exploited knowledge and provided services, distinctive features of knowledge intensive services (Bolisani et al., 2014). Horgos D. and Koch A. (2008) describe the NACE classification as inadequate to KIBS firms because of its output-driven orientation and propose a new classification based on firm-internal attributes related to interactions patterns and innovation behavior, identifying seven different groups of KIBS that are not fixed and immutable and where problem of partial overlapping in the subdivision could be bypassed by the creation of new firm clusters, being able to consider the innovative nature of KIBS firms not only as an intrinsic characteristic but also as a variable of their development and organization shaping. Bolisani et al. (2014) considers cognitive features to jump over the limitations of traditional classification: cognitive characteristics of KIBS firms derive from external sources of knowledge, such as suppliers, network of business partners and clients, and from internal development of knowledge. KIBS can be therefore classified on the basis of how they manage the related knowledge resources to successfully deliver their services and achieve competitive advantage (Bolisani et al., 2014). Cluster analysis provided by the literature furnishes strong evidences of how the standard classification of KIBS is not able to identify essential terms that describe independent groups of firms, as standard dimensions such as output services and structural characteristics are no longer exclusive of a specified group. Furthermore, the open debate and issues about KIBS classification let us intend that knowledge intensive firms are understandable subject only when they are individually fully described in the specificity of their knowledge resources and knowledge process dynamics.

1.2.2: Development of KIBS in the Business Arena

Business services in the European countries has passed in the last 30 years to account from less of 12% of the share of the GDP to more than 17% on average, while in the most developed countries they represent more than 22-23% of the GDP in 2014 (ECSIP Consortium, 2014), showing increasing contribution in economic value added, employment and numbers of hours worked. The magnitude of the growth of business services is testified by the graphic in Figure 1.2, showing the increasing level of employment from 2005 to 2015 in the first fourteen European Union countries (OECD data, based on ISIC nomenclature of economic sectors, excluding UK). The contribution of services is becoming more and more relevant with higher rates of growth than other sector in most of the developed countries, where KIBS represent not only an answer for companies to the complexity of the economic scenario and the specialization required to face it, but also they are promoter and interested in the redefinition of other sectors, by mixing them in inter-sectoral linkages and contributing to its innovation (e.g. The concept of Smart Factory), therefore their growth reflects demand for knowledge inputs from organizations dealing with changing technologies and social conditions (Miles, 2005).

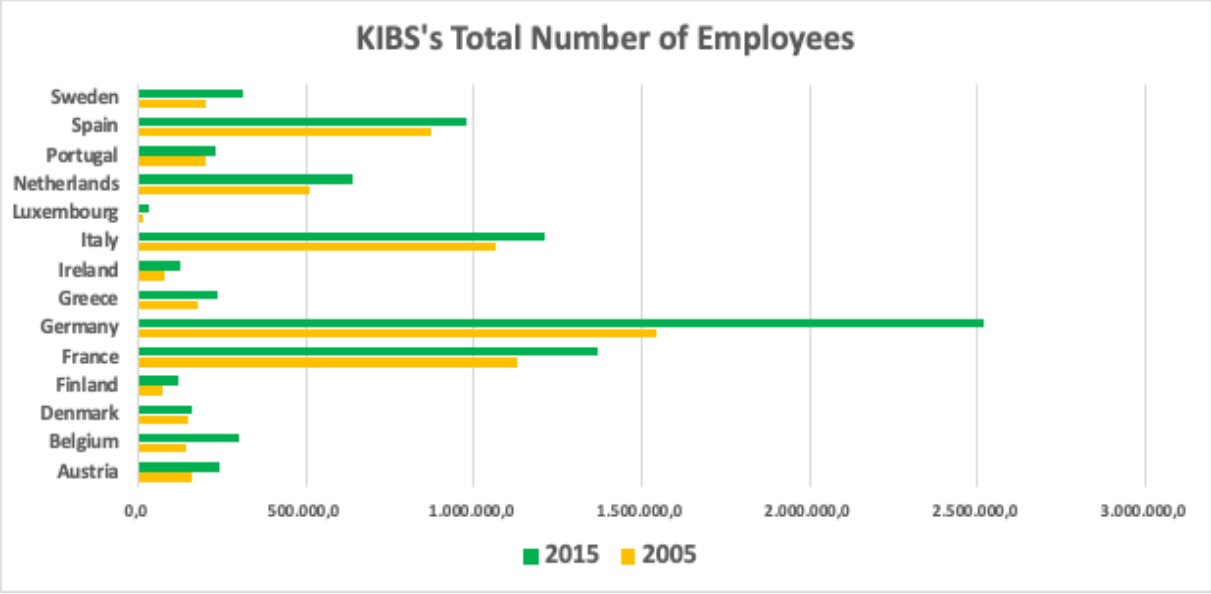

Figure 1.2 Total number of employess in KIBS activities in the first fourteen European Union members (excluding UK), Elaboration from OECD SDBS – Structural Business Statistics

Antonioli et al. (2020) testifies that KIBS growth is strictly embedded to the fact that other sectors require KIBS input in their business activity, focusing on their core competencies and Outsourcing activities that were previously conducted internally following a “make or buy” logic. The scientific literature agree on “outsourcing” as one of the main factors, both with

innovativeness, that leads to the structural growth of services; the need to focus on core competencies of business firms have been exploited by specialized business services that were being able to achieve economy of scales, increasing experience towards different clients and businesses and customized and efficient services, while their clients were no longer bounded to a in-house labor force, gaining flexibility and the possibility to switch from a service supplier to another, benefit from the advantages of the competitiveness towards them (Miles, 2005). Because of their interconnectedness to companies of different sectors, one of the main debated argument concern the relevance of the spatial proximity for KIBS companies, intended as proximity to clients and regional concentration. Supply and demand of knowledge-intensive services are mutually reinforcing: from one side KIBS benefit from a face-to-face interaction with the downstream part of the supply chain represented its customers, but on the other side it exploited also the linkages with other services provider and supplier that creates in a concentrated geographical cluster (Di Maria et al., 2012). Simmie J. and Strambach S. (2006) contribute to sustain the significance of spatial proximity for KIBS showing the positive correlation between the economic performance of a city region and its KIBS segment shaped by the institutional, social and technological conditions of the city region itself. Andersson M. and Hellerstedt K. (2009), analyzing KIBS start-ups in the Swedish region, argued that spatial proximity of already existing KIBS significantly affect the born of new start-up companies within the same geographical area as they are usually correlated to a presence of a already knowledge intensive workforce and an active regional demand, while Antonietti R. and Cainelli G. (2008), considering the Italian manufacturing sector outsourcing activity toward KIBS services, display how geographical externalities as knowledge spillover and geographical proximity represent for knowledge-intensive companies an essential factor for their competitiveness as it allow to have a closer relationship with their customer that helps to efficiently face complex transactions. Part of the literature in does not sustain the same hypothesis concerning the significance of spatial proximity sustaining that information and communication technologies. Globalization, generally more integrated markets allowed KIBS to enter a process that result in the extension of the potential customers and markets beyond their geographical area. Antonelli C. (1999) underlined how ICT technology have been the leading cause that deleted the relevance of spatial proximity for KIBS companies fueling the growth of their market extension outside the border of their geographical location. On the contrary, Koschatzky (1999), by conducting an empirical analysis towards a sample of german innovative firms, argued that geography has carried on as distinctive factor of service companies in their activities; First of all, service firms interactions with industrial customers and partners in a spatial proximity context are more relevant for advisory services more than

technical services. Second, urban based services of the central region that are collocated in a more knowledge-intensive environment tended to have linkages with their partners provider of knowledge input at an interregional level more than a intraregional one. Blomstermo et al. (2006) showed how soft services (that doesn't produce physical output for their customers) are more likely to increase their market extension through direct investments in foreign countries or direct contact with their customers, allowing them to benefit also from a wider intelligence information that facilitate selecting the right business partner and market abroad while Morgan et al., focusing on the analysis of market extension of consultancy firms, argued how national and local firms are more likely to become "virtual firm" not bounded to their local competitive space, but able to compete on the international market through their expertise in defined sector and the ability to create unique solutions for their customers in a way that global firms cannot easily do (Morgan et al., 2006).Spatial Proximity is not itself an element which distinguish KIBS activities but rather an element that explain as a consequence of customers and companies needing of local resources and knowledge for their business purposes that make knowledge intensive services be some connection between local economy and non-local networks (Herstad and Ebersberg, 2013). Service companies doesn't rely on their location as much as they can rely on their "hard" innovativeness and ability to codify it and to create networks affecting both their knowledge input resources and consequently their market extension (Di Maria et al., 2012). Once sketched out the first dynamic that has been enhancing KIBS growth, the one of outsourcing, let's focus on the other factor which is of great relevance as it regards Knowledge-intensive services in their somatic characteristics: Innovation.

1.2.3: Role of KIBS in the Innovation Process

A wide part of the literature agrees on the relevance of KIBS in the business innovation process, their own features makes them vectors of information and knowledge: they are innovative activities by definition, source of innovation both internally and for their customers and part of the knowledge transfer (Mas-Verdù et al., 2011) (Miles, 2005). Although defining innovation and consequently innovation process as the dynamic which leads to its obtainment has been an issue of relevant debate in the economic and business literature, hereafter we are relying on the definition used by Gault (2018) where innovation is about " the implementation of a new or significantly changed product or process". Product can be either a good or a service and implementation means making it available to potential users. Knowledge-intensive services can act as enablers or as knowledge creators for their own right (Zieba M., 2017). Hertog (2000) conceptualizes the dynamic of KIBS firms in the Client-led innovation pattern, where innovation of firms is driven by the perceived emerging market needs, moving as "Facilitator" by supporting client firms in their innovation process without an actual transfer of knowledge, or as "Carrier of innovation" , acting as a bridge of knowledge by transferring it from one industry or firm to another, while Muller (2001) stressed the positioning of KIBS as Co-creators of innovation in other clients' dimensions than R&D departments, i.e. investment financing, management of human resources and marketing strategies, supporting customers in sharing the risks of innovation in shared dynamic. Gullaj (2002) defines it "Consultant-assistant model of innovation", while Smedlund and Toivonen (2007) unlight how KIBS play a crucial role as brokers of knowledge, recombining existing knowledge resources to create a customized service for their clients. In the role of Innovation and knowledge creators, KIBS firms are containers and producer of new ideas (Smedlund and Toivonen, 2007), producing internal organizational improvements and carrying out innovation activities on their own initiative in different fields (Zieba, 2017). Innovation dynamics are considered similar to the same dynamics of other sectors in some aspects, as they are all led by the same purpose of finding out new possibilities to increase economic value added (Drejer, 2004), but going beyond the old dichotomy of process/product innovation towards an "Expertise-field Innovation" that detects and responds to new needs and opens up new markets. Researchers that focus on firms' internal capabilities of creating knowledge draw their attention to R&D investments of KIBS, putting particular emphasis on high-tech services and showing their competitiveness and innovation skills are strictly related to their internal investments in R&D, which is able to create knowledge spillovers and a proactive behaviors of other firms stimulating investments in other industries (Rodriguez et al., 2008). Empirical validation of the theoretical literature finds out how

manufacturing firms still have higher levels of investments in R&D than most of the business services firms; a closer gap results if human resources investments are considered , suggesting that hard investments and standard innovation research policies are not able to fully capture the relationship between KIBS and innovation, as the efforts of those firms in the creation of the human capital for the accumulation of specific skills and capabilities must be considered (Evangelista, 2006). The rigid subdivision of KIBS firms made by part of the literature in the studies of service companies and innovation dynamics looking at those companies as 'enablers' rather than 'creators' shows limitations as they don't capture any distinguishing pattern of the firms in their business activities, but rather tries to canalize them into an already existing scheme. An alternative theoretical framework is created by considering the relation between KIBS and innovation as not extrapolated from the context but rather inside a framework which considers the innovation flow towards the linkages and business systems which service firms play a role into. Inside this innovation flow intermediation of KIBS should not be seen as professional intermediaries and brokers, but rather as players that act in different roles and are also able to conduct and address knowledge to the final exploiter, drafting the shape of an organization that blurred the line that separates being an intermediary and an innovator and can potentially cover multiple roles in interorganizational innovation patterns (Shearmur, 2018); the same firms can act as innovators in specific transactions, while they could be the exploiters of external innovation as well as the intermediaries between clients and suppliers. The multidimensional activity of KIBS firms has been pointed out by Stewart and Hysalo (2008), defining the category of 'intermediate users' of the innovation involved in the technological, cultural and products development that performs at the same time as innovators and users of innovation. Toivonen (2004), considering KIBS' role in innovation dynamics with customers, highlights two different roles: KIBS as facilitators of innovation at the company level and KIBS as carriers of innovations at the level of innovation system. Companies rarely are able to adopt external knowledge effectively and KIBS can enable the innovation process acting as supporters of direct transfer of knowledge inside the boundaries of the company, as brokers creating relations between demand and offer of expertise, as partner in the diagnosis of internal innovation needs and by applying benchmarking initiatives to help customers to find the best innovative solutions. KIBS play the role of carriers of innovation in a system of companies on the base of their positioning in the system that allows them to have a relative high numbers link between different stakeholders and companies. Those contacts, strengthened by the regional and usually local business activity undertaken, promote KIBS as fundamental "node" of the system and potential "orchestrators" of the innovation networks, developing a structure of "second" knowledge that substitute the classic formal and public knowledge base. Braga et al.

(2015) confirm Toivonen's findings related to KIBS contribution in knowledge sharing and creating activities, underlying the critical role played by T-KIBS in the absorption of technical knowledge and the resulting capacity to efficiently spread it towards customers in the form of innovative solutions. Resorting to innovation has been pointed out also by Howells (2006), who, analyzing intermediation dynamics in the innovation field in the UK, highlights a series of patterns supporting the ones that are detached from unilateral framework of innovation in favor of a more holistic and interconnected dynamic: firstly, innovation intermediaries, and KIBS as part of those, work creating both vertical and horizontal relationships and linkages reshaping the power forces of the different actors. Secondly, the innovation supply role and intermediation is only one of the various roles that service companies may undertake in terms of strategic remit. Lastly, networks and linkages created come to light the necessity to develop relational capabilities to know their competitive environment, allowing service companies to create more valuable and long-term relations. Focusing on these final aspects, it's straightforwardly understandable that innovation, either created or simply transferred, needs a link with a customer to become valuable: the objective of the next chapter is to break down and analyze the relation between KIBS firms and their customers, as their interaction represents a crucial factor to determine KIBS business activity effectiveness.

1.2.4: KIBS-Customer interaction and dynamics

As we have previously highlighted, linkages and networks in an increasingly compenetrated business environment are one of the main dynamics which define the economic activity of KIBS. The Client – supplier dynamic represents one of the most important relations in this sense: customers have been leaving the role of pure beneficiaries of the service and have become instead "co-creators" and resources of the supplier company. Since the end of the 20th century business literature has addressed the necessity, in the study of services, of leaving the product centric relation between supplier and customer, based on the concept of "value-for-exchange", in favor of a "value in-use" view, where the value of a service is given by the extent to which it contributes to the accomplishment of a specific purpose or goal of the customer (Grönroos, 2010). Market-oriented dynamics represent one of the main factors which have influenced the spread of value-in-use concept towards business literature, drawing attention to customers' dynamics and considering that "'buyer value can be created at any point in the chain by making the buyer more effective in its markets or more efficient in its operations" (Slater et al., 1994). The relevance of value-in-use is highlighted by Woodruff (1997), who starts to evaluate the relevant issues of knowing and learning from customers for competitive advantage obtainment, highlighting the importance of focusing on external incentives as an answer rather than on internal capabilities and skills. In Woodruff's theoretical framework, customers' evaluation of the product is based on a hierarchical chain that starts with the assessment of the attributes of the product, moves to the creation of preferences on the basis of their experience in its use and finally expresses their appreciation of the consequences of the use based on their goals and purposes. Customer's value perception hierarchy founded the base on which companies try to decrypt their behavior and start customers' learning process, defining the fundamental role played by the use of a product by the consumer in the effectiveness of the business activity of a company. Market-orientation and value-in-use concept extended in some way the understanding of value beyond the simple creation and production of a tangible product and started to consider an external environment that must be engaged and taken into consideration. The application of the value-in-use concept to services and service providers has had a significant importance in the analysis of value creation dynamics and vice versa; if for tangible products the analysis of customers was strictly related to the logic of exchange, in which customers gave a value to the result of the production process, the increasing interest in services pointed out the limitation of value-for-exchange as services couldn't be evaluated without considering the support provided and the use made by customers (Grönroos, 2008). The changing business environment and the new paradigm of the value creation increased the

interest of the economic literature in the first years of the 21th century and in 2004 Vargo S.L. and Lusch R.F. published the paper "Evolving to a new dominant logic"', a relevant step of the service-oriented debate in which the two authors introduced the so called "Service-dominant" logic (hereafter referred as S-D logic). Vargo and Lusch ascertained that intangibility, exchange process and relationship were playing a central role in marketing and that services were affirming as the application of specialized competences where knowledge becomes the new fundamental unit of exchange, stating that the value of a service (as well a product) is established in the moment of consumption (Vargo and Lusch, 2004). S-D logic was originally based on seven fundamental premises, that became ten because of the integration and redefinition made by the two authors in 2008, which aims to clarify how value is created and the role of the different actors as co-creators (Edman, 2009).

Table 1 Service-dominant logic foundational premise modifications and additions

FPs	Original foundational premise	Modified/new foundational premise	Comment/explanation
FP1	The application of specialized skill(s) and knowledge is the fundamental unit of exchange	**Service** is the fundamental **basis** of exchange	The application of operant resources (knowledge and skills), "service," as defined in S-D logic, is the basis for all exchange. Service is exchanged for service
FP2	Indirect exchange masks the fundamental unit of exchange	Indirect exchange masks the fundamental **basis** of exchange	Because service is provided through complex combinations of goods, money, and institutions, the service basis of exchange is not always apparent
FP3	Goods are a distribution mechanism for service provision	Goods are a distribution mechanism for service provision	Goods (both durable and non-durable) derive their value through use – the service they provide
FP4	Knowledge is the fundamental source of competitive advantage	**Operant resources are** the fundamental source of competitive advantage	The comparative ability to cause desired change drives competition
FP5	All economies are services economies	All economies are **service** economies	Service (singular) is only now becoming more apparent with increased specialization and outsourcing
FP6	The customer is always a co-producer	The customer is always a **co-creator** of value	Implies value creation is interactional
FP7	The enterprise can only make value propositions	The enterprise **cannot deliver value, but** only offer value propositions	Enterprises can offer their applied resources for value creation and collaboratively (interactively) create value following acceptance of value propositions, but can not create and/or deliver value independently
FP8	A service-centered view is customer oriented and relational	A service-centered view is **inherently** customer oriented and relational	Because service is defined in terms of customer-determined benefit and co-created it is inherently customer oriented and relational
FP9	Organizations exist to integrate and transform microspecialized competences into complex services that are demanded in the marketplace	**All social and economic actors are resource integrators**	Implies the context of value creation is networks of networks (resource integrators)
FP10		**Value is always uniquely and phenomenologically determined by the beneficiary**	Value is idiosyncratic, experiential, contextual, and meaning laden

Figure 1.3 Fundamental Premises of the S-D logic, Adapted from Vargo and Lusch (2007)

As we can see, Vargo and Lusch firstly referred to customers as “co-producer” (FP6) but that highlighted how the definition was still bounded to the good-dominant logic and lead to understand production as an output-driven activity as admitted by the two authors, who later on decided to change it into “co-creation”, emphasizing the collaborative nature of the interaction between the parties in the value creation. FP10 also states how value is “always uniquely and phenomenologically determined by the beneficiary”, and not by the service supplier which cannot define independently to deliver value (FP7). The contribution of the S-D logic in redefining the relations and the role of the client on value creation creates the basis for the analysis of KIBS context; by definition, KIBS are interested in addressing specialized knowledge to their customers and applying the knowledge which is relevant to the classes of problems confronted by its customers (Miles, 2012). The consequence of the wide scope of the economic activity of knowledge-intensive service providers pointed out a complex and asymmetric relationship between them and their customers (Aarikka-Stenroos and Jaakkola, 2012), where the capacity to get in touch and create an effective communication channel supports the creation of value-in-use (Grönroos, 2008) and of a valuable supplier’s value proposition. Asymmetric information between KIBS and clients concerns the nature of the issues faced by the former to answer to the necessities of the latter; sometimes clients are not able to fully disclose their necessities as they are not fully aware of them while in others, as suggested by Miles (2012), the lack of internal cognitive capabilities results in ineffectiveness of capturing external knowledge provided by KIBS relations. The fact that the service provider isn’t considered a bearer of not held knowledge by the client, as well as the provision of ‘commoditized’ services and consequently knowledge which is not considered valuable by them, or not considered strictly connected to their core activities, are the main causes of the lack of knowledge absorption by KIBS’s customers because of the absence of a real interest in setting a valuable relationship with their supplier (Miles, 2012). Potential obstacles to the effectiveness of the supplier-customer relationship in the KIBS context suggest that the creation of a high value-in-use is higher as higher is the engagement of the parties in a problem-solving dynamic where the usefulness of the supplier’s knowledge is valued on the basis of its ability to benefit the customer and serving “’solutions’’ rather than simple services. In the view of the S-D logic, Aarikka-Stenroos and Jaakkola (2012) propose a co-creation of value-in-use framework based on the joint problem-solving process elaborated through an empirical analysis conducted through buyers and Knowledge-intensive services providers. The resulting framework breaks down the function of KIBS and clients in their dyadic relation starting from their internal resources and the potential roles they can act through their involvement in the different phases.

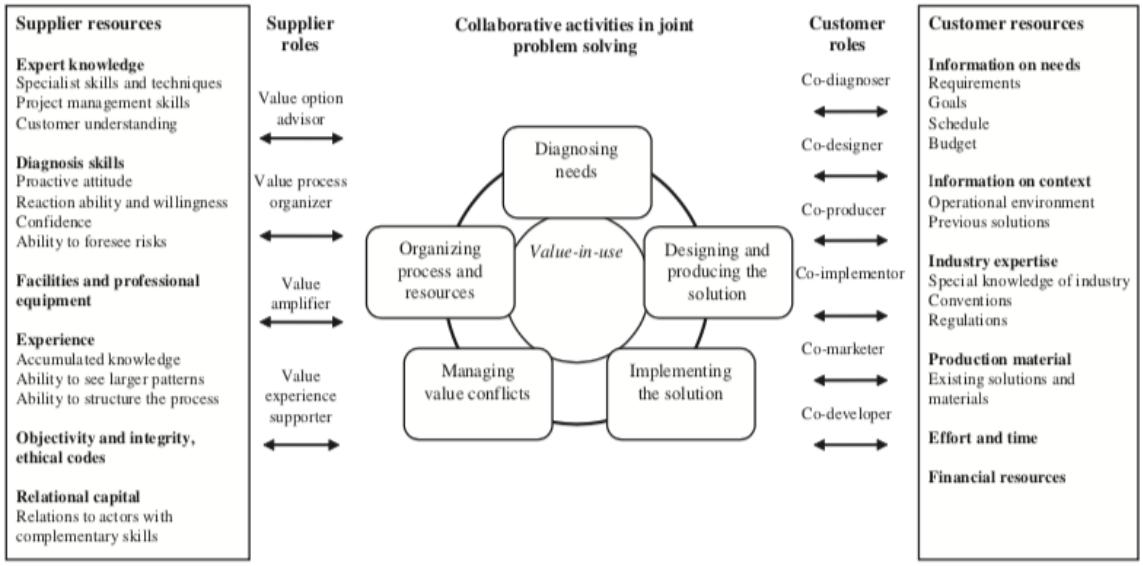

Figure 1.4 Joint Problem-solving framework as a value co-creation process, adapted from Aarikka-Stenroos and Jaakkola (2012)

Problem-solving dynamic starts with the understanding of customers' desired outcomes and related activities performed, where the former is about to switch the supplier's points of view from its perspective of providers (what services "are") to the one of its clients (what services "'do"), while the latter aim at understanding the cycle of actions engaged to solve a specific issue. The first phase is defined by the two authors as "Diagnosing needs" and clients act as co-designer of the resulting value propositions options offered by suppliers, supporting them by furnishing critical information on their needs. The Diagnosing phase is followed by the Designing and Production phase where customers act both as co-designers, defining the optimal value proposition, and as co-producers, proactively providing support to supplier's in its creation. Aarikka-Stenroos and Jaakala explain how that phase is in particular the most time consuming but also one of the most important ones in building value-in-use, where KIBS act as "value amplifiers" applying their expertise and knowledge resources and at the same time as tracers of possible new issues which need to be taken into consideration to achieve client's objectives. The next phases regard the configuration and organization of the process and resources and the possible conflicts management in the relations. Suppliers undertake the role of organizers of the resources helping in particular inexpert customers to fully disclose the potential value of their services and the relationship but at the same time those phases could raise a series of conflicts due to various obstacles set up by the parties: an example could be the

potential reluctancy of customers to fully disclose sensitive information (e.g. financial information) to KIBS companies, or the arrogant behavior of suppliers as well as the formulation of unrealistic expectations of the effectiveness of the service. All these conflicts of formal and informal nature need to be managed because of their potential to be highly harmful for the value-in-use and final result, suggesting how the co-creation of value is strictly bounded also to the human resources dimension of the relationship. Implementation phase concerns the running phase of the solution in which suppliers support clients in the execution to extrapolate the maximum level of value-in-use but at the same time the customers act as co-implementer, helping to customize their own solutions. Value-in-use is appreciated by customers both in terms of direct or indirect monetary benefits (e.g. decreased costs or increased revenues, reliability and usability of the solution provided) as well as non-monetary benefits given by the support of external expertise. Aarikka-Stenroos and Jaakala's framework could be seen as a development of the S-D logic, breaking down the co-creation role of clients in the service production and focusing on the relation-intensive business environment of KIBS companies and the competitive advantage given by the supply of a valuable knowledge resources for clients.

CHAPTER 2: KNOWLEDGE MANAGEMENT DEVELOPMENT AND THE ROLE OF ICT IMPLEMENTATION

2.1: THE KNOWLEDGE MANAGEMENT PARADIGM

2.1.1: Defining Knowledge Management

Knowledge and Knowledge Resources have become increasingly relevant in the economy, substituting the role of land and capital in the creation of a sustainable competitive advantage (Beijerse R.P., 1999). Straightforwardly, the consequence for firms has become the necessity to manage them in order to pursue its economic objectives. Managing something requires first of all the definition of what needs to be managed. Although giving a definition of what knowledge is has been the object of a huge debate that for many aspects goes beyond the borders of the economic and business literature, we will try to analyze knowledge and knowledge contents by taking into consideration the different sources which try to give an answer focusing on the economic field application. Despite the ontological characteristics of knowledge, the most important things to evaluate are its epistemological aspects, intended as trying to define which are its origin, nature and validity (Baets W.J., 2005). Van Krogh and Roos (1996) state that knowledge can be defined by three different epistemologies that co-exist; the first, the information processing epistemology, deals with the view of "information' as an object that identify "knowledge", resulting in the overlapping of the two concepts. The second one, the network epistemology, argue claims that knowledge is the result of the individuals' interaction, while the third one, the self-referential epistemology, is the result of the internal cognitive process of each individual. The two authors emphasize how, from these epistemologies, knowledge can be seen either as an "object" and as a "process", looking at the context to define which one of the opposed views is considered. The "knowledge is object" view is developed also by Cook and Brown (1999) in the "epistemology of possession", where it is described as an objective entity, based on "facts" and derived from Intellectual process, but at the same time many authors started to detach from the common objectivist view to join views opinions that derive from different philosophies (Hislop, 2005). Generally speaking, for epistemological purposes, Knowledge can be grouped on the base of two different main perspectives: the objectivist approach and the subjective approach. Objectivism relies on the positivist view, by which true knowledge is the definition of something external and separable from the knower, trying to indagate knowledge as something that is possible to understand through the application

of the scientific method. Another specific feature of the positivist point of view is considering the strict relation between causality and determinism where the clear connections between cause and effects lead to predictable outcomes (Baets W.J., 2005). Although positivism and the clear separation between subject and object is one of the fundaments of the western scientific approach, Bolisani et al (2015) highlight how this approach point of view shows many limitations in the study of knowledge; the main reason reseeds in the fact that knowledge itself is always related to something and if studied in the perspective of "scientific knowledge", as the use of positivist point of view does, it does not lead to any relevant result. Knowledge could not be putted put into the scheme of management subjects in a standard e pre-deterministic way. On the other hand, the subjective approach doesn't fall into the trap of trying to separate knowledge and knower, starting from a knower-centric point of view and stating that no external knowledge could exist without someone "thinking" about it. Knowledge is the result of the interaction of knowers' discrete and experienced modes. Authors which fall into subjective approach are those that consider the inseparable dichotomy between "tacit" and "explicit" knowledge, with the former as an expression of the knowledge that comes from individual's own experience and the latter as an externalization to define a shared world (Bolisani et al., 2015), as well as considering knowledge as multidimensional, not rejecting its potential taxonomies, but rather arguing that it can be simultaneously declined into different categories at the same time (Hislop, 2005). By showing the shortcomings of the application of the positivist philosophy in the knowledge definition, the subjective approach leads also out the broader and not well-defined profile of knowledge itself and, as a consequence, to clearly defines its management. The ambiguity and difficulties of defining Knowledge reflect also in the definition of Knowledge Management: how is it possible to decline and breakdown the management of something that is not so clear? These difficulties are testified by Girard and Girard (2015) that collected more than 100 definitions of Knowledge Management coming from different subjects and disciplines. The work of Girard and Girard highlights another characteristic of KM that is its multidisciplinary nature, rooting its development in many social and science-based disciplines such as organizational science, sociology, cognitive and computer science and information technology science. This acts as a double-edged sword, as from on one hand Knowledge Management is open to many several points of view and different disciplines contributions, on the other hand it further obfuscates its boundaries (Dalkir, 2017). Considering different perspectives, we can rely on the definition categories proposed by Dalkir (2017), that aims to identify them on the base of exclusive features attributed to KM. The business perspective definitions of Knowledge Management highlight the relevance of

knowledge in the organizational context to which it is applied and define the objectives that it has to accomplish. Some examples are reported hereafter:

- *Knowledge management is a business activity with two primary aspects: treating the knowledge component of business as an explicit concern of business reflected in strategy, policy and practice at all levels of the organization: and, making a direct connection between an organization's intellectual assets- both explicit and tacit – and positive business results (Barclay & Murray, 1997)*
- *…the function of knowledge management is to guard and grow knowledge owned by individuals, and where possible, transfer the asset into a form where it can be more readily shared by other employees in the company. (Brooking,1999)*
- *Knowledge management is achieving organizational goals through the strategy-driven motivation and facilitation of (knowledge-) workers to develop, enhance and use their capability to interpret data and information (by using available sources of information, experience, skills, culture, character, personality, feelings, etc.) through a process of giving meaning to these data and information (Beijerse, 1999)*

The business perspective is placed side by side by the Intellectual and Knowledge assets point of view, maintaining the same organizational focus but enhancing the necessity to manage knowledge as an asset of the company:

- *Knowledge management consists of "leveraging intellectual assets to enhance organizational performance (Stankosky, 2008)*
- *Knowledge Management is the identification and analysis of available and required knowledge assets, knowledge asset related processes, or the subsequent planning and control of actions to develop both the assets and the processes ("Knowledge Management", IBM Glossary,")*
- *KM is the process through which organizations generate value from their intellectual and knowledge-based assets (Levinson, 2007)*

As we can see, some examples of the Intellectual and Knowledge assets perspective are strictly correlated with the objective and positivism-based perspective of knowledge. A relevant contribution into the definition of management was given by information management and information technology literature: on one side, part of the literature sees no distinction between information and knowledge management; an example is given by the definitions furnished hereafter:

- *The objective of IT Knowledge Management is to create, maintain and make available concise and actionable information to users and IT support groups in order to resolve service disruptions quickly and respond to customer queries satisfactorily (McGlynn, 2013)*
- *KM is predominantly sees as information management by another name (Davenport and Cronin, 2000)*
- *Knowledge management is explicit and systematic management of processes enabling vital individual and collective knowledge resources to be identified, created, stored, shared, and used for benefit. Its practical expression is the fusion of information management and organizational learning (Serrat, 2009)*

While the other hand part/side of information management literature distinguishes the two concepts:

- *Knowledge management is the concept under which information is turned into actionable knowledge and made available effortlessly in a usable form to the people who can apply it (Petel & Harty, 1998)*

Many other contributions arrive from cognitive and process/technology perspective, all emphasizing different schools of thought about KM definition. The previous examples show the limitations of trying to define what KM is in absolute terms; seeing as how considered/assuming that there are different definitions and perspectives on knowledge and consequently potential infinite discipline interpretations of what its management is, the research of a single answer may only lead to a huge effort with no logical results. In this sense, a possible solution is trying to consider KM on the base of our objectives and in light of the most logical and shared results of the literature. By considering the business and organizational point of view, KM is a subject that must be evaluated in the terms of its effort to the organization and capacity to answer the following questions: What necessity does the KM fulfill in a firm? What objectives does it help to accomplish? Many definitions rely on the proper contribution of Knowledge Management to the creation of the competitive advantage for economic purposes by leveraging and improving the knowledge resources of the firms. The business and economic point of view itself helps us to define KM as the resource that answers to the previous questions, as KM is taken into consideration for its ability to increase performance. Authors of the late 90s refer to KM as a possible solution to leverage and enhance knowledge workers' capabilities, giving a sense to information and data, bringing higher value to their customers (Beckman, 1999) (Beijerse, 1999), while O'Sullivan (2007) refers to KM as the instruments that allow

organization to allocate knowledge where it can bring the highest payoff. In order to take into consideration the different contents of knowledge previously showed and the different definitions based on the business and management perspective, we rely on the synthesis proposed by Kumta G. and North K. (2014), which states that

> *Knowledge management enables individuals, teams and entire organisations as well as networks, regions and nations to collectively and systematically create, share and apply knowledge to achieve their strategic and operational objectives. Knowledge management contributes to increase the efficiency and effectiveness of operations on the one hand and to change the quality of competition (innovation) on the other by developing a learning organisation.*

The proposed definition does not actually define in a static way what KM is, but rather dynamically state what the KM do for the organization, touching and considering all the relevant dimensions that shapes it: the organization is identified in its individuals and groups of them, the knower that are the origin and the final receiver of the knowledge, the activities that are involved in the KM and finally the consideration of the objectives of the interaction. On one hand the development of the a Learning Organization deals with the ability of the organization to generate new knowledge and insights through the acquisition of information in the environment, their dissemination and interpretation (Slater and Narver, 1995), on the other the more known theme of the creation of pursuing strategic and operational objectives are strictly related to its ability to enhance organizational competitive advantage. In the next chapter we will focus on the study of the relation between these three elements: Knowledge Management, Organizational Strategy and competitive advantage.

2.1.2: Knowledge Management relation with Strategy and Competitive Advantage in KIBS

Competitive Advantage is one of the main issues for firm's management in the context of the strategy definition. We define it as the ability of the company to offer services or goods which are perceived in some way as superior than the one offered by competitors. As previously said, the contribution of knowledge to this objective has been indagated by many researchers and practitioners since the beginning of the development of Knowledge Management literature, as for example Stender (1996) argues how the creation of competitive advantage could be at least seen as the interaction of different knowledges giving particular relevance to tacit knowledge as the root of competitive advantage. By starting to consider an external environment characterized by volatility, uncertainty and complexity (Kumta G. and North K., 2014) and the necessity to face it to perform in the market, it has become more and more relevant to rely on intangible and irreplaceable assets which are the results of the exploitation of knowledge in an economic context. KM as source of competitive advantage is an implication rooted in the characteristics of the resource-based view, in which assets and resources of the company must be managed ad evaluated on the base of their ability to create value-added and costly-to-copy attributes which enable the firm to achieve superior performance; for the resource-based perspective this is expressed by four distinctive feature of company's own resources that are their valuable nature, the scarcity of the resource among competitors, the difficulty of replying them and substitute them (van Krogh and Roos, 1996). Individual's cognitive resources and organizational knowledge fit with the characteristics of uniqueness of the resource-based view but at the same time they address a relevant issues for strategic management activity regarding the spread of knowledge resources inside the firm for achieve superior performances and the ability to contain them inside company's borders and not share them outside, issues that KM has to give an answer to (Lubit, 2001). Organization's strategy must work to build up knowledge management infrastructure and tools in order to pursue its objectives, maintaining and developing its competitive advantage and build up a knowledge strategy. Zack (1999) considers the addressing of a knowledge strategy based on the main questions of "what needs to be managed" and "how it must be managed", defining a framework which can enable it in the strategic thinking. He underlines how the most important contribution of knowledge in terms of organizational competitive advantage is given by its nature, as its main strength is the fact that competitors cannot acquire in any ready-to-use form the knowledge possessed internally. Firms must consider in their strategies how to focus on the definition of a knowledge competitive position of the firm, starting from the analysis and classification of the already existing knowledge resources, assessing what is already known and what needs to be known to

sustain competitive advantage. Knowledge resources are considered and evaluated on the base of the SWOT analysis, highlighting internal weakness and strengths that the firm must take care of and detecting possible external threats to avoid as well as opportunities to exploit. The result of a Knowledge-based SWOT analysis helps the firm to understand the presence of possible "knowledge gap" that must be filled in order to pursue company's strategy. The identification of a Knowledge gap deals also with the so-called Knowledge Infrastructure, tangible assets and investments which are able to determine the efficiency of knowledge supporting in the different activities in which it is involved. Another important aspects of the Knowledge strategic planning is the necessity to focus on Knowledge critical areas of the business activity, the ones that are able to sustain and enhance the overall strategy (Capeda-Carrion, 2006), highlighting how strategically speaking a framework based on a knowledge resource view is a specification of the more broader resource-based view. The strategic analysis of firm's knowledge needs to take into consideration also the presence of competitors and the industry knowledge flow, considering possible sources of competitive advantage and the uniqueness of industry rivals' knowledge resources in order to compete in the market in the best way. The contribution of KM in terms of helping the company to create, directly or indirectly, higher results is seen also in its capacity of enhancing organizational performance, considering both financial and non-financial parameters (O'Dell and Grayson, 1997). Zack et al. (2009) indagate the relation between KM and organizational performance finding out a positive relation that is able to indirectly enhance the financial performance of the firm, stating that the benefits of KM can be empirically proved, following the same conclusions of other authors which analyzed the same topic on a qualitative perspective (Nonaka and Takeuchi, 1995). KIBS deal with knowledge on a regular basis and they are felt primarily involved in the effective and efficient management of it (Zieba M., 2014). Knowledge-Intensive Business Services activity is focused in the delivery of both "outsourced solutions" and "innovation dynamics" with their clients, highlighting different strategies towards Knowledge Management according to clients and business necessities. On one hand KIBS are interested in the customization of their services and creation of tailored solutions for clients, suggesting the necessities to look for a "personalization strategy", while in the other hand many studies revealed also the necessity for those firms to codify existing knowledge and create a replicable pattern in order to efficiently exploit already existing knowledge. Codification and personalization seems apparently a trade-off for KIBS firms which have to find an internal equilibrium to ensure effectiveness of the offer but, actually, the two strategies coexist, as firms invest on technology to assess their developed knowledge and codify it to make it replicable, while the interaction with clients and the external environment allow them to stay in the market by capturing necessary knowledge to stay in and

to tailor solutions on the base of their needs. Coexistence of the two strategies was also ascertained in empirical studies, as made by Bettiol et al. (2012), where the "balance" was founded out between a necessity of codified knowledge to reach the target quality of services offered and to cope with the alignment of operations and strategy, while at the same time this necessity doesn't compromise the personalization and creativity of the final output. Going beyond the codification-personalization dichotomy, Bolisani and Scarso (2010), on the base of empirical surveys, confirms the central role of knowledge as a core asset in KIBS realities, valuing the distinction of different T-KIBS companies' strategies built in its exploitation through the use of a "Knowledge strategy matrix".

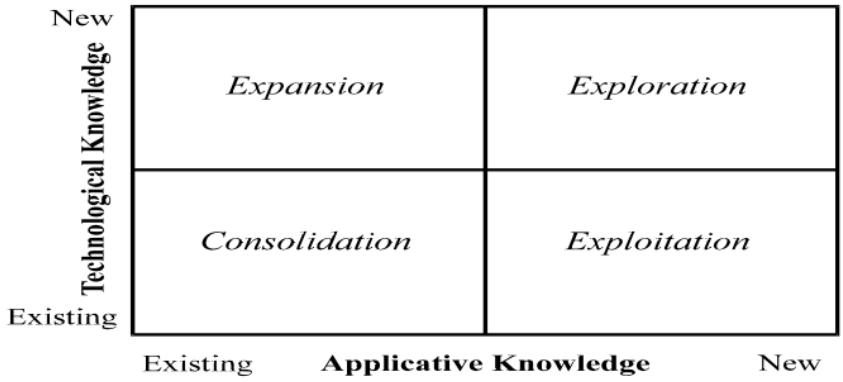

Figure 2.0: The Knowledge strategy matrix, Source: Knowledge-Based Strategies for Knowledge Intensive Business Services: a Multiple Case-study of Computer Service Companies, Scarso E., Bolisani E., 2010, Electronic Journal of Knowledge Management, 8 (1)

The matrix develops on two different dimensions: the internal technical development ("Technology knowledge") and the kind of business needs which the service is designed to meet ("Applicative Knowledge"). The result is the distinction of four main strategies: "Consolidation" strategy deals with offering the same knowledge-based services to a list of consolidated clients. It's a conservative strategy which could have high benefits in the short run but weakness the positioning of the company in the long one. On the other hand, "Exploration" is a very risky strategy based on offering always new services to new customers. "Expansion" strategy allows KIBS to develop their internal knowledge base but staying in the same applicative field, while "Exploitation" is followed by those companies that want to apply the same knowledge base into a wider audience of customers.

2.2: KNOWLEDGE MANAGEMENT: A LITERATURE REVIEW

2.2.1: Knowledge Management Models

The following chapter presents a theoretical review of the most widely known and influential Knowledge Management Models. KM models cover different aspects, from the knowledge creation dynamics to ontologies of knowledge and sharing activities, giving their contribution in furnishing helpful roadmaps and techniques for practitioners and companies in assessing the internal dynamics of such a valuable asset.

Nonaka and Takeuchi's knowledge creation model

Nonaka and Takeuchi's knowledge creation model is still considered the most famous and debated model. An increasing interest of the literature in knowledge creation was born at the beginning of the 1980's, where the researchers explained the idiosyncrasies of firms as the result of different knowledge bases intrinsic to them (Nonaka and von Krogh, 2005). Winter (1987) firstly started to talk about a taxonomy of knowledge assets and the importance of create and manage knowledge as fundamental source of competitive advantage for organizations in the competitive arena. On the base of Winter conjecture, Kogut B. and Zander U. (1992) formalized a model based on the so called "Knowledge-based view of the firm": they affirmed that knowledge could be either "information" by knowing something, and "know-how", that is about knowing how to do something and that this categories of knowledge are part of the expertise of different owner as individuals, groups, Organization and inter-organizational networks. In this ecosystem the creation of knowledge is given by specific capabilities, called "Combinative Capabilities", that are the result of the intersection of the capabilities of the firm to exploit its already existing knowledge base to create new connections. Kogut and Zander's epistemological and ontological dimensions of knowledge and idea of combinative capabilities will be of high influence in the conceptualization of the most known and debated Nonaka and Takeuchi's SECI model.

The most famous Knowledge Creation Model is the SECI model, developed by Nonaka I. and Takeuchi H. and exposed in 1995 in their work "The Knowledge Creating Company: how Japanese companies create the dynamics of innovation". Nonaka and Takeuchi studied the success of Japanese companies and realize that their competitive advantage was based on their

skills and expertise at “organizational and knowledge creation” and not on those elements as manufacturing prowess, customers and suppliers relationship and access to cheap capital typical of western companies; the two authors underlined how that distinctive traits of their local companies was the result of their survival instinct in the Japanese macroeconomic context, characterized by uncertainty which pushed them to rely on continuous innovation as the main directive to compete in the business arena and the application of Japanese intellectual tradition which distinguish them from Western culture even in the business administration field. Nonaka and Takeuchi define two dimensions, epistemological and ontological, to describe knowledge creation; The first one deals with the type of knowledge while the second one with the levels of knowledge-creating entities. The authors’ epistemology is based on two different type of knowledge: Explicit and Tacit knowledge. Explicit knowledge is codified and objective knowledge that is possible to share through a systematic and formal language while Tacit knowledge deals with personal knowledge, difficult to formalize and communicate through formal tools. Tacit and Explicit knowledge are not independent in Nonaka and Takeuchi theory, but on the contrary they interact each other helping to create and expand human knowledge towards the organization, creating a relation which is defined as “Knowledge Conversion”. Knowledge Conversion is declined in 4 different forms: from Tacit to Tacit (Socialization), from Tacit to Explicit (Externalization), From Explicit to Explicit (Combination) and from Explicit to Tacit (Internalization). The 4 types of Knowledge Conversion are the fundamentals of the matrix which are at the base of the Nonaka and Takeuchi Knowledge Creating Model.

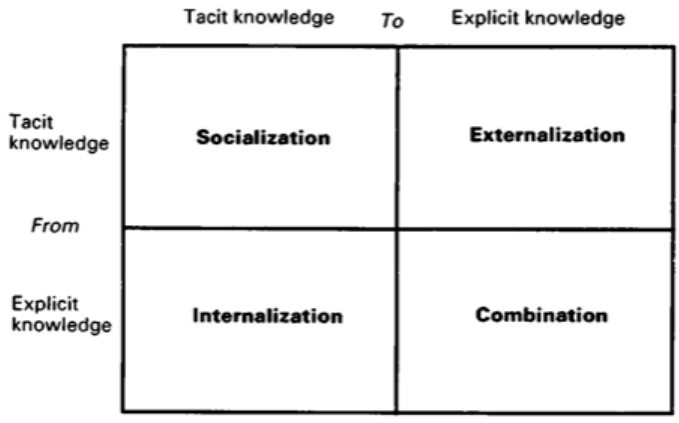

Figure 2.1: Illustration of Nonaka and Takeuchi’s Knowledge Creation Model, Source: The Knowledge-Creating Company, Nonaka I., Takeuchi H., 1995, Oxford University press

Socialization is the process of sharing tacit knowledge as mental models and technical skills generating new tacit knowledge, an example is given by on-the-job training, in which the main determinant of knowledge acquisition and creation is experience. Externalization concerns the transformation of tacit knowledge into explicit knowledge, a dynamic which involves both deduction and induction activities of the participants in the concept creation. Combination is a process of systemizing concept into a knowledge system (Nonaka and Takeuchi, 1995), the result of the sharing of explicit knowledge between individuals, as for example education at school. Finally, Internalization deals with the transfer of shared explicit knowledge and experiences in the individual mindset, defining and shaping new mental models: one of the most common example is the "learning by doing", in which individuals internalize already existing knowledge, make it proper and creates new mental models which forms the base to find new practices and knowledge. The internalization makes knowledge once again tacit and closes the cycle of knowledge creation while at the same time opens a new one, Creating the field for the creation of new capabilities, skills and mental models through the direct link with the socialization phase. The dynamic which is created by the four categories of Knowledge Conversion is represented by Nonaka and Takeuchi as a spiral, underlining their interaction in the creation process.

As mentioned before, ontological dimension concerns the entities involved in the knowledge creation. The authors assert that the creation of knowledge creation interests in a strict sense only individuals, but organization and groups, both at organizational and inter-organizational level, create themselves the environment that enables individuals to create and innovate. Knowledge creation dynamics starts at the individual level and pass through different organizational groups through the knowledge conversion spiral, shaping an interrupted flow where knowledge is created from knowledge.

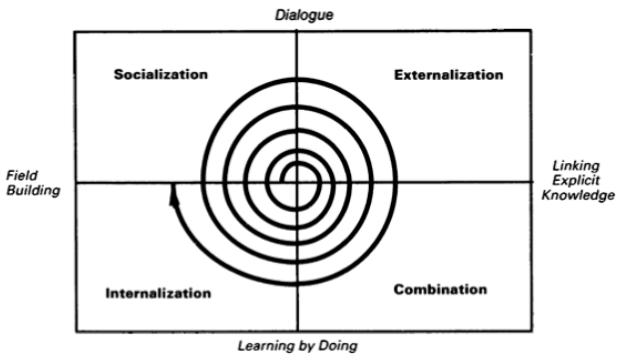

Figure 2.2: The Knowledge Spiral, Source: The Knowledge-Creating Company, Nonaka I., Takeuchi H., 1995, Oxford University press

Nonaka and Takeuchi's SECI model of knowledge creation is subjected to different criticism by the literature: McAdam (1999) found the epistemology of SECI model as not completely inclusive of all the possible types of knowledge and unidimensional, resulting in a mechanistic and limited model. Gourley (2003) underlined shortcomings in the survey used by Nonaka and Takeuchi in the validation of their model, affirming that only two of the four knowledge conversion phases are validated by the empiric research and that concepts of combination and internalization have not been clearly described. Engeström et al. (2012) criticized the SECI model as tautological in its fundaments, as it describes the spiral mechanism of knowledge conversion modes as necessary without arguing why. Nonaka and Takeuchi's SECI model has been subject of many knowledge creations debates and but nonetheless it's still unquestionable the contribution of the Japanese authors to Knowledge Management and the use and study of their model as a milestone of the literature and fundamental base to understand the development of knowledge models, creating a relevant base for KM processes analysis.

Wiig's Knowledge Management Model

Wiig (1993) approached the construction of a knowledge management model starting from the pragmatic thought that knowledge, in order to be useful and valuable, needs to be managed. In Wiig's model effective knowledge is described by four main characteristics: it must be complete, congruent, connected and must take into consideration the perspective from which it is seen. Completeness refers to "how much is complete" the knowledge base of a certain object or matter, connectedness to its degree of interconnection of a specific knowledge base to the others, congruency to the logical clearness of those connections while purpose and perspective to take into consideration the point of view from which an individual as well as an organization know something and the extent for what it is known. Knowledge could be "public" if it is explicit, shared and generally available in the public domain, "shared" if it is owned by knowledge workers and used in their working routine or embedded in technology and "personal" if it is owned specifically by an individual; Personal knowledge is considered the most important one, most of the time it's a form of tacit knowledge deeply automated, internalized and used "without explicit awareness and understanding of the person who holds it" (Wiig, 1993). Public, Shared and Personal Knowledge are form of the knowledge, ways through which it can appear, and they are juxtaposed by the four typed of knowledge, defined

as the types of knowledge that the individual and the organization is interested in for their purposes. These categories divided knowledge into “Factual”, meaning that knowledge which deals with data and facts, “Conceptual”, concerning concepts and perspectives, “Exceptional”, that is about judgements and hypothesis, lastly “Methodological” knowledge which deals with the elaboration of strategies and decision-making methods. Once described the different form and categories, Wiig’s model organizes them into a hierarchical structure presented by the scheme hereafter, highlighting that all forms can show either in passive or active ways:

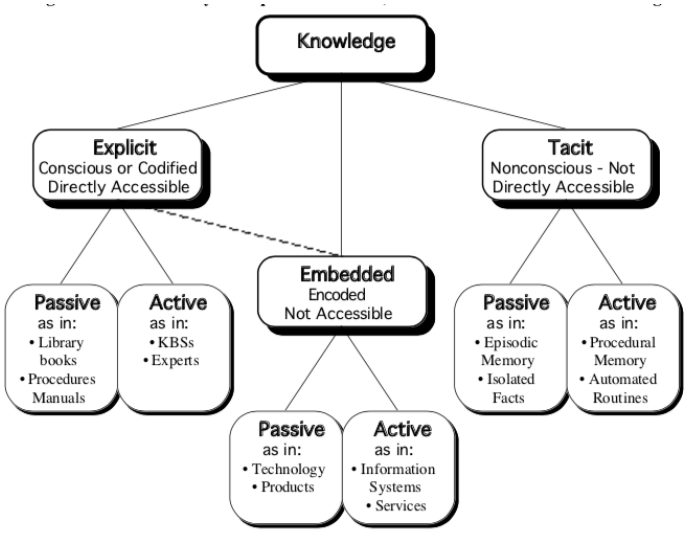

Figure 2.3: Wiig’s categorization of knowledge, Source: Knowledge Management Foundations, Wiig K.M., 1993, The Schema Press

Wiig’s KM model is still considered one of the most influential models in Knowledge Management literature as it provides a theoretical distinction and breakdown of Knowledge which can reveal a potential tool to integrate to other approaches (Dalkir, 2017). Alongside the theoretical framework proposed, the great pragmatism of Wiig’s model is shown by the 4 stages KM Cycle, each of them related to the activities of creating, holding ,pooling and using knowledge, proposed by the author to accomplish to the main purpose of Knowledge Management, defined as “To make the enterprise intelligent-acting by facilitating the creation, commutation, deployment and use of quality knowledge” (Wiig, 1993).

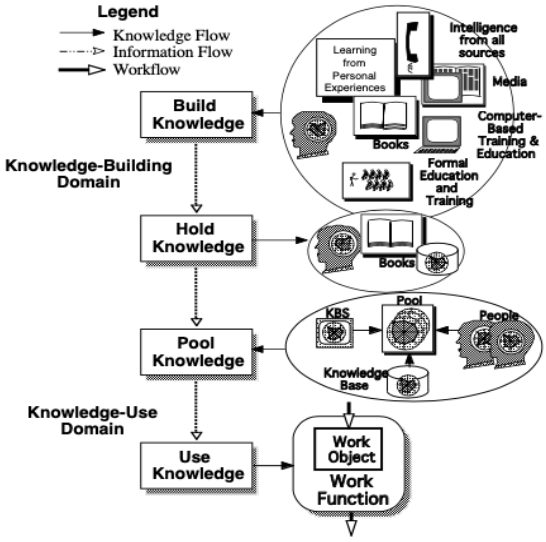

Figure 2.4.: Wiig's KM cycle, Source: Knowledge Management Foundations, Wiig M.K.,1993, Schema Press

All the stages of KM Cycle are presented showing example of different businesslike activities that directly helps to understand the direct impact of the KM in the daily routine of the organization. Company's actors act as active players of the Knowledge creation process and they develop different levels of expertise on the base of the numbers of knowledge area involved and individual's depth of understanding of each of them, creating a sort of hierarchical knowledge ladder that helps the organization to understand the level of "internalization" of the knowing. On one hand Wiig's model surely heavily contribute in the Knowledge Management literature by creating a complete model which was able to mix theoretical and practical issue but, on the other hand, probably because of its intrinsic complexity, there are very few empirical researches concerning its implementation.

Skandia Intellectual Capital Model

Intellectual capital model was developed by Skandia AFS, a Swedish insurance company, and presented by Edvinsson L. in 1997. Skandia Intellectual Capital model was an extremely pragmatic and business-oriented model internally developed for the main purposes of understanding the value of intangible and soft assets, packaging and support the access of knowledge, grow and cultivate intellectual capital and increase "recycling" knowledge activities as well as the transfers of skill and applied knowledge. The model starts by considering the difference from financial capital and intellectual capital, where the latter is defined as " the possession of knowledge, applied experience, organizational technology, customer relationships and professional skills that provides Skandia AFS with a competitive

edge in the market" (Edvinsson, 1997) and is further subdivided into Human Capital and Structural Capital. Structural Capital is the defined as everything that "stays inside the company when people go home" and is directly tied to Human Capital; in order to create tangible financial benefits for the company, the role of the firm's management is to transform personal held knowledge (Human Capital) into Structural Capital. Structural Capital have further subdivision into Customer Capital, Organizational Capital and many other levels which were added and introduced in the subsequent studies and approached to Intellectual Capital Models.

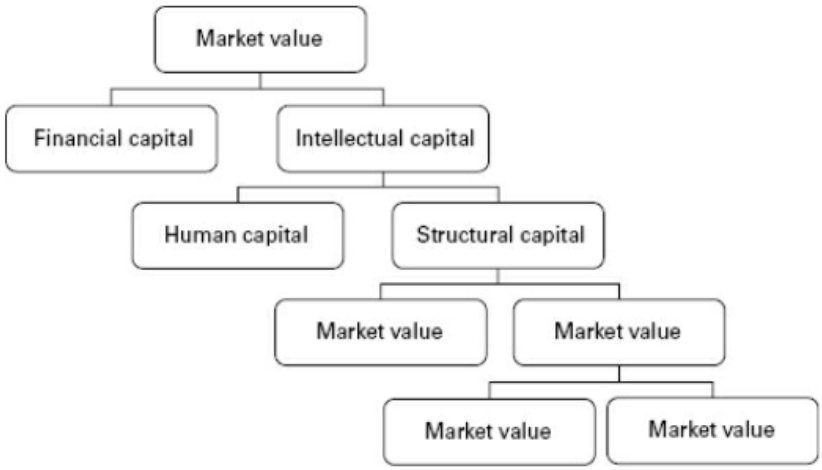

Figure 2.5: Skandia ICM, Source: Knowledge Management in Theory and Practice, Dalkir K., 2017, The MIT press

Edvinsson considered KM activity as strictly tied to Human Capital, considering human knowledge, experience and expertise of organization's individuals (Dalkir, 2017) and he didn't consider the transformation process into Structural Capital, fundamental in the creation of financial benefits for the company out of intellectual assets. Intellectual Capital Models introduced the broader concept on Intellectual Capital Management (ICM), defined as the management activity which allows to leverage both Human and Structural Capital and the organization to achieve a steeper learning curve, shortened time lead to application and savings in costs and investments. Skandia model highlights the presence of knowledge assets that are able to create economic value and a it constitutes a framework map to identify them. Nonetheless, the purpose of the model represents itself its main shortcoming; the presence of a interorganizational tacit knowledge which resides in the relation between individuals and its value for the company is not considered as part of the Human Capital and at the same time it does not consider explicitly management issues related to ICM activity, as for example the innovation process or the creation of new knowledge.

Boisot Space-I Model

Space-I model was formulated by Max H. Boisot in 1998. The model is based on the distinction of the concepts of "information" and "data": information is what an observer extracts from data on the base of its expectation and prior knowledge (Boisot, 1998). In order to process information goods into "knowledge goods", individuals must interact on the base of a common and shared context, coding scheme and language. The base of Space-I model is therefore knowledge sharing inside the border of the organization and in Boisot's view it must be addressed on the base of two principles: Firstly, the more easily data can be converted into information good, the more diffusible it become and secondly, the less structured data requires a shared context for their interpretation, the more diffusible it become. Data is structured and understood through the process of abstraction and codification, where the former refers to the number of cognitive categories through which an agent makes sense of events, the latter to the number of categories that the agent invokes or creates to use them efficiently and in discriminating ways (Child J., Ihrig M., 2013). Codification and Abstraction are mutually reinforcing and represents two of the three dimensions of the Boisot's Space-I Model. The higher is the degree of abstraction and codification of knowledge, the easier it become its transfer it but at the same time, as previously said, the social conveyance requires a shared environment that constitutes the third dimension of the model.

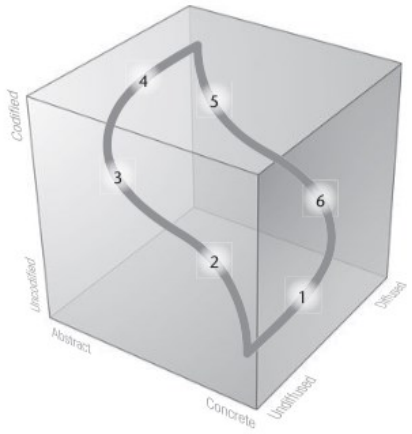

Figure 2.6: Boisot's Space-I Model, Source: Knowledge, Organization Management, Child J., Ihrig M., 2013, Oxford University Press

The model is visualized as a three-dimensional cube, where the more abstract, codified (constructed) and diffused knowledge is, the more it will be efficiently spread throughout the

organization. Knowledge must always have some degree of abstraction and codification before spreading inside the company and this degree is defined by the needing of broadness of the knowledge itself. Although Space-I model theoretical framework main objective is the efficient spread of knowledge, the social dissemination of knowledge presents a shortcoming concern the spread of tacit knowledge which is potential valuable and that cannot be structured and abstract so easily for its transfer: not all the knowledge could be transferred between individuals as "we always know more that we can say" (Polanyi, 1958). Boisot's theorize six steps of the Social Learning Cycle (SLC), presented as different stages that are able to bring concrete and uncodified knowledge to become structured, diffused and abstract:

1) **Scanning:** Identifying the opportunities as well as the threats in available and generally fuzzy data. Scanning activity deals also with the identification of specific insights hold by individuals and small groups inside the company.
2) **Problem Solving:** Concerns the identification of a likely structure and coherence of identified insights. The main purpose of this phase is codifying them
3) **Abstracting:** Abstraction usually works in tandem with Problem Solving activity. It consists to the conceptualization and generalized application of codified insights to a wider range of situations.
4) **Diffusing:** Sharing the newly created insights with a target population, where the diffusion of highly codified and abstract insights become easier than the one regarding uncodified data.
5) **Absorption:** It consists in the internalization and application of newly insights through learning-by-doing and learning-by-using situations.
6) **Impacting:** the embedding of abstract knowledge in concrete practices. The embedding could take place in the artifacts, behavioral practices as well as technical and organizational rule

Choo Sense-Making KM Model

The Sense-Making KM Model has been elaborated by Choo C.W. stressing elements coming from Nonaka and Takeuchi's knowledge creation model and the decision-making theory. The sense-making approach is based on the principle that organizational actors need to make sense of what is happening in their organizational environments in order to define a shared interpretation that creates the ground for their common decisions. In other words, "people create their own subjective reality rather than try to discover some existing reality" (Choo, 1996). An organization engages in sense-making through four different stages: ecological change, enactment, selection and retention. When some inputs of the external and organizational environment modify and change, members of the organization try to understand the swing; an ecological change is faced by individuals by trying to isolate some portion and bracket of the phenomenon in order to understand it. Gradually individuals adapt to the new changes and try to cope with them giving a new interpretation of reality and enacting the new scenario. Enactment creates a series of different interpretations and raw data that are subsequently processed and turned into meaning and action. The selection process creates a series of plausible relationships between raw data starting from the historical interpretations, reducing equivocality in the understanding process. Finally, in the retention process, the products originated by sensemaking are captured for future use.

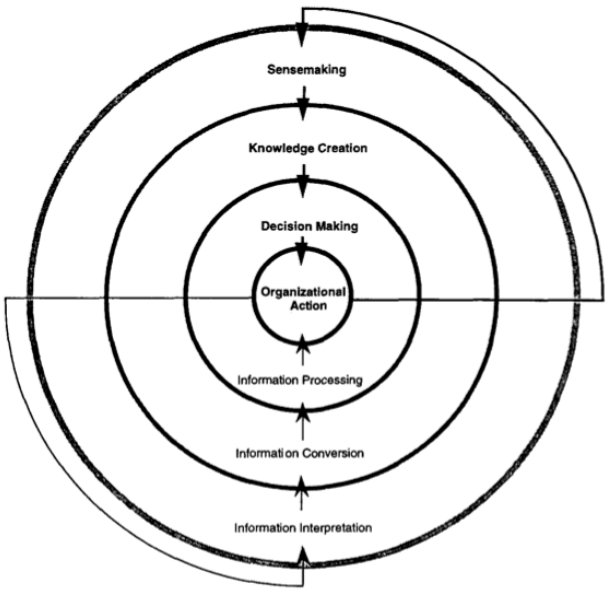

Figure 2.7: Choo's sense-making KM model, Source: The Knowing Organization: How organization use information to construct meaning, create knowledge and make decision, 1996, International Journal of Information Management

The sense-making process constitutes the first layer of Choo's model and accomplishes to the objective of creating a meaningful environment for organizational actors, which are subsequently called to process their retained knowledge, convert them into explicit forms and spread it throughout the borders of the organization. Nonaka and Takeuchi's knowledge creation model, its dichotomy between tacit and explicit knowledge and its main phases of internalization, socialization, externalization and combination are evaluated as a complete model that fully describes the activities that must be followed in that phase. Decision-making represents the last layer; once knowledge is created and internalized in the organization, the actors must act accordingly, acting on the external and internal environment and creating the premises for the beginning of a new cycle. Choo's model has been one of the first holistic model which integrate different approaches, trying to give an explanation to the knowledge cycle, contemplating even the decision-making dimension that on the contrary was not so previously considered as matter of KM. That characteristics made the model one of the most feasible and practical one, mostly used in simulations and scenario-testing applications. (Dalkir, 2017)

Wang and Noe's Knowledge Sharing Model

Wang and Noe (2009) focused on the knowledge sharing activities, looking for the most important enablers and motivational factors that contribute to sustain it. The model was built on the base of a meta-analysis of more than seventy studies on the same topic and based on a framework in which knowledge sharing behaviors of individuals are affected by three main factors: Environmental factors, Individual characteristics and Motivational factors.

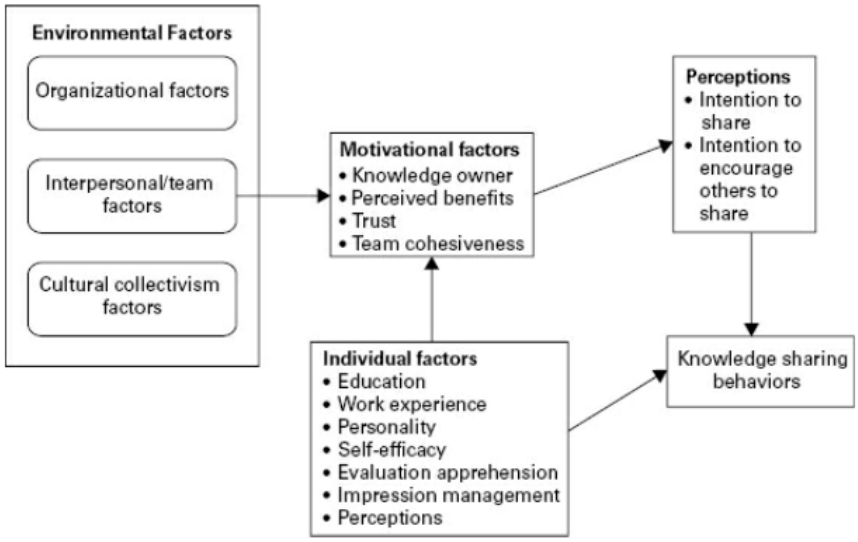

Figure 2.8: Wang and Noe's KM model, Source: Knowledge Management in Theory and Practice, Dalkir K., 2017, The MIT press

Environmental factors concern the organizational context, which must have a cultural dimension supportive with knowledge sharing among individuals and must be based on mutual trust, a fundamental behavior that helps the organization to come across the perceived costs of something that doesn't have a straightforward positive financial impact. Management support as well is a relevant environmental factor strictly tied to the cultural dimension; a supportive and proactive management is having been showed to be correlated to a higher level of commitment of the organization towards KM and perceived levels of usefulness. Similarly, employees who are engaged through incentives and rewards in their KM activities are more enthusiastic to share their knowledge. Finally, a less centralized organizational structure, that encourage informal meetings, interactions and de-emphasize hierarchy is fundamental to create a positive environment for sharing. Individuals characteristics deal with the personal skills and behavior of the organization members, as for example the personality, self-efficacy, perceptions but also education and work experience. The two authors highlight how only few studies had focused on the role of individual personality or disposition sharing, showing that employees with high levels of expertise and confident with their abilities are more likely to share their knowledge through the organization. On the contrary, factors as evaluation apprehension, work anxiety and fear of negative evaluations negatively affect knowledge sharing. Environmental factors and individual characteristics influence are strictly correlated to motivational factors. Trust and individual attitude are in that sense a crucial point: when employees perceive that they know more than the organization, they are more likely to share their knowledge, expecting positive outcomes, as for example an improvement of their reputation. Motivational factors studies show also how affect-based and cognitive-based trust among organization's individuals is of fundamental relevance both at dyadic and team levels, as individuals seems more accommodating in sharing their knowledge with people who are perceived to share the same value of principles, integrity, credibility and authority. The model created by Wang and Noe, similarly to the Choo's sense-making KM model, put an eye on aspects which were not considered previously by the academics in the theoretical formulation of frameworks, resulting in a relevant integration to the already existing models to understand the attitude of individuals and key success organizational factor that contribute to the successful implementation and improvement of KM.

2.2.2: Knowledge Management Cycles

KM models represent theoretical frameworks which usually do not necessarily provide a distinct subdivision of the different organizational activities that must be taken into consideration in the structure of a KM routine but, rather, they analyze part of them. Knowledge management cycle can be defined as all the activities that are related to the management of knowledge and are carried by the organization through internal or external parties (Kordab M., Raudeliūnienė J., 2018). Some KM models have a holistic approach and propose a KM Cycle, as for example the Wiig KM model, but of them are focus on part of the cycle (E.g. Knowledge Creation and sharing) as well as epistemological aspects. Business and management literature offer many interpretations of the KM cycle. Nonetheless, is possible to define a common pattern between knowledge management processes such as "share, create, use, store, identify and acquire". Hereafter are presented some of the most relevant KM Cycle that are part of the early literature as well as more recent models, in order to give an overview of the topic's development towards researchers. In some sense, KM Cycle is the tool that must be provide to practitioners for the implementation of KM.

Meyer And Zack's Knowledge Management Cycle

Meyer and Zack interest in 1996 was the one of the so-called "Information products", defined as "any information sold to internal or external customers, such as database, news synopses, customer profiles, and so forth" (Meyer M., Zack M., 1996). The two authors started to analyze how the prevailing business activity that had been followed since the 90s, focused on the production of physical goods, could enlarge useful lessons for the "new" development of the information products era: The first one is related to the necessary presence of a "product platform" , the second the so-called "process platform". Information product's platform is composed by "Repository" comprising both content, those data that forms the substance of an information product, and structure, defined as those schemes which are used for labeling, indexing, linking, and cross-referencing the content of the repository and are strictly tied to the storage, access and retrieval capabilities. Process platform deals with the "Refinery" process that data need from the repository to be transformed into informational products and it's composed of five main phases: Acquire, Refine, Store/Retrieve, Distribute and Present. Every step of the refinery process must add higher value to the resulting information product.

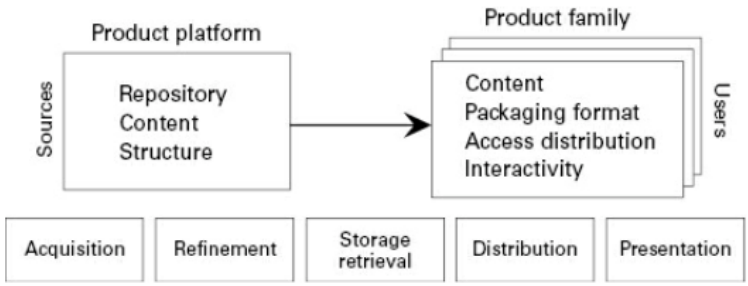

Figure 2.9: Meyer and Zack's KMC, Source: Knowledge Management in Theory and Practice, Dalkir K., 2017, The MIT press

In the "acquire" stage information and data are gathered to create a solid base. Controlling of the data is one of the most important activity in this phase as acquisition bias unavoidably lead to a misleading and wrong production of information products. Data are than refined, reorganized, relabeled and indexed. Refining is a value-adding activity that could be performed both physically (E.g. shifting from one media to another) or in a logical form (E.g. a new indexing of the data) and makes data usable and flexible for their use. Storing and retrieving phase act as a link between acquiring and refining part and the subsequent phases, focusing in the creation of the information product. Information can be stored either physically or digitally, then in the distribution phase they are spread throughout the context in which they're used. Distribution deals not only with the medium used but also with timing, frequency, language and other features that determines the arrival of the information to its final user. Presentation it's the final phase in which the incremental work made in the previous phases is evaluated; If the final user is able to exploit the information in the context, the KM Cycle worked and the information product is successful; on the other hand, if the context of the user is not sufficient to fully exploit the information product, the KMC fail. Meyer's and Zack's model is highly appreciated for its completeness in describing the key elements of the KM Cycle and the emphasis on the usefulness aspects of information products. Nonetheless, its main weakness is given by the lack of consideration for tacit knowledge and the process for its management.

The Bukowitz And Williams' Knowledge Management Cycle

Meyer's and Zack's model, as well as many other ones, considers Knowledge Management Cycle as an addition of sequential phases. Bukowitz and Williams (2000) elaborated from a different perspective a KM Cycle based on a cyclical pattern of activities dealing with both operating and strategic issues; from an operating point of view the main focus is on the capture of knowledge development opportunities in the market, while from a strategic point the emphasis is given to the changes in the macro-environment in which the firm operates and aim at matching intellectual capital hold by the firm with its strategic requirements.

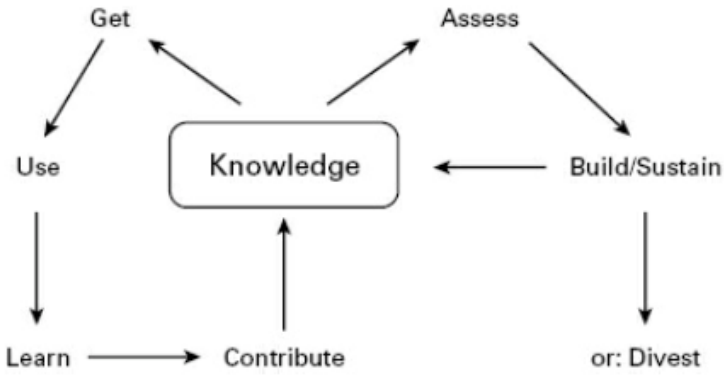

Figure 2.10: Bukowitz and Williams' KMC Source: Knowledge Management in Theory and Practice, Dalkir K., 2017, The MIT press

"Get, Use, Learn and Contribute" phases deal with tactical and operating aspects of the model. Knowledge doesn't need just to be captured, but the company has also to seek out those information and knowledge that is correlated to its needing which could either innovate, solve a problem or take a decision. "Get" phase, in some sense, is quite similar to the "acquire" phase of the Meyer's and Zack's model but at the same time differ in its premises, as getting knowledge imply to have a strategic or operating issue to face yet. The main challenge in this phase is to look for the necessary knowledge, avoid information overload and knowing where knowledge resides, involving not only explicit and coded knowledge but also tacit valuable one. Knowledge is than "used", combined and exploited by organizational individuals and groups in order to focus on the creation of new solutions. The two authors describe different methods to encourage out-of-the-box thinking and creative-enhancing activities for innovation. "Learning" phase is related to the empirical aspects of knowledge, the ability of the organization and its individuals to learn from experiences, discovering best practices or learning from failures. Learning phase is a transition step between the application of knowledge and the development of new solutions and ideas and it necessarily has a strong link with strategies in

order to be effective and efficient. The experiences and outputs of knowledge application by individuals is than reported and registered in common repository during the "contribution phase", essential in the transformation of individual knowledge into collective and shared knowledge and in the creation of organizational memory. The way in which the different organizational actors contributes to the creation of the knowledge base is crucial for the authors; employees must not create just an overloaded repository that reports every kind of data and information, but they must focus on those experiences and output which are considered relevant and may benefit the organization, than they must be leveraged and generalized for common sharing. Other important aspects of the "contribution" phase is the presence of so-called "knowledge brokers", organizational actors which ensure the effectiveness of the system through the promotion, gathering and packaging of those experiences throughout the organization. Employees, on the other hand, may be stimulated in the knowledge contribution by the presence of rewards, not necessarily of financial nature, but also through the recognition and enhancement of their effort in the creation of a useful knowledge base (E.g. taking track of how popular their contribution are). "Asses, Build/Sustain and Divest" phases, as we previously said, compose the strategic part of the cycle, dealing with the matching of strategy with intellectual capital. In the "asses" phase the organization is interested in evaluating intellectual capital, comparing the existing knowledge inside the company and define future needs. The company has also to develop metrics for a clear evaluation of the ability of knowledge to transform into financial profits from their customers. "Build/Sustain" step must ensure that future intellectual capital will maintain the organization competitive advantage; the key activity in that phase is the allocation of the resources in the growth and maintenance of knowledge. Finally, in the "divest" phase the organization is called to analyze cost and benefits of possessing knowledge and let it go externally. If an asset is no longer creating value for the company it must be divested, as those resources and efforts may potentially converge in more valuable activities. The Bukowitz's and Meyer's model introduced and considered tacit knowledge as part of the KM Cycle and knowledge base of the company, while at the same time introduced new concepts as the one of learning phase and the trade-off evaluation of the costs and benefits of holding knowledge internally.

Mcelroy's Knowledge Life Cycle

McElroy (1999) elaborated the Knowledge Life Cycle trying to break with what he called the "First generation of KM" of early 90s, shaping a new framework based in a series of premises about knowledge itself. Individuals engage in learning as result of their perception of gaps in their current and goal states, trying to achieve their desired outcome. The learning activity leads to the formulation of the so-called "Knowledge Claims" that are hypothesis, arguments and assertions about potential actions which are able to achieve the desired outcome. In the elaboration phase of the knowledge claims individuals attract new actors and form groups with the main purpose of sharing and validate their knowledge claims; at the organizational level, the validation of the claims at social level happens with the presence of an authority group (e.g. the management), which validates or refuses knowledge claims on the base other claims, called "meta-claims". Validation phase of claims identify the knowledge creation process and can have three possible outcomes, all defined on the base of meta-claims: the claims are validated, they become undecided or tagged as falsified knowledge claims. Validated knowledge claims are then diffused at a wider organizational level and integrated into the company, initiating the "Knowledge Integration" phase. Once the knowledge is successfully integrated into the company, it can manifest itself as mentally held knowledge of the individuals or in the form of explicit linguistic expression in artifacts: the former takes the name of "subjective knowledge", the latter of "objective knowledge". The combination of subjective and objective knowledge hold by the company take the name of "Distributed Organizational Knowledge Base" (DOKB). The use of knowledge from the DOKB is not part of the knowledge processing phases but part of the business processing, as its creation and integration exists for the main purpose of its exploitation within the business context, which in turn detects new knowledge gaps and creates the context for its application.

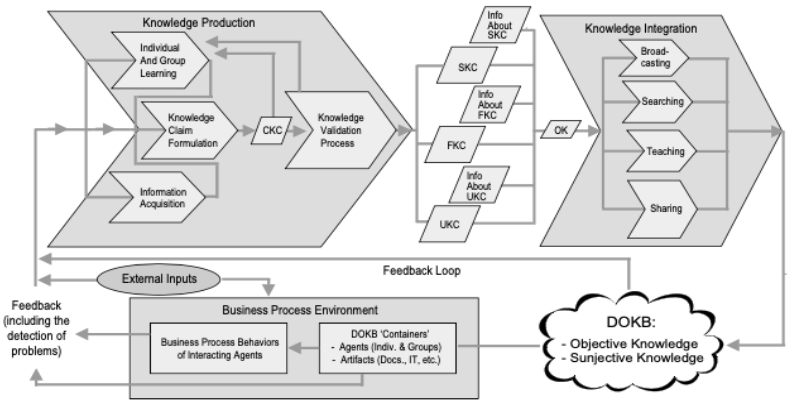

Figure 2.11: McElroy KMC, Source: The new knowledge management: Complexity, learning, and sustainable innovation, McElroy W.M., 2003

The framework considers the presence of the three main components discussed above: The Knowledge processing environment, the Distributed Organizational Knowledge Base and the Business processing environment. The Knowledge processing environment is composed of the two main phases of knowledge production, where knowledge claims are created, and knowledge integration, where they are spread throughout the organization, tied together by the presence of the "validation phase" of claims that transforms individual and group knowledge into organizational knowledge. Integration could be pursued through many different activities as broadcasting, teaching, sharing and searching. The business exploitation of the DOKB results in outcomes that validate the reuse of knowledge or into mismatches that trigger knowledge adjustments through the "single loop learning". If different applications of the same knowledge lead to other empirical failures, knowledge is entirely rejected and the process rebegin, triggering "double-loop learning". Another important aspect of McElroy's framework is the concept of Knowledge Management, declined as a narrower subject which doesn't identify in the knowledge life cycle but of which the latter is a part and is influenced. The main contribution of the model was finding out a linear and coherent framework which tries to face misleading issues and definitions by creating a coherent point of view which analyze all the different aspects of the life cycle until the knowledge application. Nonetheless, the introduction of a "validation" phase, where the organization consciously decides what is valuable knowledge and what is not, is of relevance compared to the previous models: As a matter of fact it distinguishes knowledge processing activity from simple document management and creation of a repository.

Holistic Knowledge Management Cycles

From the end of the 90's to the beginning of the 21st century business literature has proposed lots of frameworks, each of them considering different phases but similar in their content, showing the difficulties of the researchers to confront on such a multi-disciplinary field. Heisig (2009) developed a new framework as result of the meta-analysis conducted over 160 different knowledge management cycle, pointing out common patterns and similarities. Heisig underlined 6 common phases: Use, Identify, Create, Acquire, Share and Store. The most important critical success factors of the KM implementation which are highlighted by the researchers are of very different nature, from human-oriented factors as culture, people and leadership, to organizational factors, strategy and technology support (Heisig, 2009). On the base of the previous statement, Heisig developed a three layered KM framework, called "GPO-WM-framework"; the first layer, the "business focus" one, deals with the business process as primary source of definition of knowledge analysis and activities, defining the scope of knowledge for the company. Knowledge in the business process could arise in different ways, acting either as product or as resource and it's up to the company to identify which one may fit better for its strategy. "Knowledge focus" is composed by the four main activities for systematic handling of knowledge: create, store, share and apply. These activities should be integrated within the business process (Heisig, 2009), knowledge could be either a resource for the process or its outcome. Finally, "enablers focus" displays the most important factors in the effective implementation of KM, considering those elements that were considered key success factors in the meta-analysis (E.g. organization, strategy, technology…).

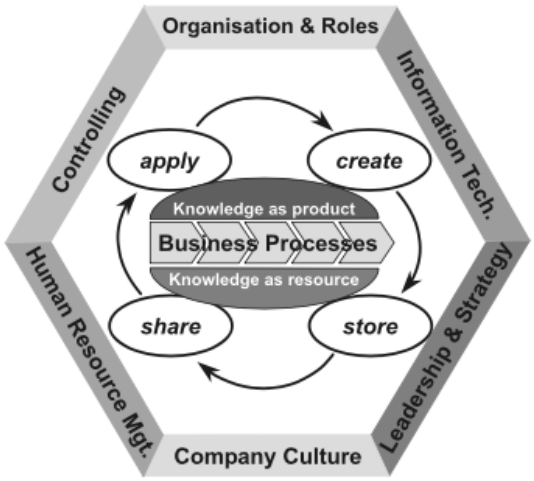

Figure 2.12: Heisig's KMC, Source: Harmonization of knowledge management – comparing 160 KM frameworks around the world, Heisig P., 2009, Journal of Knowledge Management, 13 (4)

Heisig's empirical quantitative and qualitative method of research has highly influenced the subsequent literature in the formulation of frameworks, considering that its only shortcoming was the absence of a clear presence a KM Life Cycle order between the various activities (Evans et al., 2015). His study and methodologies were at the base of the subsequent development of KM's literature in the last decade. A new framework was presented by Evans and Ali (2013), called "IOSAEC framework", resulting from the synthesis of other authors' management model and composed of the seven main phases "Identify, Organize, Store, Apply, Evaluate and Create" and comprehensive of double loop learning dynamics. Evans et al. (2015) created, on the base of their previous studies and meta-analysis, a holistic framework which integrates the main discoveries and theory developed by the literature. Even the "holistic KM Cycle" was divided into seven main phases presented in the scheme hereafter:

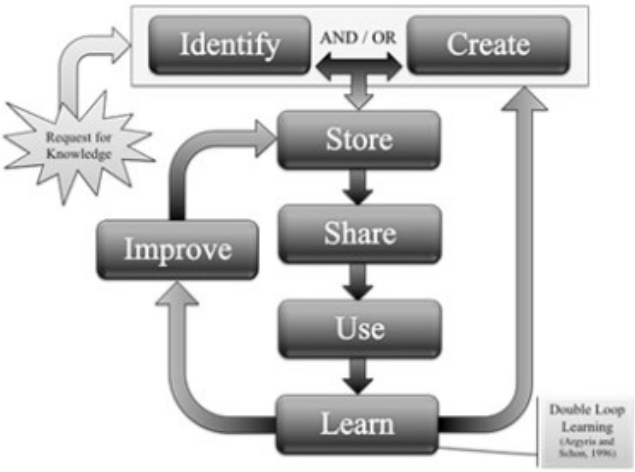

Figure 2.13: Holistic KMC, Source: A holistic view of Knowledge Management Cycle, Evans et al., 2015, The electronic journal of knowledge management, 12 (2)

The KM Cycle activation is triggered by the presence of a "Knowledge request", a perceived gap of knowledge which the organization have to fill in order to achieve its goals (McElroy, 2003). Two parallel phases act once a knowledge request is promoted; on one hand, if required knowledge assets are already inside the organization, a "identification" activity of those assets starts eliciting existing archived data and documents, involving similarly the retrieving activity of tacit knowledge through methods as network analysis and brainstorming (Evans et al., 2015). On the other hand, the absence of internal knowledge assets must be filled through the creation and acquisition of new one, engaging the organization members through activities as information and workflow analysis, expert interviewing and prototyping. Once knowledge is created or identified it is stored inside the organizational memory in such a way that it could be easily and systematically shared, retrieved and efficiently manipulated (Evans et al., 2015).

Explicit and codified knowledge is stored into knowledge artifacts or corporate portals, while storing activity of tacit knowledge could involve the use of knowledge maps, models and taxonomies. Stored knowledge, in order to be used, needs to be shared inside and outside the organizational boundaries. Timing is fundamental into sharing: it could be "pre-established" or planned on an "ad-hoc sharing" on the base of immediate needs. Tacit knowledge could be shared through narratives, storytelling as well as coaching and mentoring, while codified knowledge could exploit technology channels. The choice of the share medium is strictly tied to the level of development of the KM system: the more a company has a developed and integrated KM system, the higher is the effectiveness of that medium. Arrived at organizational users, knowledge assets are ready to be applied for the purposes for which they were created. The effective use of knowledge by individuals involve partially tacit knowledge for being understand (Evans et al., 2013) (Dalkir, 2017); the more larger and complex is the assets the more difficult it become to make it valuable and understandable. Once the knowledge is used, the outcome of the application is analyzed in the learning phase, involving "deconstructing the knowledge blocks, integrating, connecting, combining and internalizing knowledge" (Evans et al., 2013). If the knowledge assets are considered valuable, they are successively sent to the "improve" stage of the KM cycle, while on the contrary, if they fails in effectiveness and efficiency, the KM cycle restarts from the beginning with the create and identify phases, on the base of the double-loop learning dynamics introduced by McElroy (2003). Finally, "improve" phase includes reflection time, actions review, and adaptation of lessons learned from the application of knowledge (Evans et al., 2015). If Knowledge is considered effective and efficient, it is repackaged to be stored or referenced (Tacit knowledge) for future use and leveraging. The holistic KM cycle presented represent a perfect synthesis of the most important literature's frameworks and analyze in its entirety the different phases that have to be faced while handling knowledge for effective use, representing a useful map for practitioners in the implementation of Knowledge Management.

2.2.3: Evaluating Knowledge Management Initiatives

Company's evaluation of KM initiatives deals with assessing their effectiveness according to the purposes to which they were put into practice. The main difficulties of the evaluation are given by the "intangible" nature aspects of KM which results in a difficult straightforward application of the financial measurements that organizations are usually taking into considerations to assess value of their strategies. Another complexity of KM evaluation is the outcomes that result in these initiatives, that usually require consistent and perceived investments and costs for "soft" benefits which may arise only in medium-long term, making financial evaluations unable to fully consider the actual effects of implementations. Nonetheless, a large variety of methods was formulated to evaluate if KM is succeeding and consequently achieving the organizational goals. Wall (2004) proposed two different measurement tools that can be exploited by organizations to undertake the evaluation of intangible assets which can been applied into KM initiatives as well: balanced scorecard and the value-added approach. The Balanced Scorecard (BSC) was a tool elaborated by Kaplan R. and Norton D. based on the construction of a series of measures on four areas concerning financial aspects, customer valuation, internal processes and learning and growth measures. Starting to translate the KM vision and strategy into measurable goals of the four perspectives, different metrics targets and initiatives for each of them are set. The effectiveness of the initiative in achieving the general vision is evaluated on the base of those factors.

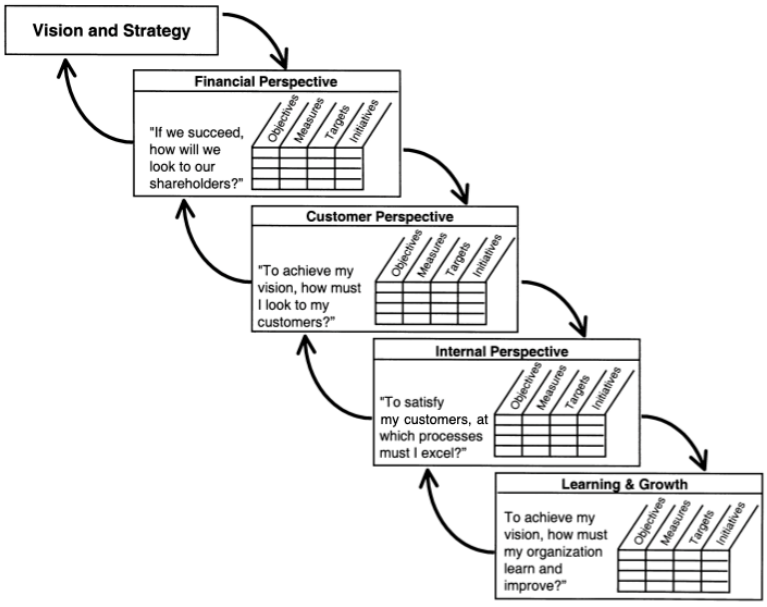

Figure 2.14: Structure of a BSC, Source: Transforming the Balance Scorecard from Performance Measurement to Strategic Management, Kaplan S.R. and Norton P.D., 2001, Accounting Horizons, 15(1)

An example of empirical model was the Skandia's Navigator System, a KM valuation model based on the BSC approach. Five different focuses are set on five different perspectives: the "human" one proposes to evaluate the human capital of the organization and how those resources are being developed, the "renewal and development" focus captures the innovative capabilities and R&D effectiveness, "process" focuses on the use of technology within the organization, "customer" assess the value of customer capital while "financial" focus represents the monetary terms of the initiative. The five focuses were compared year by year in order to take track of the level of effectiveness of KM initiatives. Other tools based on the BSC approach were developed by companies during the late 90s; another example is given by Ericsson's "Cockpit Communicator", a commercial product developed by the Swedish company Ericsson. Value-added approach put its theoretical bases on Economic Value Added (EVA) theory developed by Stern and Stewart & Co., a financial theory for investment decisions which argues that if the return on capital is higher than the cost of capital, the investment must be undertaken (Wall, 2004). The main difficulties of the theory application into KM initiatives it's the difficulties to create economic and quantitative elements for its application. Most of the applications of the value-added approach rely on the identification of the main processes that KM initiatives undertake and asses the value added in each one of them. Generally speaking, the most important processes of the KMC to focus on in the creation of value is its application (Dalkir, 2017).

Benchmarking represents another important tool of evaluation of KM, based on the comparison of organization's own KM initiatives with those undertaken by competitors and other firms in order to assess their effectiveness. An organization's knowledge center can use benchmarking to measure and compare its processes with those of others'. There are four different types of benchmarking, defined on the base the relation created and the actors involved. "Competitive benchmarking" deals with the comparison of the processes with competitor firms, while collaborative and cooperative benchmarking rely on the friendly approach of different organizations that are willing to disclose each other their KM initiatives to enhance their effectiveness. Internal benchmarking activity is conducted inside the same company, usually large and multinational companies, to identify best-in-house practices. An example of benchmarking tool developed for KM evaluation purposes is the Knowledge Management Assessment Tool (KMAT) designed by Artur Andersen, a business consulting firm. The KMAT tool is a collaborative benchmarking instrument that have the main purpose of helping firms to make a high-level assessment of their Knowledge Management initiatives status, stating in which ones they excel and which require more attention. The comparison is made at the multi-

industry level, internal level and on average level, in which small groups and individuals are compared to KMAT databases, considering four enablers of the KM organizational development (leadership, culture, technology and measurement). The results are interpreted according to a matrix suggesting the best strategic choices on the initiatives considered.

Finally, another evaluation tool developed in the end of the 20th century was the "The House of Quality Method" by Hauser J. and Clausing L. Initially created for linking customers, quality characteristics of the product and processes, the House of Quality Method provides a support in the evaluation of desired quantitative outcomes (goals) that had to be achieved by the company in short-medium term, linked with practices put in place to pursue them. Desired outcomes are weighted to set levels of priority and metrics are put at the top of the model, while the center highlights the levels of correlation between initiatives and desired outcomes. Some examples of possible tracked initiatives are the time spent into codification of knowledge, the numbers of ideas implemented per year, the information seeking time spent on average per employee or keeping track of benefits and costs of workers' training and learning activities (Dalkir, 2017).

2.3: ICT IMPLEMENTATION AND KNOWLEDGE MANAGEMENT: FROM THE PAST TO THE FUTURE

2.3.1: Information and Communication Technologies and the development of Knowledge Management Systems (KMS)

The unexpected huge development of Information and Communication Technology (ICT) in the last forty years has gone along with the progression of Knowledge Management as an organizational and business issue, making the two subjects necessarily permeating each other. The first theoretical studies which highlight the potential of ICT in the management of knowledge were focused on the potential of this tools in enhancing knowledge sharing by going beyond structural barriers which previously people couldn't cross (Larsen, 1987). Larsen (1987) talked about a specific potential of ICT and computer programming as tool for the externalization of knowledge in line with disruptive cultural changes such as social organization and the invention of writing, allowing individuals to share and consult contents of knowledge without knowing the structure in which it is embedded (E.g. The use of the contents of a computer program without any knowledge about how it is actually created or structured). Lately, many other researchers expressed appreciation for the potential in the use of ICT in the management of organizational knowledge (Hendriks, 2001) (Laudon and Laudon, 1997), but at the same time the new enthusiasm for the potential applications of technology into knowledge management was partially blocked by a series of issues concerning the misleading advancement of KM; as a matter of fact most of the initial critics regarded the consequential "exclusion" of any forms of tacit knowledge that couldn't be entrapped by ICTs, risking a potential loss of contents by firms, too concentrated on codification strategies and promoting the mistaken view of a knowledge which is independent from the knower (Hendriks, 2001). The 90s' ICT-friendly thesis were grounded on the ability to enhance knowledge dissemination, storage, creation and generally all the phases of the KMC, sticky them and sustain the knowledge chain (Weggerman, 1996). Hendriks (2001), a researcher who deeply analyzed the early relation between ICT and knowledge management, pointed out five different questions that organization needs to answer in order to create an efficient relation with knowledge management; Particularly, the organization needs to define the relations between ICT and knowledge strategy, knowledge categories , organizational perspective, knowledge processes and knowledge efficiency measures. The answers given by the author pointed out that the potential of ICT application was given by the alignment of knowledge strategy with the use of technology, that must be used as a tool for effectiveness in the product/service delivery; at the same time knowledge strategy

do not have to fall in the trap of considering ICT as the center of its strategy, confusing knowledge with the delivery and creation of information assets. Another risk which a company jeopardizes to fall into is the "deackowledgement", word coined by Pruskas and Davon (1998), given by the information overloading created by ICT that causes difficulties in their interpretation. ICT implementation needs also to take into consideration knowledge life cycle and processes, as well as the risk of "depersonalization" and lack of social aspects of ICT platforms, which can result into the transformation of knowledge management into information management, considering knowledge independent from the knower, against the principles of cognitive perspective. Another important issue regards the construction of metrics for measuring the level of effectiveness of ICT and the evaluation of the presence of possible tools and practices which are able to enhance its effectiveness. Despite of the critics and uncertainties of the earlier literature in the application of knowledge management, especially regarding the possibility not to consider the social construction aspects of knowledge, ICT has been permeating organizational boundaries until it has become one of the most important tools for organizations to build business activities, from corporate and financial aspects to operation and production activities. The business world runs in parallel with technology development and consequently it has made knowledge management activity completely dependent from technology's development of the company, where engineering and technology structure design plays a leading role. Rollet (2003) proposed an integration of a KMC with the main technology tools, starting from the main principle that technology acts as enabler of knowledge management rather than its driver. The framework proposed is presented in the pic hereafter, synthetized into three main parts by Dalkir (2017): Knowledge Capture and Creation, Knowledge Sharing and Dissemination, Knowledge Acquisition and Application.

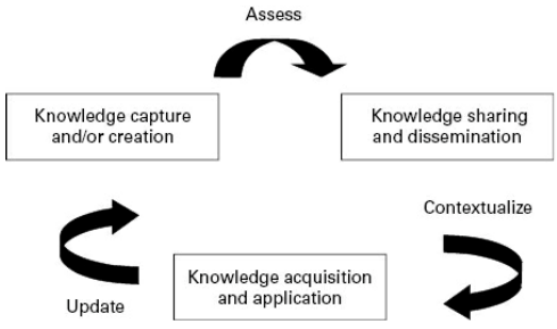

Figure 2.15: A integrated and synthetized KMC, Source: Knowledge Management in Theory and Practice, Dalkir K., 2017, The MIT press

Knowledge capture and creation is supported by information technologies for contents creation (data mining, templates, annotations, knowledge maps) and content management (metadata,

folksonomies and taxonomies). Particularly relevant is the application of technology in knowledge sharing and dissemination, considered by Rollet (2003) both in terms of sharing (Telecommunications, smartphones, videoconferences, email, chatrooms and social networks) and networking technologies (Knowledge repositories, intranets, extranets and browsers), whose effectiveness and efficacy in the field of knowledge management was amply debated in the literature (Lee and Kelkar, 2013) (Bolisani and Scarso, 1999) (Marwick, 2001); empirical studies, based on Nonaka and Takeuchi's knowledge creation model and transfer of explicit and tacit knowledge, find out that ICT is able to break sharing barriers, enhance interactions between workers and helps them to find each other (Marwick, 2001), on the other hand it represents a useful tool not only for who have to share, but also for the interpretation and acquisition of the receiver of knowledge, helping the conversion of tacit forms into explicit and shared one, both in internal and external knowledge transfer situations (Bolisani and Scarso, 1999). Finally, technology could work as an enabler of knowledge application (i.e. decision support systems) and acquisition (i.e. databases of lessons learned, storytelling and best practices). The picture described contemplates KM and ICT as two complementary subjects where the latter act serving the purposes of the former. But KM and ICT relation goes beyond the simple exclusive relation between the two elements as they inevitably touch all the different aspects of the organization in which they are implemented. That's the fundamental bases to start to talk about Knowledge Management Systems.

Meier (2004) defines Knowledge Management System (KMS) as "an ICT system in the sense of an application system or an ICT platform that combines and integrates functions for the contextualized handling of both, explicit and tacit knowledge, throughout the organization or that part of the organization that is targeted by a KM initiative. A KMS offers integrated services to deploy KM instruments for networks of participants, i.e. active knowledge workers, in knowledge-intensive business processes along the entire knowledge life cycle. Ultimate aim of KMS is to support the dynamics of organizational learning and organizational effectiveness." The definition highlights a series of components of KMS which distinguishes from simple ICT application: First of all, the goals of a KMS are defined by the initiative for which it is deployed, enhancing through the use of technology the productivity of knowledge work. KMS acts upon a contextualized knowledge, leveraging codified but also tacit knowledge, organizing and structuring in a meaningful manner information for their application in processes along the chain of the knowledge management cycle. Users of KMS are active participants, acting in the context, employing codified knowledge and mixing it with hold tacit knowledge, experiences, interactions and evaluations of other participants. Great relevance is given to meta-knowledge

application in KMS over content knowledge, as the wisdom of skilled workers and management is fundamental in the effectiveness of the system. ICT fosters itself the creation and applicability of other instruments (e.g. networks for knowledge sharing) that aim at furnishing a service to the final users of knowledge, who are involved in the system by the presence of a common platform.

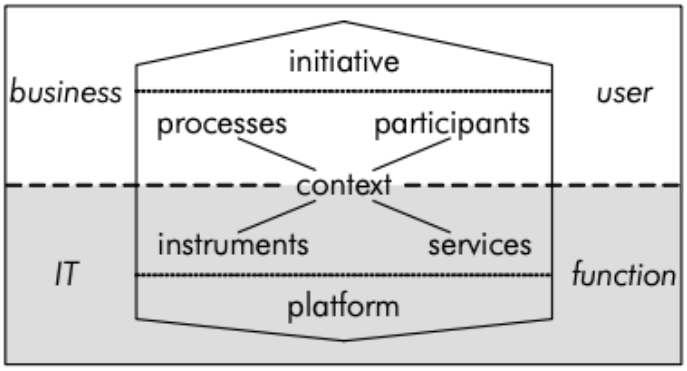

Figure 2.16: A Knowledge Management System composition, Source: Knowledge Management Systems, Maier R., 2007, Springer

The scheme presented by Maier (2004) emphasizes the coexistence in the KMS of two dimensions, where on one hand the system must be aligned in the initiatives to the business environment and the user environment, on the other with the Information Technology environment that represents the technical base of the platform and the function environment that defines the services interface furnished. Both those forces, in order to sustain efficacy and efficiency, must be at the same time be aligned with the context of applicability of the KMS.

Maier identifies two main KMS architectures that provide theoretical designs of the networks of interaction of the different subjects involved in KMS: centralized KMS and peer-to-peer KMS.

- Centralized KMS rely on an architecture aimed at creating a central KM server that contain all the knowledge shared in the organization and offers a series of services to workers. The use of the centralized KM architecture is correlated with enterprise's KM codification strategy.

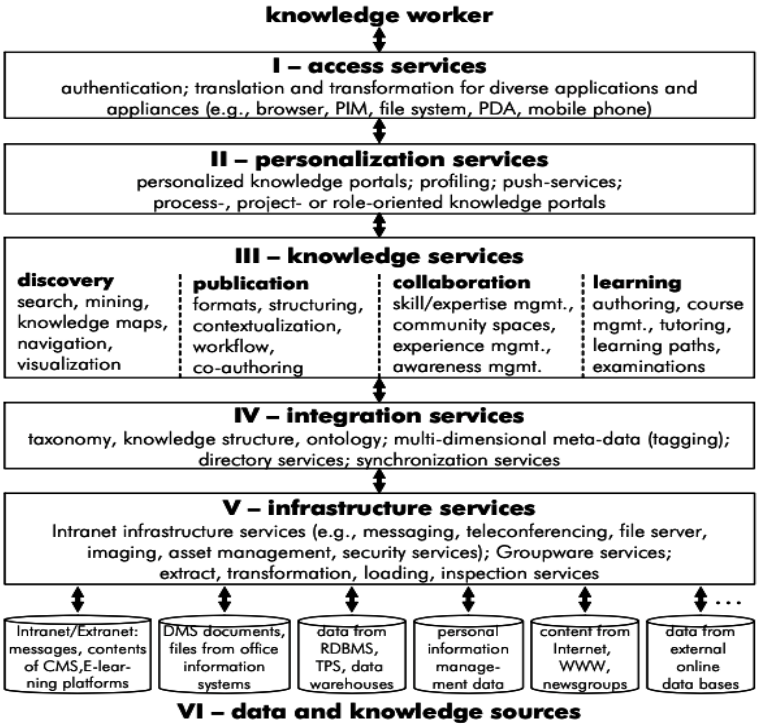

Figure 2.17: Centralized KMS Architecture, Source: Knowledge Management Systems, Maier R., 2007, Springer

Data and knowledge are captured both externally and internally the boundaries of the organization by infrastructure services exploiting tools as messaging, chats, teleconferencing file server, intranet services and groupware services. Integration services screen and transform data, linking them on the base of taxonomies and ontology through tagging activities and directory services. Knowledge services provide the tools to analyze stored knowledge and act accordingly to initiatives based on the knowledge processes. Personalization services provide a focus for practitioners, created by skilled workers and professionals, in order to achieve a more effective access to a wider amount of knowledge services (e.g. the creation of role-oriented portals). Finally, access services provide a protection against unauthorized use and eavesdropping using tools for identification and authorization

- Peer-to-peer KMS (p2p) allow practitioners to develop personal knowledge locally and to directly share knowledge with other peers without the need of a shared space server. P2p architectures could sometimes present a certain degree of centralization of their functionality, in that case it's possible to talk about "hybrid" architectures.

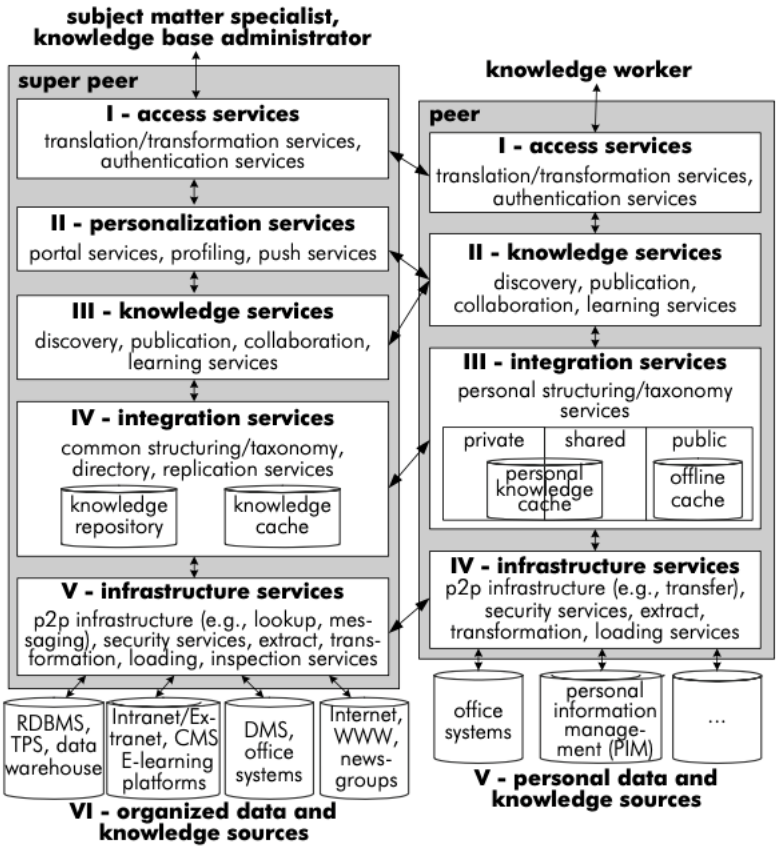

Figure 2.17: Peer-to-peer KMS Architecture, Source: Knowledge Management Systems, Maier R., 2007, Springer

Services of the p2p systems are the same offered by centralized KMS but at the same time they distinguish themselves for the functions played: infrastructure services assure the exchange of data with other peers and the security of the practitioner personal knowledge base, while integration services work on personal knowledge ontologies. Knowledge services are still built on the knowledge base, repositories are shared among all the peers and personalization services are designed on individual users' profiles. The use of p2p architecture design seems more suitable for personalization strategies, focused on sharing and exchange of ideas, individual knowledge and experiences. Particularly relevant is the presence of the so-called "super-peers", providing services as a subject matter specialist of a certain topic (Maier, 2004).

2.3.2: ICT and Tools for practical KM implementation

Taking into consideration the role of ICT and the theoretical KM Cycle by Evans et al. (2015), the following chapter proposes to analyze possible effective solutions which could be implemented in the company to comply with processes main goals and objectives. As previously exposes, nowadays the exploitation of tools relies heavily on the use of technology and network systems as base for their functioning, helping to cross distancing barriers and providing support not only in codification strategies of explicit knowledge, but also in the communication of tacit one (Dalkir, 2017). Most of the tools presented hereafter are nowadays already developed and implemented with companies and workers, technology has gone further and has enhanced methods and tools according to the development of Industry 4.0 phenomenon. Nonetheless, in order to furnish a complete point of view able to cover the historical perspective of KM development, assessed and widely known tools are separately presented from the technology development potential, on which still today heads a trace of uncertainty.

Knowledge Capture and Creation Tools

Knowledge capture tools interest the initial phases (knowledge request, create and Identify phases, Store phase) of the knowledge management cycle triggered by the knowledge requests. Emergent knowledge requests can potentially be monitored by the mapping tools that acts as planning instruments to detect critical knowledge (Levy, 2011). Mapping knowledge requests implies prioritizing the acquisition and retention of some knowledge assets over others: potential approaches for prioritization are the one proposed by Beazley, Boenisch and Harden (2003), based on the creation of target knowledge areas tailored on group of workers needs and continuously updated and monitored, as well as Landon's and Walker's approach, focused on the identification of knowledge gaps using location and timing.

Capturing knowledge involve different levels of the organization, from single individuals to groups and organization in its wholeness, and at the same time both tacit and explicit forms of knowledge (Dalkir, 2017). Capturing tacit knowledge at individuals and groups deals with the use of social interaction tools between holder of the knowledge and individuals which are looking for filling specific knowledge gaps; some examples are given by interviews and observation techniques. Interviews could be either "structured interviews", in which the elicitation knowledge process follows a predetermined format and questions, exploiting the

possibility to clearly detect tacit knowledge, while “unstructured interviews” are free-forms interviews where nor the content and the sequencing are pre-determined and they work more efficiently when tacit knowledge contents are not well identified and interviewer benefits in maintaining a wider scope of its interview (Cooke, 1994). Observation of individuals is one of the most powerful tools to capture tacit knowledge and can act in the forms of “active observation”, if the individual or group is directly involved in the activity, and “focused observation”, if it concentrates in a narrower set of activities and structured observation in the case the observer has prior detected the elements of the environment to look at (Cooke, 1994). The capture of tacit knowledge requires a further step from individuals and groups learning (Dalkir, 2017) which consists in the codification of the extrapolated knowledge and experiences at a macro-level, involving the subsequent storing phase. Some firms could extract tacit knowledge through joint ventures and collaboration with other external entities, exploiting tools as “grafting” and “vicarious learning”, forms of observation techniques that take into consideration the entire organization as an observer. “Learning stories” as well is a way of capturing knowledge which involves the representation of significant events at the organizational level, giving a voice to involved workers that are able to share tacit aspects of their experiences, personal points of views and observations, simplifying the subsequent codification of internal hold knowledge assets. It must be taken into consideration that tools for tacit knowledge conversion are not able to fully transform it into explicit and codifiable: the cognitive perspective remembers us that some residual tacit knowledge is uncatchable because it’s inseparable from the knower; an example is given by the application of codified knowledge by individuals, action which implies the application of a personal internalization and consequently the presence of tacit individual knowledge (Ancori, 2000). Capturing and conversion of tacit knowledge into explicit one must be seen not as a “perfect” transfer, but rather a partial disclosure of a knower personal deeper understanding.

Codification of explicit knowledge and converted tacit knowledge entails the subsequent organizational sharing perspective. Codifying knowledge allow the organization to share it to a wider internal audience. Taxonomies are one of the most relevant tools used, allowing knowledge to be graphically displayed following a hierarchical and sequential structure. Knowledge taxonomies help to share concepts and a professional jargon among practitioners, enhancing their interactions and keeping track of terms and concepts used. Cognitive Maps, in the other hand, help to identify knowledge contents of individuals’ and groups’ “mental models”, clarifying the existing links and cause-effects relations. Those maps are based on “concept maps” initiative, defined as “a two-dimensional graphical representation of a set of

concepts connected by directed arcs encoding propositions in the form of simplified sentences, such that the interrelationships among them are evident" (Leake et al., 2003). Cognitive and concept maps are useful tools in the organization and coordination of explicit knowledge for successive storing and retrieving activities. Another important codification base tool is represented by so-called "decision trees", structures used to identify decision flows and potential cause-effects relation of organizational decisions, acting as "story maps" that memory their impacts. ICTs has taken a relevant role in the codification phase as powerful enablers of a shared language, providing benefits in terms of efficient processing (codified and standardized knowledge is easier to process), interconnection between different economic players and easier storage and use (Bolisani and Scarso, 2011). As a matter of fact, store processes of the KMC and the constitution of a knowledge base work exclusively with the support of server, computer, online and cloud storage. Considering the application of ICTs, firms undertake two potential strategies to pursue, basing the choice on the desired output: hard codification and soft codification (Bolisani and Scarso, 2011). Hard codification deals with exploiting the maximum potential of ICTs in processing data and information using an extremely systematized shared language, while soft codification main objective is adapting the use of ICTs to the social and cultural features of knowledge transfer, i.e. enhancing knowledge transfer in the fashion sector where the application of hard codifications strategies could be detrimental itself.

Knowledge Sharing Tools

Knowledge sharing activity involves the social dissemination of knowledge towards the organization. Once codified knowledge is stored and hold by the companies, now the focus become the ability to spread it among workers who can exploit the products of capture and store activities. First of all, sharing implies social interactions between individuals and groups (Huysman and DeWit, 2002) in order to keep in touch individuals who are looking for knowledge on one side, and out-of-the single individual validation of knowledge on the other one. Most known tools that enhance the social aspects of knowledge sharing are Communities of practice (CoP) and creation of networks. CoPs are defined as "a specific kind of community. They are focused on a domain of knowledge and over time accumulate expertise in this domain. They develop their shared practice by interacting around problems, solutions, and insights, and building a common store of knowledge" (Wenger, 2002). CoPs as an instrument for knowledge sharing was an amply debated issue among the literature and many potential categorizations were proposed: some authors differentiated from CoPs and "networks", considering CoPs as

groups of individuals with stronger shared commitment and identity, while others, as for example Andriessen et al. (2004), proposed a categorization where CoPs are divided on the base of purpose, degree of formalization, boundary, composition and virtualness. Bolisani and Scarso (2008) proposed an analytic framework based on four pillars that ensure an effective exploitation of CoPs; those are the organizational, economic, cognitive and technological dimensions. The "four pillars" must be supported by external factors, i.e the business context where the CoP takes form and the knowledge strategy pursued by the organization. Wenger (1998) fueled the relevance of the "commitment" dimension of CoPs where members are involved putting into actions mutual trust, interest, credibility, professionalism and ethical behaviors. Another relevant aspects regarding the efficacy of knowledge sharing towards CoPs is the "medium choice"; the creation of a "Virtual space" (Wenger, 1998) is nowadays fundamental in the efficient exploitation of CoPs in sharing knowledge (Dalkir, 2017) and ICTs represents the most important enablers in that sense. Groupware solutions as mail-management, workspaces based on internet and intranet, digital repositories and social bookmarking represent important supporting tools in teamwork and information sharing solutions and became the new technology standards, flanked by the introduction of social media technologies that further foster internal and external communication, enhancing the commitment and involvement of actors (Kumta and North, 2018). Nonetheless, basic elements for the effective and efficient use of ICT on sharing knowledge are the development of an organizational culture that enhance social interaction, meetings and an environment that encourages networking. An example of developed social media exploitation for knowledge sharing purposes is given by "gamification", the use of gaming elements to improve user experience and engagement in non-game services and application. Through the use of this platform workers have been seen more collaborative and able to share their knowledge (Tsourma et al., 2019).

Knowledge Retrieving Tools

Individuals and groups applications of stored knowledge start with the identification and retrieving of assets in the knowledge base. Retrieving activity is supported by the use of searching techniques as the use of taxonomies, folksonomies and tagging systems. The use of these tools requires a knowledge of the meta-data structure that enable individuals in effective use of those instruments. Taking into consideration Nonaka and Takeuchi's knowledge creation model, the presence of some degree of personal tacit knowledge, involving problem solving of the knowledge gap that must be filled and the codes to look for solutions, is essential in the

internalization process (Bolisani and Scarso, 2008). Artificial intelligent support through Intelligent Software Agents (ISAs) represents a useful technological for workers, helping them through intelligent filtering to retrieve knowledge assets accordingly to their requests, avoiding wastes of time because of information overloads. Another important tool is represented by Adaptive technologies, defined as all those software and platforms that interact with the user learning and adapting to its own needs. Adaptive technologies help to furnish a customized base to individuals and groups on the base of shared work needs (Dalkir, 2017) through individual customization, intelligent software personalization and creation of affinity groups.

2.3.3: The present and the future of ICT and KM relation

Since it was born in early 90s, Knowledge Management has faced two generation of development. The first one, from 90s to the beginning of the 21st century, was not strictly correlated to the Information Technologies (IT) development, which was facing the main business issue of storing and spreading information throughout the company in a timely fashion and cheaper manner, while Knowledge Management was developing its theoretical approaches and was structuring as a new entity to manage inside organizations. The consistent meeting of the two has arrived with the introduction, during the second-generation wave, of three important technological revolutions: Enterprise Resource Planning (ERP), Business Process Reengineering (BRP) and the development of Web as an enterprise tool (Bettiol et al., 2020). ERP provided a single platform for different business functions and a single database, becoming fundamental in the value creation, while BRP transformed firm's approach toward production activities providing a tool for interconnectivity among them. ERP and BRP became related disruptive technologies that had a successful implementation among companies, changing their production paradigm and giving higher relevance to KM dynamic of codification and explicit knowledge processing. Web huge development in the last 30 years has been contributing to the creation of relevant amounts of external information for companies and a re-definition of enterprise-customer relations, switching the focus to the active roles of the latter in the production and innovation activities of the former (Bettiol et al., 2020). The introduction of effective ICT technologies in the companies is associated as well to the implementation of KM initiatives supported by this technological revolution, allowing i.e. the development of Knowledge Management Systems. After 2010, the new technological development has become the one of "building the digital enterprise" (Reinhard, 2016), a paradigm started in Germany and based on the implementation of new technologies to connect people, machines and objects and re-design a new value chain to face the request of higher level of customization and personalization required by customers (Kagermann, 2015). Industry 4.0. relies on different enabling technologies : from the implementation of "smart manufacturing", the exploitation of IT into manufacturing technologies and processes to furnish intelligent and responsive operations, to Cyber-Physical Systems (CPS) that act through data gathering for the management of interconnected systems between physical assets and computational capabilities with the main purposes of enabling an autonomous functioning. Industrial Internet of Things (IIoT) allows the connection of physical and digital elements to enhance the autonomous and remoting functioning of factories, while Intelligent Manufacturing Systems (IMS) entails the plants and machines self-control of production activity on the base of design directives. Virtual

and Augmented reality (AR) provide tools for the combination of real and virtual objects enhancing training activities and production time, Machine Learning and Artificial Intelligence (AI) are technologies and solutions that enable machines to learn and act autonomously. The imperative of "connection" of Industry 4.0. results in an enhanced level of horizontal and vertical integration of the company, reducing the costs of an efficient communication along the value chain and supporting the internal information transfer. How Knowledge Management needs to cope with such a disruptive technological change is a hot topic in the modern business and management literature. Capestro M. and Kinkel S. (2020) highlight the new "upgrade" by which KM is invested into Industry 4.0, taking a holistic role in a paradigm which introduces new and shared competences at the center of company's functioning. The two authors identify benefits of the application of new technologies in terms of processes, supporting a more and more efficient coordination of information assets, and products, increasing the number of interactions and the general involvement of customers in their development, fulfilling the need to know how products and achieving a higher understanding of possible new solutions, as well as the development of new human resources training and learning activities. Empirical researches show how the companies have not already jump into the 4.0 technology environment, but they rather are engaged in an incremental and prudential investment plan based on the further development of already "known" technologies as cloud systems and seems more reluctant in the adoption of technologies as AI, which are perceived of less immediate impact (Bettiol et al., 2020). A possible explanation is given by the lack of internal knowledge of technology digital skills, recalling the cognitive perspective features of the necessary presence of personal knowledge to act effectively upon instruments and technology. The distance between external technology vanguard and internal exploitation ability raises the need for horizontal integration through the relations with external technology partners (Bettiol et al., 2020) and the internalization of new competences (Mielmann, 2018) to fully achieve the effectiveness and efficacy behind 4.0 technologies, in order to compete in a new raising market which requires higher levels of customers needs understanding and a deeper level of personalization and customization of products and services offered.

CHAPTER 3: DPSS SOLUTIONS IN KIBS-CUSTOMERS INNOVATION DYNAMICS: A KNOWLEDGE MANAGEMENT PERSPECTIVE

3.1: DIGITAL SERVITIZATION, DPSS AND KIBS: AN OVERVIEW

3.1.1: Digital Servitization: Business Model changes

The shift from the product-centric logic to the service-centric one has caused the creation of a new paradigm widely known as "Servitization", the integrated offer of services and physical products (Baines and Lightfoot, 2013) introduced for the first time in the literature by Vandermerwe and Rada (1988). Servitization dynamics involves manufacturers and ordinary product-centric firms, defining new possible patterns to pursue value creation through the systematization of the delivery of products and services; services offered could focus on either services that support products (Service Supporting the Product, SSP) and services that support customer's activities related to the product (Service Supporting the Customer, SSC). Some empirical examples of Servitization processes are given by Roll-Royce's "power by the hour" maintenance concepts for jet engines and Xerox copy machines with guaranteed unit cost per copy.

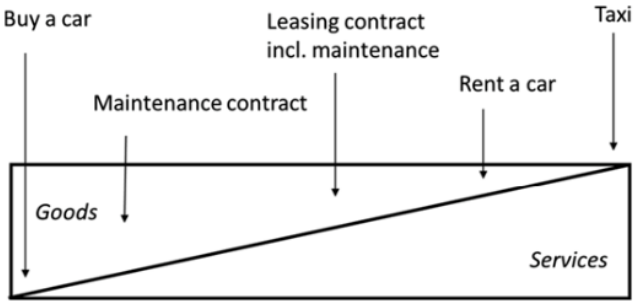

Figure 3.1: The Goods-Services Continuum, Source: Design and managing industrial product-service systems, Helo P. et al., 2017, Springer International Publishing

Exploring new forms of value creation radically changes manufacturing's firms Business Models in its fundamentals of value creation, value delivery and value capture. Annarelli et al. (2019) considers six key elements that characterized new Business Models based on Servitization logic: from the "value creation view" the most important are related to the re-designment of the offering, a new co-creation of value through customization on the base of

customers needs and the relevance of a renewed functional integration with partners (which will be broken down more specifically later in this chapter). From the "value delivery" perspective of the business model, firms have to focus on the desire level of servitization, where a higher degree of it means a higher degree of attention in assets utilization than their ownership, while pre-sales and after-sale communication has started to play a crucial role in the value delivery as phases of the value co-creation. Lastly, from a "value capture" perspective, co-creation radically changes short-term and long-term commitment as well as the retention of customers, emphasizing the creation of new outstanding relations based on new contractual forms and mutual trust. Nonetheless, manufacturing firms could take advantage from the already existing installed base of products towards their customers, fundamental for leveraging the potential of servitization-base business models, exploiting already existing process information (Paiola, 2020). Bundling services with products result in outputs defined as "Product-Service Systems" (PSS) , hybrid solutions that, considering the continuum between product and service presented in the imagine 3.1 fall in the middle and are categorized by Tukker (2004) into three main categories: "product-oriented PSS" that focus on product selling, "use-oriented PSS", where the relevance shifts from selling to the usage of the product, and "result-oriented PSS", where the ownership of the product and the usage is up to the seller and customer focuses only on the final result provided by the solution. The introduction of servitization perspective has empirically presented some barriers in the implementation into business models due to the resilience of manufacturing and production companies to rely on successful and already established models (Christensen, 2003), as well as pricing issues, perceived risks of unexpected costs (Steinberger et al., 2009) and difficulties in building a service-oriented organizational culture (Vandermerwe and Rada, 1988). The struggle between the necessity of implementation of a new Business Model focused on the delivery of PSS and governed by the service-dominant logic on one side, and the presence of an opposition made by a stabilized view on the other, obstructs the implementation of a disruptive business model innovation.

Another ingredient that must be put into place to describe the increasing relevance of KIBS is the shift of technology towards "Digitization". Digitization refers to the increasing use of digital technologies for connecting people, systems, companies, products and services (Coreynen et al., 2016). The building block of technologies that support digitization was previously described in Chapter 2 as those that are highly correlated with Industry 4.0 and responsible of the interconnection of people, processes and products, i.e. Internet of things (IoT), Industrial Internet of things (IIoT), Cloud systems, Machine Learning and Artificial Intelligence (AI).

According to Porter and Happelmann (2015) the introduction of digitization into companies has brought several changes, from products to competition: by mixing digitization and products, resulting on the new generation of "Smart and Connected Products", firms are able to exploit new capabilities, as for example the possibility to monitor its efficiency, provide remote control functions for users and shape optimized solutions for customers. From the value-chain perspective, digitization has been introducing disruptive changes in terms of lower costs faced for variability across customers' segments as well as geographies segments, enhance the introduction of forms of "remote" and "ongoing" quality management through continuous monitoring, while production is invested by a new "lean" system era, based on data gathering and analytics able to maximize the capacity of firms to drive out wasted capacity. Digitization, analogously to servitization, highly influenced the value delivery to customers; Berman (2012) highlights the possible reshape of the business model through the strategic redefinition of both value proposition and operating model, resulting into three possible paths on the base of the strategic needs that the company has to pursue.

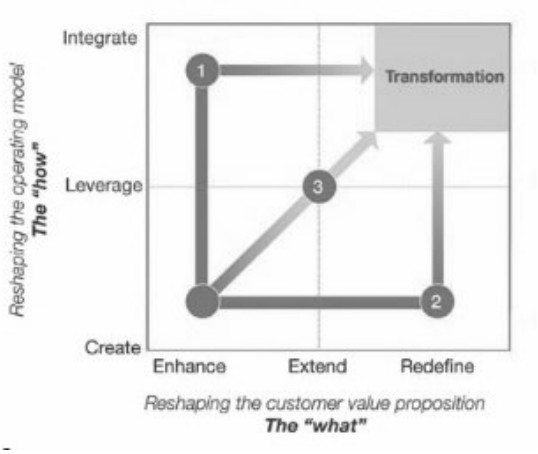

Figure 3.2: Reshaping for Digitization, Source: Digital transformation: opportunities to create new business models, Berman J. S., 2012, Strategy & Leadership, Vol.40 Issue 2

The first possible solution is the reshaping of internal operations through the implementation of digitization, then moving towards the digitization of the value proposition for customers. On the other hand, the redefinition of the value proposition with the integration of digitization elements and the following move to the reshape of the operating model. In between the two opposite and sequential strategies, the third path involves the building at the same time of operating activities and value proposition towards digitization, working on lockstep. According to Berman, the reshape of the value proposition deals with a three stages move: from the

implementation of digitization technologies into already existing products to differentiate them and increase customer experience, to the achievement of new revenue streams through the extension of the products and services through digitization and finally the total transformation of the customer experience through the recombination of information and data and the offering of fully digital elements that substitute the physical ones. The convergence of Servitization phenomenon, which has already been a matter for literature and companies in the last 30 years, with the more recent advent of Digitization results in "Digital Servitization", "the transition toward smart product-service-software systems that enable value creation and capture through monitoring, control, optimization, and autonomous function" (Kohtamäki et al., 2019). Firms capitalize on the value created by the interconnectedness of products, services and softwares. Kohtamäki et al. (2019) conceptualize three different dimensions that helps to define a starting point in shaping business models based on digital servitization: solution customization, solution pricing and solution digitalization.

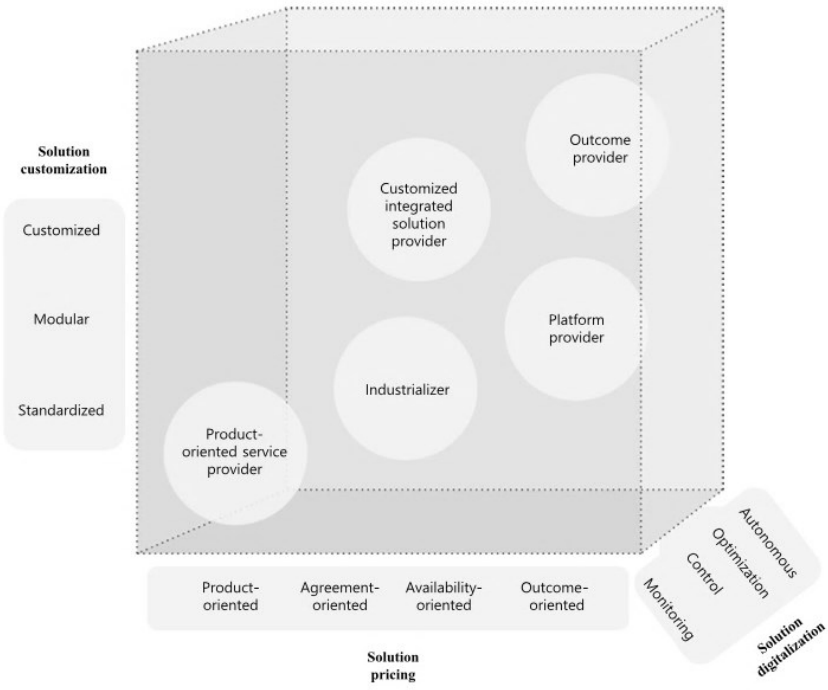

Figure 3.3: Defining new BMs on the base of the three dimensions, Source: Digital servitization business models in ecosystems: A theory of the firm, Kohtamäki et al., 2019, Journal of Business Research, n.104

Solution Customization refers to the level of tailored solutions provided by the product-service-software system, solution pricing to the modality and logic used to price the solution (i.e. outcome oriented, agreement oriented, availability oriented or product oriented). Lastly,

solution digitalization deals with the degree and type of exploitation of digitization provided by the solution to customers, i.e. monitoring, control, optimization and autonomous functioning of the solutions. From the solution digitalization perspective, a key role among all the technologies is played by Internet of Things (IoT), defined as the pervasive presence of a variety of assets which, through unique addressing schemes, are able to interact and cooperate with each other (Paiola, 2020). IoT technologies such as cloud computing, data gathering and analytics have a critical impact in business model's fundamental, as they provide mass information about products and usage directly to the production companies, affecting internal and external processes and capabilities (Paiola, 2020), optimizing the exploitation of the already existing installed base of products among customers. The introduction of new business models based on digital servitization presents some threats as well for companies that could potentially see their efforts in changing the business not rewarded by a sufficient profit stream, falling into the traps of "service paradox" and "digitization paradox". Service paradox arises in presence of high fixed costs and investments which do not paid off in a timely fashion manner (Annarelli et al., 2019) and are strictly connected to the radical change that undertakes the value chain during the shift to the servitization paradigm. Digitization paradox, analogously, stated for the lack of profits after firms undertake a series of investments in digitization. From a business model perspective, the two paradoxes shows in the "polarization" of the company towards the two elements, while scholars suggested that the creation of a new integrated solutions must move in the creation of a hybrid offer of product-services and software (Annarelli et al., 2019) (Paiola, 2020), emphasizing the connection between different dimensions as fundamental in exploring new value creation possibilities for customers. On the base of the radical changes that imply digital servitization business models, the following chapter will analyze the hybrid solutions provided by firms: Digital Product Service Systems.

3.1.2: Digital Product Service Systems (DPSS)

Digital Product Service Systems are defined as "an IT-driven value co-creation business strategy consisting of various stakeholders as the players, intelligent systems as the infrastructure, smart, connected products as the media and tools, and their generated e-services as the key values delivered, that continuously strives to meet individual customer needs in a sustainable manner" (Lerch and Gotsch, 2015). The definition provided emphasizes all the fundamental and environmental elements that contribute to the development of those solutions; servitization and digitization convergence made simultaneously act on the shape of new PSS solutions. The dynamic by which companies follow the path has been explored by Lerch and Gotsch (2015) and divided into four main stages, according to the internal equilibrium reached in terms of digitization and servitization offer.

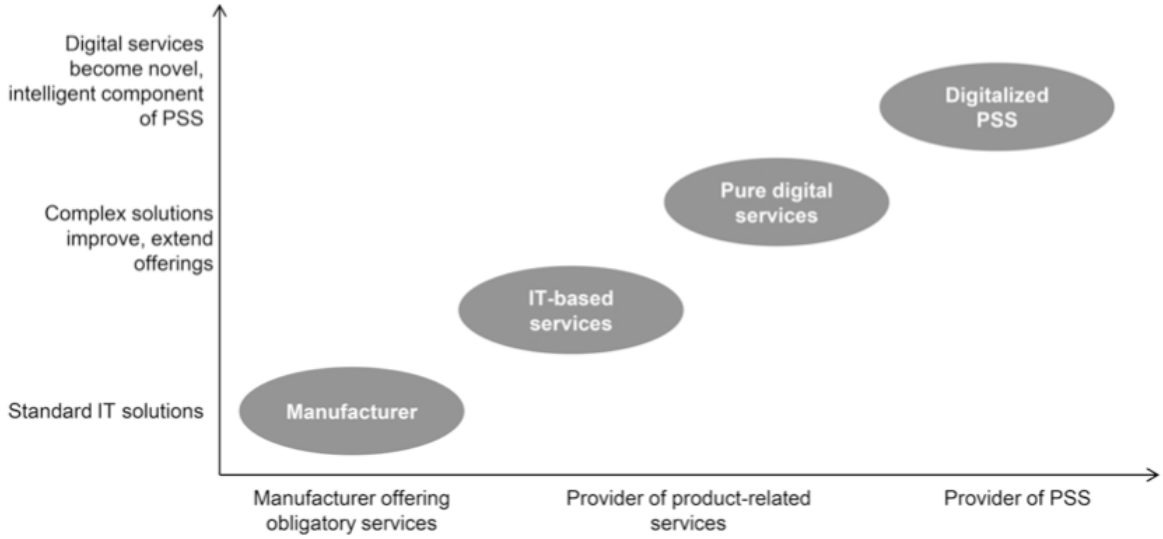

Figure 3.4: Servitization-Digitalization transformation framework, Source: Digitalized Product-Service Systems in Manufacturing Firms: A Case Study Analysis, Lerch C. and Gotsch M., 2015, Research Technology Management, Vol.58 (5)

Firms act as simple "manufacturers" if they provide only obligatory product-centric services and ICT has no impact on service offerings. Companies become provider of product-related services starting to provide ICT-based services (i.e. remote monitoring) and adding them to their offer. An incremental extension of services offers through the implementation of digital technologies transform companies into "pure digital services" providers, enhancing the

performance of the core products and services. Finally, fully digitalized PSS stage is characterized by the ability of firms to offer not only complex PSS to customers but being able to bundle them with complete digital solutions that provide intelligent and autonomous systems that deliver the highest availability possible, optimize operations and reduce resources inputs. An empirical meta-research conducted by Pirola et al. (2020) on DPSS reveals how the design of PSS solutions through digital implementation is a hot and recent topic of literature. According to the authors the potential digital implementation can be summarized on the base of two different design vectors: the PSS design itself and the outcome of PSS design, interpreted as the degree of digitalization of the offered solution.

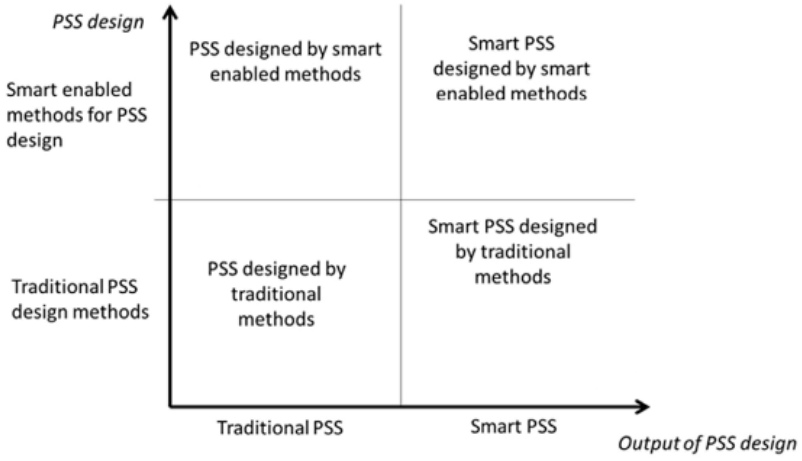

Figure 3.5: PSS Design Evolution, Source: Digital technologies in product-service systems: a literature review and a research agenda, Pirola F. et al., 2020, Computers in Industry, vol. 123

PSS and smart PSS (DPSS) designed by smart enabled methods (top quadrants of the matrix) looks for the potential integration of digitization in process design of the PSS to enhance the effectiveness and value creation of the final solution for customers; some examples are given by the application of IoT for supporting PSS design, which reveals higher companies' ability to look for customized solutions and support the fulfillment of the "listening, design and standard gap" between actual PSS services and customers' expectations (Sassanelli et al., 2016). Application of IoT in analytics and data allows also to the development of complete and in-depth information about customer usage that could be exploited into internal processes to enhance DPSS design as well as optimizing customer segmentation, positioning and strategies (Paiola, 2020). On the same direction, other researchers explore possible applications of other technologies as machine learning and artificial intelligence, which can support in the

identification of new services and value creation opportunities. The further development of digitization into smart manufacturing realities results in the creation of virtual spaces that mix with physical one and converge in new complete digitalized service offerings, i.e. the concept of "Digital Twin" (DT). In Digital Twin systems the physical space of machines for production directly communicate with the virtual one through actuators and sensors systems enabled by IoT technologies, while the virtual world processes data through artificial intelligence, cloud computing and big data analysis, providing services on the base of gathered resources and information outputs. Even if the exploitation of DT and virtual spaces by the manufacturing industries and the development of fully digitized smart manufactory is still a recent topic and has known just a partial implementation, theoretical business literature has already conceived the prospective huge enlargement of value creation through the complementary offerings of physical, virtual and data services; an example, in that sense, is given by the possible use of "gamification" dynamics in the virtual world for supporting the customization of final products, connecting the operators and the control room to the physical machine space with a dashboard which provides the access to the virtual world and achieve higher level of monitoring, customization and value creation for the final customer (Loizou et al., 2019).

3.1.3: Digital Servitization in the manufacturing sector: ecosystems of firms and KIBS

New business models based on the DPSS solutions offering reveal some shortcomings and difficulties in the implementation phase in companies due to the lack of internal capabilities, slowing down the shift to new digitized service-centered business models; complexities are related mainly to the lack of capabilities in strategic implementation, operational and organizational aspects shortcomings, financial investments and costs as well as human resource management, especially focusing in the implementation of digital capabilities (Marcon et al., 2019). Shortcomings consequently harm the delivery of the customer value proposition, highlighting a "knowledge gap" between what a firm knows and what should be known to offer the desire solutions (Ayala et al., 2019), gap which could be fulfilled by exploitation of external services and partner relations (Davies, 2004). The concept of external embeddedness become crucial in the delivery of DPSS solutions, where the relation between different actors affects the final outcomes and where firms need to persuade other players in the contribution of an ecosystem able to support digital servitization efforts (Skylar et al., 2019). Academic literature has amply focused on the theme of interorganizational business service networks and their potential for business development and value co-creation (Gebauer et al., 2013), where the exchange of services and interactions become the nest of new innovation patterns through the exchange of applied knowledge (Vargo et al., 2008). A "service ecosystem" is defined as "a spontaneously sensing and responding spatial and temporal structure of largely loosely coupled, value-proposing social and economic actors interacting through institutions, technology, and language to co-produce service offerings, engage in mutual service provision, and co-create value (Vargo et al., 2011). In the provision of services by service ecosystems each actor contributes to the creation of value and the final outcome is therefore provided by complex value creating relations between unities that maintain their autonomy (Gebauer et al., 2013). Although many designed relations in terms of business and service networks were highlighted by literature, providing DPSS solutions requires high levels of embeddedness within the ecosystem, especially at relational level (Skylar et al., 2019), fostering the close interaction of providers of services and technology solutions.

Digital servitization, in that sense, is increasingly affecting the competition of manufacturing firms shifting it, to a greater or lesser extent, in the offer of a portfolio of services and the new DPSS solutions to customers. The changing paradigm of new business models aims at

enhancing, through services, the value proposition delivery to customers and it requires firms to move downstream in the value chain, looking for the understanding of end users' needs. Despite the business model innovation changes, a series of capabilities are needed by manufacturing firms to understand the necessities of customers and efficiently implement digital solutions, facing market and technological uncertainty underlying service innovation development (Bustinza et al., 2017). Empirical evidences shows an increasing interest of the B2B manufacturing industries towards the application of IoT technologies in the configuration of DPSS (Rymaszewska et al., 2017) (Paiola, 2020), enabling a series of benefits for customers that are in parallel new value creation opportunities and revenue streams for companies: Rymaszewska et al. (2017) point out the ability of IoT technologies to enable a higher level of monitoring and control through data gathering and analysis, improving efficiency levels of maintenance reached through preventive and predictive methods in favor of Conditioned-based Maintenance (CBM) , in which replacement decisions are dependent from the present and future condition of the assets, decreasing correlated costs. Monitoring and control through data gathering and analysis enable also higher levels of reliability of machineries for customers lowering the costs of non-conformity, a crucial issue in case of complex and demanding operations. Paiola (2020) ascertains the potential benefits of manufacturing firms into B2B relations to exploit the pre-existent installed base to enhance the delivery of IoT-based services and value creation surplus throughout already existing customer relations, assessing the access of end-users' data as fundamental condition to fully achieve the value capture of digitized solutions. Services offered could entail different level of complexity: Product life-cycle services (PLS) deal with all those services that ensure the efficient use of products all along their life-cycle, Asset Efficiency Services (AES) and Product Support Services (PSS) help to achieve higher productivity gain for customers while in Process Delegation Services (PDS) suppliers takes charge of performing process on the behalf of the customer. At the same time, as exposed in the previous paragraph, in the definition of new digital servitization-based business models manufacturing firms have also to cope with new solutions pricing offers, tying revenue stream to customers' desired outcomes, redefining supplier-customer relation as not just focused on the transaction of the ownership of the product but rather on longstanding relationship grounded on outcome-based contracts (OBC) (Batista et al., 2017).

The transformation of Business Models by manufacturing firms towards a DPSS-based logic requires a series of internal capabilities which may be not already found internally. As some larger companies are able to create them through R&D departments or collect them through merger and acquisition activities, the role of KIBS, specifically T-KIBS, as technology

solutions providers and partners in the innovation process has become increasingly relevant (Bustinaza et al., 2017). The digital servitization environment confirms KIBS supporting role as co-producer and orchestrator of innovation, as we have already stressed in the first chapter, making them determinant partners of an effective transformation pattern. According to Paiola (2018) KIBS are involved both into two main dynamics within the network: the first one is the one between KIBS firms and customers, where the latter could show either a reactive or proactive approach towards digitization and servitization depending on the level of internal consciousness and existing capabilities. The second dynamic involves the interaction between KIBS firms as providers, both at regional and global level, where competition behaviors are left behind to enhance the integration of different digital systems and solutions. Integration and co-opetion dynamics are significant especially for small and medium KIBS, enabling them to work as system integrators with specific relational skills, providing not only a technical support to implementation but also an advisory support towards the strategic implementation.

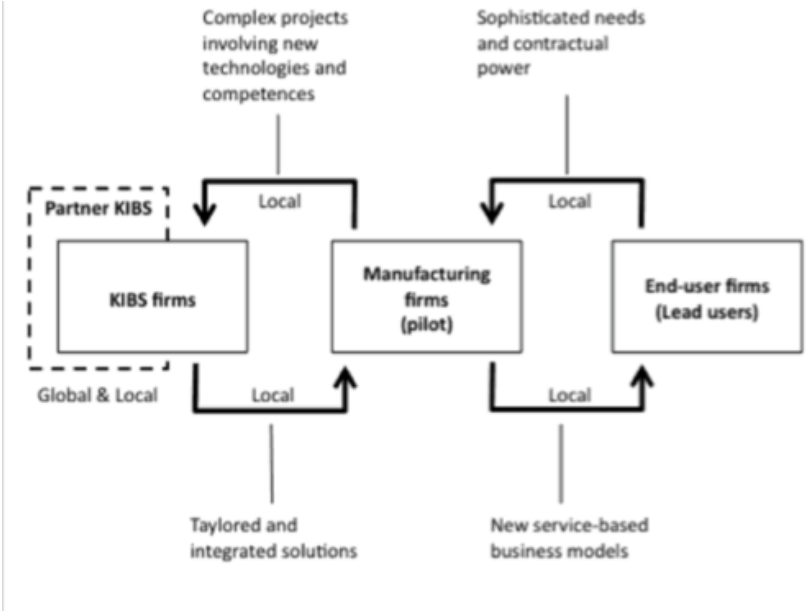

Figure 3.6: KIBS-customer and end-user firms relation, Source: KIBS, Pilot-Customers and Lead-Users in the Digital Transformation of Manufacturing Firms, Paiola M., 2018, Proceedings of the 19th European Conference on Knowledge Management

Lastly, KIBS firms' activities are also strictly tied to the requests of final lead users for DPSS solutions which are able to fulfill their needs, putting technology service providers and implementors in a direct collaboration relation with manufacturing firms, supporting them in

the elaboration and acknowledgment of the desired outputs. The presence of KIBS firms into manufacturing firm's territorial ecosystem shows positive correlation with their capacity to enhance servitization paths and innovation (LaFuente et al., 2017), helping to sustain their competitive advantage.

3.2: KIBS' KNOWLEDGE MANAGEMENT DYNAMICS IN DPSS INNOVATION PROCESS: AN EMPIRICAL CASE ANALYSIS

3.2.1: KIBS' innovation dynamics in DPSS design in the manufacturing sector: a knowledge management perspective

The role of KIBS in co-innovation dynamics, that has been amply debated in the first chapter, has been boosted by digital servitization. The lack of internal capabilities triggers for T-KIBS new business partnerships opportunities within the manufacturing sector and streams of revenue through co-innovation processes, involving intensive knowledge sharing and interactions (Ayala et al., 2019). As highlighted by Paiola (2018), digital servitization co-innovation is not strictly related to a single interaction which sees KIBS firms and manufacturing companies as the main actors, but rather on the interdependence of providers, manufacturers and final users in the ecosystem. In this ecosystem KIBS can perform different roles, from providers of technology to system integrators directly involved in the elaboration of complex IT solutions, working side by side with manufacturing firms (Miozzo et al., 2016). According to Bustinaza et al. (2019) innovation of manufacturing solutions through the involvement of KIBS allows ecosystem's companies to enhance their resource base, focusing on their unique resources and capabilities without fully internalizing the risks and costs of services implementation in the value proposition. KIBS as part of the ecosystem does not simply interact with manufacturing firms interested in the development of DPSS solutions, which in turn act in ecosystem as recipients of the innovation output, but develop fundamental knowledge-based interactions with all the business players in order to exploit useful information; as a matter of fact, useful information is disseminated all along the value chain (Choo, 1996). According to West et al. (2018) interactions between actors are based on three essential elements: Firstly, "control and feedback" into knowledge sharing between parties, stating that each actor is able to provide feedback and information to other interested parties. Secondly, "productivity", meant as the ability to co-create experience. Lastly, "adaptability", the capacity to modify data and information management on the base of the receiver. Innovations dynamics and interactions entail KIBS as main provider of technology capabilities, supporting manufacturing customers side-by-side in the satisfaction of end users' needs and facing the main issue to furnish the essential elements to create value through data gathering and analytic tools. A survey conducted by West et al. (2018) towards OEM firms and connected service providers explains how the effective functioning of an ecosystem is strictly connected to final customers interactions and mutual information sharing: on one hand data sharing

becomes crucial in the effectiveness of the final solution as well as in the cooperation between actors, on the other the ecosystem must work in the definition of "customized" value proposition for each customer and have a clear understanding of which needs to be fulfilled. We can say that KIBS generally enroll a leader positioning towards data-driven open innovation in ecosystems (Curley et al., 2018) due to their internal technical capabilities in managing and create value for manufacturers through the effective exploitation of the new "crude oil" of the 21st century that are data. The latter, thanks to the "knowledgefication" dynamics undergoing global economy, are becoming fundamental resources for value creation.

From a knowledge management perspective, the positioning of KIBS in the open innovation ecosystem of DPSS solutions has not been amply debated towards academics and business literature. Nonetheless, KM issues and implications towards PSS ecosystems, open innovation and digitization could represent a florid floor for the topic. On one hand, digital technologies boost KM tools and practices, presenting internal challenges for their application as well as the potential to increase efficiency and effectiveness, while on the other hand the exploitation within the product-service systems solutions development disclose an interdependent relation with sources of operative knowledge represented by customers' data. Open innovation dynamics are strictly correlated with higher Knowledge Management Capacity, defined as the ability of the company to explore internal and external knowledge, amplifying both search "breadth", the number of external sources incorporated in the innovation process, and search "depth", the intensity of collaboration with each partner (Santoro et al., 2017). A framework for KIBS innovation patterns in open innovation, taking into consideration the benefits of digitization, is proposed by Ashok M. (2018), focusing on the contribution on process innovation in the B2B environment, defined as the "implementation of a new or significantly improved production or delivery method that is of value for the user" (Ashok, 2018). Although the final outcome entails a narrower scope than DPSS solutions design in the manufacturing sector, the framework could be still considered valid in its main dynamics into the open innovation context for the purpose of providing benefits to the customer in terms of productivity gains, quality of the process and cost controls and improved capability:

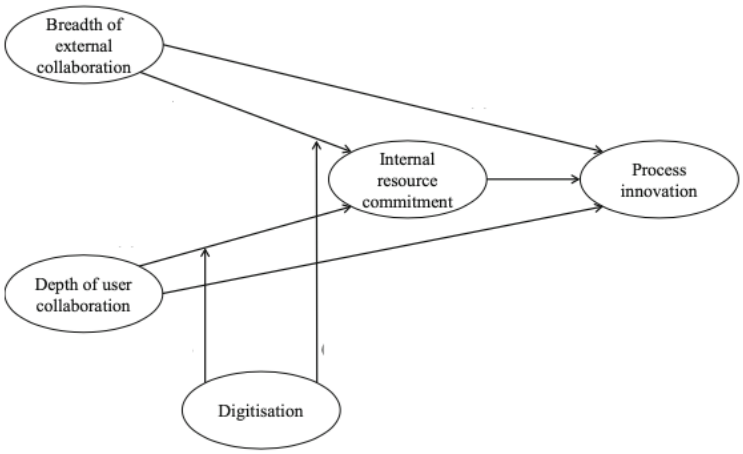

Figure 3.7: Framework of open innovation in KIBS firms, Source: Role of Digitisation in Enabling Co-creation of Value in KIBS firms, Ashok M., 2018, ICISO 2018, IFIP AICT 527

In an open innovation environment, innovation capabilities outcome of KIBS are strictly related to the number of external resources and partners used to capture useful knowledge: the higher is the number of relations, the wider will be the external knowledge base obtained by KIBS. Another element which positively influence innovation is the joint problem-solving relation between KIBS and customer, allowing to rely on users as source of knowledge: the more intensive the relation, the higher will be the contribution to the knowledge base of the KIBS. In order to become effective and be exploited, external interactions' breadth and depth requires internal proactive behaviors of KIBS to face the issue of transforming external knowledge into organizational knowledge, that is strictly related to the developed absorptive capacity of the resources. The commitment of internal resources in the innovation process highly influence also the effectiveness of external breadth and depth interactions. According to Ashok (2018), digitization and digital technologies (i.e. digitally enabled-platforms, digitized back and front-office) act as enablers and facilitators of the interactions into the open innovation environment. Interaction and connectedness with customers, fostered by digitization as a "tool" for effective open innovation, are also the main topics concerning knowledge management in the PSS knowledge management literature. The relation with manufacturers and end users becomes fundamental and consequently KIBS' focus on Customer Knowledge Management (CKM), understood as the sight of customers as active knowledge resources and "interaction" as a potential source of competitive advantage, does. CKM needs to develop a multi-actor focus and take into consideration sharing of tacit and explicit knowledge, affecting different phases of the Knowledge Management Cycle (Bagheri et al., 2015): Interaction, trust and dialogue represent relevant tools in understanding customer needs and possible solutions to provide, enhancing

knowledge creation. Tacit knowledge created is then externalized into explicit and codified knowledge to provide a common base and define accurately requirements and promote knowledge sharing, while the outstanding relations with manufacturers and partners in the development of the solution provide a source of external learning which KIBS could exploit as feedback and innovation source. The relevance of collaboration as source of knowledge in PSS environments was explored also by Xin et al. (2018), who highlights the relevance of people-to-people interaction in the co-creation dynamics with customers from a knowledge sharing perspective. At the same time, from a knowledge reuse and potential improvement perspective, repositories of codified knowledge, especially provided by previous working experiences, allows to undertake more efficiently DPSS design phases and lowering time and costs in the provision of solutions.

3.2.2: KIBS, innovation and DPSS in the manufacturing sector: a Business Case

The following paragraph proposes an analysis of KIBS innovation interactions in the manufacturing sector for the development of DPSS solutions, focusing in the determination of the main implications from a knowledge management-base perspective. The manufacturing industry, specifically Original Equipment Manufacturer (OEM), is deeply immerged in digital servitization, driven by the application of Industry 4.0 technologies as IoT, IIoT, cloud computing and big data analysis. Machineries become connected devices, equipped with sensors able to interact with each other. The tons of data produced by digital technologies provide a critical knowledge base to generate real-time insights and information useful for strategic planning, monitoring and optimizing processes and products functions locally and remotely (Paiola, 2020). At the same time, manufacturers don't have available the necessary technological knowledge to provide to their customers "smart products" and DPSS solutions in which new services, supported by digitization, are bundled with physical machineries. Moreover, a changing value proposition for customers requires also a shift from the product-dominated logic to a service-dominated one, where machineries become only part of an outstanding value relation between suppliers and customers. Servitization towards digitalization requires a set of capabilities that manufacturers are not able to provide on their own, fostering the creation of ecosystems and moving beyond firm boundaries (Kohtamäki et al., 2019). First of all, a theoretical framework elaborated by Hein et al. (2019) is exposed in order to provide a guide map for the understanding of interaction and innovation dynamics towards the different actors involved into innovation and value creation in business-to-business platforms ecosystems.

The framework is based on the S-D logic elements proposed by Lusch and Nambisan (2015) and is composed by three elements: The presence of a service ecosystem, a service platform and value co-creation interactions. Service ecosystem is defined as "a community of interacting entities – organizations and individuals – that coevolve their capabilities and roles and depend on one another for their overall effectiveness and survival" (Lusch and Nambisan, 2015). Service ecosystems are characterized by interdependent actor-to-actor (A2A) interactions, "structural flexibility", meaning that the ecosystem is able to adapt and shape to face different value creation opportunities, and "structural integrity", stating that each actor is part of the ecosystem because of its competences to share within. Service platform is a "modular structure that combines tangible and intangible resources or components and coordinates the interaction

of resources and actors" (Lusch and Nambisan, 2015). Resources in the service platform are "liquefied", they are not bounded into physical products but stand by themselves (e.g. data) fostering their sharing between actors, and they are characterized by a high degree of "density", meaning that they can be shared more easily and faster. Architecture of the service platform is fundamental in enhancing the exchanges and service innovation between actors; in that sense, the authors suggest layered-modular architecture as the most suitable. Value co-creation identifies the creation of value between actors of the service ecosystem on a service platform. Actors could be platform owners, customers (i.e. OEM manufacturers), hardware manufacturers (i.e. sensors for IoT technologies manufacturers) as well as partners companies that offers IT, technical and applied strategic expertise to customers. Ecosystem platform provides a standardized common ground of boundary objects, namely Software Development Kits (SDK) and Application Programming Interfaces (API), through which value co-creation between different actors occurs. Nonetheless, standardization provided by SDKs and APIs is not able to cover all value co-creation; indeed, new platform users can arise new issues that foster the development of boundary objects. Under this framework value co-creation can arise through different practices, considered on the base of the different target actors:

1) **Integration of complementary assets:** the practice targets the supply-side of the platform, the platform owners. Platform owners provide to partners (hardware manufactures as well as service developers and system integrators) boundary objects as SDKs and APIs to self-integrate their solutions within the platform and benefits from the integration of resources that are able to enhance the value of the platform. Moreover, the application of solutions by partners and customers are exploited by platform owners to develop industries-specific insights and support customer-driven innovation. Strategic partnerships between platform owners and partners represent value-generating dynamics in the understanding of how creating vertical solutions for customers.

2) **Ensuring platform readiness:** the practice focuses on the demand-side of the platform. Due to the complexity of digital technology-based solutions implementation, customers rely both on platform owners as well as partners to ensure its readiness. Partners act as consultancy firms which are able to create value through their expertise over the platform functioning.

3) **Servitization through application enablement:** It represents the core value co-creation between the platform owner and the customer. Platform owners provides to

customers a Platform-as-a-Service (PaaS) infrastructure, in which they can construct value for final users providing new solutions based on the combination of existing applications of the platform.

Following the presented framework, an analysis of the innovation dynamics in DPSS ecosystems solutions is presented. The analysis in conducted towards semi-structured interviews over two different actors of a DPSS ecosystem: the first company, which we refer to as "Company A", is an international player KIBS interested in the development of IoT, Augmented Reality (AR), Computer-Aided Design (CAD) and Product Lifecycle Management (PLC) solutions. The second company, which we analogously refer to as "Company B", is a KIBS software solutions provider and system integrator which develops its solutions using different owner platforms, among which the one provided by Company A. From an ecosystem perspective in the development of IoT solutions, Company A acts as a platform owner while Company B as partner integrator of the platform and as solutions implementer for customers. The two companies represent critical players of the ecosystem that fosters DPSS innovation in manufacturing customers; as previously highlighted, innovation in the manufacturing sector has to answer to increasing customization needs of final users. In that sense, IoT technologies represent an unprecedented answer for the creation of tailor-made solutions in the B2B market through the linkage of "things" and the conception of communication between machineries and the cyber world of applications, supporting data-driven innovation. Taking into consideration the significance of data, platform provided by Company A sustains manufacturing innovation through IoT analytics support and, at the same time, presents other relevant features concerning smart solutions development as augmented reality integration and machine-to-machine remote monitoring and service. System Integrators, on the other side, occupy a leader positioning on the operative "field" of innovation, they are involved in a tight relation with customers, sustaining them in going over the complexity of technological innovation and successfully starting a transition over digital servitization solutions. In light of that, system integrators activity in the ecosystem has a great potential of influence for the reshape of customers' business model and value proposition delivery. By taking into consideration platform owners and system integrators activities in the ecosystem, the empirical case examines the contribution of KIBS in the innovation process of DPSS solutions analyzing, according to the literature, the diversified roles that they undertake, from "enablers" of innovation, i.e. platform owners which provides toolboxes and software, to "facilitators" as system integrators. Knowledge management implications for KIBS in the innovation dynamics for DPSS solutions are

analyzed mainly paying attention to the influences given by the ecosystems, both in terms of knowledge sharing and external capture phases of the knowledge management cycle. Longstanding relationships based on partnerships raise an increasing relevance in customers understanding, involving bidirectional transfers of explicit as well as tacit knowledge, while the innovation purpose of those relationships touches directly the capabilities offered by KIBS in the "productivity" dimension of the ecosystem and consequently the consistence of their internal knowledge base. The market taken into consideration for the analysis is the Italian one, considering mainly OEM manufacturers as customers of medium size and large dimensions. The table proposed hereafter resumes the main characteristics of the interviewed companies.

	COMPANY A	**COMPANY B**
Description of the company	International computer software and services company interested in the development of platform solutions for B2B markets. Solutions offered involve PLM, CAD, IoT and AR technology.	System integrator partner focused in providing solutions in the manufacturing sector (CPG, Food&Beverage, Pharma and OEM).
Number of employees	~ 6000	~ 40
Revenues (mln. €)*	~ 1300	~ 4
Role covered in the ecosystem	Provider of IoT platform and software which enables customers' DPSS innovation	System Integrator which exploits platform's technology provided by company A to elaborate solutions for customers
Role of the interviewee	South Europe IoT/AR pre-sales manager	Chief Executive Officier
Duration of the interview	1:12'	55'

*f.y. 2019

3.2.3: Discussion of the empirical findings

Both company A and company B highlight how IoT technologies and digitalization are still not fully compenetrating the manufacturing sector, notwithstanding the presence of an established market in which at the beginning first movers had tried to gain a competitive advantage over competitors, and now latecomers are trying to align to them. The innovation is still bounded to Product Lifecycle Services and Product Support Services, while a "full servitization" shift towards the offer of DPSS solutions has been achieved only by a restricted number of manufacturers. Company B's CEO identifies a deeply rooted product-centric logic as the main refrain to digital servitization implementation in business models by many manufacturers, which are still considering the interaction with technology providers as a pure supplier-customer relation in which KIBS act as "data provider" instead of a longstanding relationship with partners for value co-creation. Company A points out how some customers completely outsource every technology-related management capability, as those concerning i.e. ERP and CRM, remaining intentionally bounded to system integrators activity as source of technology innovation and not considering the direct involvement in the ecosystem to build new DPSS solutions, failing to achieve the potential gain coming from new marginalities on service provision. Another refrain acting in the innovation path is the lack of a "heterogeneous" solutions for manufacturing machineries; the effectiveness of providing digital service solutions is weakened by the absence of a common platform for all the machineries, which instead work on the base of different ecosystem platforms that do not communicate each other, causing a lack of alignment of data provided along all the plant. Moreover, data protection is still considered a relevant issue: interviewed KIBS confirm the presence of a spread fear towards manufacturers in the external sharing of own data, even to technology partners.

Despite all the cultural and organizational factors slowing down the path of transformation in the sector, many manufacturers present longstanding relationships with platform owners and technology partners, being deeply involved in digital servitization-driven reshape of their business model. Those relationships may be previously built-up through the offerings of technologies such as PLM and CAD, highlighting how a pre-existent link between members of the ecosystem could support the switch towards new technology solutions, following a "land and expand" strategy: at the same time, the presence of those bygone relations could be harmful for the development of servitization features of the solutions offers within customers value proposition, as their focus on the incremental technological innovation results in the development of "improved technology products" not sustained by a fitting servitization offer

rather than a DPSS solutions implementation into the value proposition. Manufacturers and platform owners are moving to set closer and tight partnerships: on one hand, customers are strategically moving to bring internally digital skills, especially IoT design competences, enhancing the potential to create tailor-made solutions for final users customers, gaining more flexibility and less costs than those sustained with the partnership of system integrators. On the other hand, platform owners KIBS has been starting to collaborate side by side with customers, focusing on the capture of industry specific knowledge through partnerships. Innovation dynamics of the ecosystems start to rely heavily on the "servitization through application enablement" between platform owners and customers, while at the same time the former is able to innovate their SDKs and APIs with a direct view on end-users' applications and final customers' necessities. From a knowledge management point of view the following reshape of the ecosystem in the implantation of innovative solutions has a series of consistent implications: First of all, customers need to capture and internalize new technological skills to develop IoT solutions for final users. Secondly, they have to develop internal tacit and explicit capabilities to foster the value co-creation with platform's owner, while they previously relied on the external knowledge of system integrators partners. Lastly, platform owners themselves need to develop internal capabilities taking into consideration the narrower extent of the relation with a certain customer, in order to capture industry-specific knowledge. For example, Company A highlights how, in order to face those issues, they create internal teams devoted to the development of manufacturers' relation and industry-specific insights, while customers' themselves develop analogous solution for technology capabilities internalization. Moreover, customers' teams have been trained by platform owners through learning-by-doing methodologies with the main purpose of developing IoT data gathering and analytic skills, enhancing the role of out-of-the-boundaries knowledge sharing in the ecosystem. Technology partners as system integrators seems to be pushed out from the innovation dynamics of the ecosystem, at least as "holder of pure technology knowledge": if in the introduction phase of the IoT market partners' value creation was strictly correlated to the provision of technology-based knowledge, now the role of partners system integrators in innovation is going to shift on the provision of problem-solving expertise for customers, recurring to the "structural flexibility" of the ecosystem adapting their knowledge contribution offer to the new needs. As a matter of fact, while codified and replicable knowledge has been absorbed by customers due to its replicable nature, tacit and internal knowledge hold by technology partners in the form of expertise over the diagnosis of the complexity in the offer of digital services bundled to machineries, is hardly replaceable. Nonetheless, system integrators need to be on the front line of technology development to maintain their capacity to sustain DPSS innovation and not fall

into “obsolescence” of their offer: a perfect match of the two different necessities could be reached by a knowledge base reshape, mixing up incoming human resources, holder of the latest technology developments, with the existing internal expertise base in customers’ necessities and servitization strategies. The contribution of KIBS as system integrators in the innovative DPSS design solutions in the future seems to be bound to their ability to provide shorter time-to-market and avoidance of design mistakes in customers’ innovation. Nonetheless, present ecosystems still require the presence of partner as system integrators in a tripartite scheme with customers and platform owners, especially in ensuring the platform readiness due to the complexity of the implementations which customers are not yet able to face alone. Facing the complexity of implementing solutions requires to partner not only to take into consideration customers specific needs but also to work side-by-side with platform owners, as they actions are dependent from the boundary resources provided.

From a general perspective, taking into consideration the role of KIBS in the ecosystem, it’s straightforward to acknowledge the critical resource represented by Customer Knowledge Management in the effective implementation of innovation into DPSS solution; the higher is the capacity to understand customer explicit and implicit needs, the higher will be the probability to undertake a valuable relationship which lead to effective innovation. Finally, in ensuring the innovativeness of the platform, Company A suggests how critical knowledge could be provided also by external technology partnerships, able to ensure possible sources of competitive advantage through the enlargement of the services and products offered for DPSS solutions design: innovation capabilities of KIBS are strictly connected to the “breadth” of their relation with other entities, both in and out of the boundaries of the ecosystem. Despite that, external environment presents potential benefits as well as relevant threats for KIBS belonging to the ecosystem: platform owner are engaged in the development of joint innovative collaborations with large software developer companies but, at the same time, the latter could easily become strong competitors that could push them out of the market through the acquisition of expertise and the support of a huge financial power. The threat of “substitution” for platform owner and system integrators is reinforced by the high standardization of solutions in the market of digital technology as IoT, which are developed on similar computer programming competences and standards, making customers’ switching costs to another platform not so high and weakening the “lock-in” potential in the relation. The table presented hereafter synthetizes the main findings of the empirical analysis made.

	COMPANY A	COMPANY B
Relations with other KIBS in the ecosystem	Partners are considered relevant players in the effective implementation of complex solutions. They ensure the readiness of the platform and sustain its innovation.	Platform owners are fundamental in the business activity of system integrators as providers of toolboxes, SDKs and APIs. Strong relations with platform owners are required in order to understand the potential of innovation in DPSS solutions.
Relations with customers	The development of tight and direct relations with customers ensure to achieve win-win situations through the creation of value in the ecosystem and pursue a "land and expand" strategy.	System integrators work side-by-side with customers in the innovation process on a regular basis to ensure the readiness of solutions. Direct and frequent relations with customers ensure the effectiveness of their activity.
Contribution to innovation in DPSS ecosystem	Platform owner provides toolboxes, SDKs and APIs for the implementation of DPSS solutions and customers' business models innovation. Customers implementation of the platform provides useful resources for the innovation of the platform itself.	Enable customers innovation through the support in the implementation of complex digitalized services solutions and ensuring the readiness of the platform. They furnish problem-solving expertise to customers over the design of DPSS solutions.
Knowledge Management implications	Innovation requires knowledge transfers involving both knowledge sharing and knowledge capture outside the borders of the firms. CKM must take into consideration both tacit and explicit dimension of knowledge to ensure effective innovation for customers.	Providing expertise means partially reevaluating the knowledge base, making explicit the tacit knowledge accrued in the innovation relationships with customers and leveraging it to foster value creation. High relevance is given also to external technological knowledge.

Perceived barriers to digital servitization innovation of customers	Customers are sometimes still bounded to product-centric logic which compromises a full servitization of the business model. Heterogeneity of the platform's solutions exploited by manufacturers harms the possibility to achieve full potential of servitization.	System integrators could be trapped into a customer-supplier relation instead of a collaboration approach with customers. At the same time, the lack of shared technology and servitization capabilities in the ecosystem may refrain their value creation ability.
Perceived threats in the business environment	Platforms are "standardized", switching costs for customers are low: owners couldn't rely on a strong lock-in. Another threat is given by the entrance in the market of big software companies.	The main threat is given by the "commodization" of technology capabilities which are going to be acquired and possesed internally by customers, ensuring by themselves the readiness of the platform and the elaboration of DPSS solutions.

3.3: CONCLUSION

The path of Digital Servitization shows us how the increasing complexity of the business world requires knowledge as critical resource which stands at the heart of value creation and competitive advantage (Powell W.W., 2004). KIBS in ecosystems of innovation for DPSS solutions in the manufacturing sector act according to the multiple roles supported by the literature; They are "facilitators" of innovation, providing critical knowledge, tools and expertise to foster innovative solutions for customers, they are enrolled in the orchestration of the innovation development occupying critical "nodes" of the ecosystem (Toivonen, 2004) (Shearmur, 2018) and stimulate relation for innovative solutions development involving actors along the value chain (Brunswicker and Vanhaverbeke, 2015). Moreover, KIBS shows their ability in enhancing proactive behaviors of customers through knowledge spillover activities, stimulating investments in industries' innovation (Rodriguez et al., 2008), leveraging the overall ecosystem in formulating new ideas and interfacing between the generic knowledge available and the tacit knowledge located within the firms (Braga et al., 2015). The creation of value and innovation is strictly bounded to the capacity of KIBS to accomplish to the specific purposes of customers, following the "value-in-use" paradigm (Grönroos, 2010) and configuring longstanding relationships where different entities compenetrate each other and settle mutual collaborative behaviors in joint problem solving activities (Aarikka-Stenroos and Jaakkola, 2012). In this settle, KIBS deal with knowledge on a regular basis and they felt primarily involved in the effective and efficient management of it (Zieba, 2014). Knowledge Management issues regard in first place structured and explicit scientific knowledge; as a first step, explicit scientific knowledge represents the main "enabler" of innovation, the base to achieve and sustain digital servitization strategies, but, on the other face of the coin, doesn't provide itself a solid competitive advantage. As a matter of fact, due to its nature, it's highly subjected to the absorptive capacity of other firms, i.e. customers and competitors, as ascertained in the case of system integrators KIBS. Tacit forms of knowledge derived from on-going application of innovative solutions in form of expertise and problem-solving capacity represent a more solid ground for the constitution of a long-term competitive advantage and, according to the cognitive theory, accent the essential role played by the "knower" as holder of effective knowledge. In order to contribute to the creation of innovative DPSS solutions, KIBS companies have to evaluate accurately the potential of the internal Human and Structural Capital according to the external needs of customers, while at the same time they have to keep their eyes peeled to the development of digital technology as resource for providing new possible solutions. Knowledge Management Cycle has to take into consideration the potential

for knowledge sharing outside the internal boundaries through the relationships created in the ecosystems, and on the other hand it has to exploit those relations to capture critical knowledge, sustain its application in innovation and trigger double-loop learning and internal improvement to construct industry-specific expertise which can act as form of competitive advantage. Nonetheless, being part of an ecosystem which moves all together in the fulfillment of innovation solutions means being dependent from the other actors: in that sense, KIBS activity is strictly related to customers behavior towards digital servitization and service-dominant logic. As a matter of fact, innovation and value creation are triggered by manufacturers reshape of the business model and the necessity to renovate the delivery of a value proposition which otherwise will become spare and obsolete. Being late on servitization and on the adaption of new digital technologies could entail being inevitably pushed out from the market. The big time is coming, innovation do not wait any longer.

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