Developing Digital Capabilities for SMEs: SMART4ALL's Cross-Border Experiments for Emerging Technology Development and Adoption

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Abstract. This paper outline a proposal to study the build-up process of digital capabilities in SMEs and technology-based startups that are produced through the exchange of complementary knowledge between external stakeholders. The SMART4ALL consortium aims to accelerate the launch and adoption of emerging technologies that potentially ensure the improvement of digital infrastructure of the SMEs located in South- Eastern and Central Europe. The introduction of Pathfinder Application Experiments are cross-border experiments that pursue the use of cross-domain of CLEC, CPS and the IoT technologies based co-opetition, co-evolution and co-specialization processes which will be combined in parallel with expertise in R&D, networking and business strategies. Most of these innovation activities are geared towards the development of digital capabilities apply in agriculture, transport, environment and the interconnection of anything, which are considered to be low-embedded digitalization. The research proposal aims to answer what elements influence the fast track build-up of digital capabilities in SMEs and start-ups participants and what organizational elements are influenced by digital capabilities support the launch and adoption of emerging technology?

Keywords: Digital capabilities, new capabilities building, cross-border experiments, Pathfinder Application Experiments, emerging technology development

1 Introduction

According to the European Commission the small-medium size enterprises' (SMEs) activities are the core of the European economy. They are responsible of the 67% of the employment meanwhile large companies cover the 33%, the SMEs´ activities represent the 76% of the EU economy and they have important effects in five areas

such as Manufacturing, construction, business services (professional, scientific & technical activities), accommodation and food, wholesale and retail trade, which represent the 71% of the economy net contribution [1]. Added to that, the status of the digital economy and society reports, during 2019, reveal and highlight the relevancy to support the SMEs' sustainability where the urgency to boots new digital capabilities, and the use of new technologies [2] in agriculture, transport, environment and the interconnection of anything sectors that report a high deficiency [3]. The development of digital capabilities are critical in activities regarding operations in e-commerce, teleworking, online training, and cybersecurity services[2].

Since 2014, the EU Commission has started the quest to build a unique digital market to standardized the digital operability of the economic activities to allow State Members' governments, companies, universities and citizens having access to digital equal conditions[4]. Under this context, with the COVID-19 pandemic contingency, the social distancing provoked a new paradigm with the halt of the global economic activities conditions that affected all industrial activities, and also many small businesses broke down. The social distancing shows the real need of digitizing and automation of some activities such as food provision, transport in delivery and business operability [5], [6]. Since then there is an urgency to upgrade the digital operability infrastructure between the State Members in these economic areas, specially to prioritize those country members with low access to the digital groundwork[7], [8].

The current strategic vision of the European Commission towards the creation of a European digital single market encourages collaboration and know-how sharing between member States and associates, through public procurement[9] primarily to support SMEs and to stimulate the economy[10]. Nevertheless, the conditions of a unified digital market in the EU will inevitably bring about aggressive international competition to most SMEs. They themselves undoubtedly have to carry out this digital transformation, which is accompanied by an internal organisational shifting process to build new digital capabilities linked to the uncertainty of adopting the appropriate technology[11]. And on the other hand, regarding emerging technology proposals, considered as potential startups, it is necessary to support digital capabilities building to bridge the gap to the market [12].

This article draws the research proposal to study the digital capabilities building process in the SMART4ALL's Pathfinder Application Experiments (PAEs), which consist on cross-border experiments between SMEs and potential innovations. The following research questions are supported by theoretical approach regarding: What elements influence the fast track build-up of digital capabilities in SMEs and technology-based startups participants and what organizational elements are influenced by digital capabilities to support the launch and adoption of emerging technology. Therefore, this document is structured as follows: the section two is a brief explanation of the theoretical background of Dynamic Capabilities as an approach to explain the concept of fast track of capabilities building, digital capabilities and the emerging technology co-creation through technological complementarity both grounded on innovation and strategic management literature. The third section introduces SMART4ALL consortium as the case study. The fourth section provides details of SMART4ALL's cross-border experiments programme characteristics. The fifth introduces the methodology of data collection and future

analysis regarding digital capabilities' indicators to identify the expected impacts and possible implications to the theory. The final section exposes the expected outcomes.

2 Dynamic Capabilities: New Capabilities Building

Given the current turbulent conditions of the economic activities that put pressure to the operability of many SMEs, the digitization process gains an important role toward their sustainability. The theoretical element that gives an explanation of how firms address changes to overcome rapid contextual change are Dynamic Capabilities[13]. The dynamic capabilities most common and primary definition is: "*the firm's ability to integrate, build, and reconfigure internal and external competences to address and shape rapidly changing environments*"[13], [14]. It refers to a systemic approach, where the firm develops in short time extraordinary organizational capabilities[15], [16] that allows it to sensing, seizing and reconfiguring capacities under difficult environmental conditions. These capabilities let firms create and scale up their value, but also allow them to escape from zero profit to survive to the turbulent conditions[17], [18]. Becoming these new abilities or capabilities, as excel and unique internal conditions which in the long run will become a sustainable advantage, and an intangible asset difficult to replicate[19], [20].

The study of the origin of fast-track and specialized new capabilities building under turbulent conditions, in firms and technology-based startups has been undertaken under the umbrella of the dynamic capabilities. It has been identified four common approaches of analysis to study the origin of new capabilities in innovation environments, the first is from the resource-based view that refers to the combination of tangible and intangible assets used to overcome turbulent conditions [21], [22], the second relates to the intangible sources or knowledge-based view of the firm, where the value is created by the knowledge and expertise of the firms' human resources and its valuable intangibles assets that the firm owns such as, the logo, its mission and values, licenses, intellectual property, market strategies, business models [23]; the third is from microfoundations of dynamic capabilities approach[24]–[26] that pursues the study of dynamic capabilities as the introduction of new routines and capabilities as organizational and managerial structures, systems, processes and procedures[27], in addition of new skills available that readapt the organization[28]. Finally through the team interaction approach as the origin of new capabilities from specific information exchange and interdependencies, based on team collaboration capabilities leveraging the operational capabilities [29], [30], supported by orchestrating and reconfiguring the firms' resources from internal and external know-how. Hence the harnessing of the team interaction is essential where the 'cross-functional cooperation'[31], that refers to constant interactions and exchange of information between the team's members to configure and adapt the firms' operations according to the market conditions [32].

2.1 Digital Capabilities

The European digital market integration is grounded on collaboration between EU State members. The SMEs digitization processes will catapult a new technology era to business, people, communications, production, economic and trade activities including traditional practices [33], [34]. The digitalization of SMEs and the fast-track the launch of emerging technologies involves multidisciplinary interactions and a systemic reconfiguration at strategic, organization, information technology, supply chains and marketing levels [35]. Here we introduce our first research question apply to the SMART4ALL's Pathfinder Application Experiments (PAEs):

What elements influence the fast track build-up of digital capabilities in SMEs and technology-based startups participants?

To answer this question, it was necessary to conceptualize theoretically the organizational knowledge creation process, and design hypotheses to be tested empirically. First of all, the digital capabilities involve adoption of new business concepts, new technology, specialized knowledge, skills, communications and activities human-machine interaction[36]. The conceptual basis of new capabilities building, dynamic capabilities, depend on the previous settlement of organizational and operative structures inside the SMEs, and in technology-based startups the definition of team organization with specific responsibilities[37]. According to Winter in established firms [38, p. 984]: *'to create a significant new capability, an organization must typically make a set of specific and highly complementary investments in tangible assets, in process development, and in the establishment of relationships that cross the boundaries of the organizational unit in which the process is deemed to reside'*. The interaction and collaboration, in innovative contexts and networking[38], produce in SMEs and startups the abilities to harness and enhance their operational capabilities through a set adaptive capabilities to survive under uncertain conditions[19], [32]. Moreover, this means that the SMEs and scientific teams working on developing emerging technology–as potential startups require, external knowledge accompanied by collaborative behaviour[39] as teamwork integration to acquire and assimilate external knowledge.

Hypothesis 1 Organizational teamwork influences the rapid creation of new digital skills[32]

Hypothesis 2 The type of investment in resources - for example, man-hours (in training), operating costs and acquisition of new technologies - influences the rapid creation of new digital capabilities.

Hypothesis 3a The involvement of new stakeholders in their environment - with new technical knowledge - influences the rapid accumulation of new digital skills.

Hypothesis 3b The intervention of new stakeholders in their environment - with complementary specialized knowledge - influences the rapid accumulation of new digital capabilities.

2.2 Complementarities in Technological Environment

To understand the innovation dynamics it is necessary to insight that technologic environment around the SMEs' and startups' activities, then their environment is

constantly shaping their innovation, and it is also where technological opportunities are appearing and disappearing[39], [40]. Technological complementarities occur when two or more factors increase the return compared with each isolated factor's income as reference[40]. Teece defines that "*complementary relationships [*occur between*] heterogeneous factors [*outside and*] inside the firm (and that these can impact firm performance), the contexts in which such interfaces [*happen*] is yet to be adequately specified*"[40, p. 720]. Complementary technologies demand high levels of absorptive capabilities it means fast learning and applying of multidisciplinary know-how in different areas of the organization [41].Then our second question is:

What organizational elements are influenced by digital capabilities support the launch and adoption of emerging technology?

The technological complementarity goals, pursue cospecialization goals where all the stakeholders acquire knowledge from their interaction [15], [16]. It is based on the collective collaboration and knowledge exchange activities between established innovation ecosystems and respective networks[42], where the partners combine their expertise[43]. The technology cospecialization involves external know-how exchange –from the partners' network[44], applied through internal learning and adaptation of organizational processes. These will be reflected on the firm growth as indicators[45], that will be revealed on their innovation performance as outcome e.g. sales, number of clients, market share[46].

Hypothesis 4 Digital capabilities are linked to the type of complementary knowledge that is applied on strategic actions regarding new business models design, identification of new markets, application of materials.

Hypothesis 5 Digital capabilities are linked to technical areas regarding new product development/ new market development/ or in addition to external knowledge from the stakeholders' network.

Hypothesis 6 Digital capabilities are linked to management and internal operation regarding logistic, transport, providers.

3 Case Study: SMART4ALL Consortium

The Europe digitization target to spread the benefits and opportunities to all economic activities through a consortium [30]. The role of a consortium is to integrate the multi-actor activities where their members work and contribute in different activities to develop opportunities aiming at a common goal, but at the same time sharing the risks and benefits[47]. The European Commission has an umbrella of different funding programs, in this case Horizon Europe offers support to initiatives that backing SMEs and mid-caps through research and innovation in their quest to digitization[48].

The SMART4ALL consortium is a supranational collaborative network and a Horizon Europe funded action, that combines multicultural ecosystems, with interdisciplinary skills and know-how to establish a Pan European network of Digital Innovation Hubs. It pursues an extended impact across South, Eastern and Central Europe envisioning the production of digital innovation through ICT technologies [49]. The SMART4ALL's mission is to strengthen the inter-European innovation network supporting SMEs, who represent the 90% of businesses in the EU [50].

The SMART4ALL is composed by 25 partners from 15 countries, its goal is to support collaborative cross-border network activities and knowledge transfer through experiments that join academia and industry [49]. It is shaped by a diversity of regional stakeholders, such as universities, research institutes, Investors, networking organizations, SMEs, Digital Innovation Hubs, and NGOs.
Some of the characteristics that stand out this consortium are the integration of cultural diversity, geographical location, but also contribution of specialized capabilities to provide the support required to scientific activities and proposals that are considered "hidden treasures of innovation", with great deficit on technology application, investment and business vision[51]. The underestimated areas selected are digitized transport, digitized environment, digitized agriculture and digitized anything, becoming these the innovation impacts that SMART4ALL seeks to achieve.

The consortium introduce a unique concept named Marketplace-as-a-Service (MaaS), as strategic service to catapult and back up an idea to prototype/test through simulation and providing to the participants with tailored services to offer (1) practical technical tools/services to accelerate design, development, prototyping and manufacturing phases and (2) brokerage, coaching and guidance to access funds and pave the path towards market growth and investment. The consortium partners are involved in the performance stages with different technologies domains through their extended network[47]. All these to reduce the time to market gap of a new technology. Because of the high level of research components behind the SMART4ALL's innovation, its activities are pursuing to frame and promote good practices in innovation and ethical behaviour in research [52], [53], particularly focus on those who involve cross-boards experimentation activities [54].

4 Pathfinder Application Experiments (PAEs)

The strategic tasks are distributed between the partners according to their expertise areas applied on four domains targeted: Digitized transport, Digitized Agriculture Digitized environment, and Digitized Anything (See Fig. 1). The digitized transport tasks identify concepts regarding digital transport, mobility of goods and people, all digitally connected with low carbon impacts [32]. Digitized Agriculture tasks, highlights the introduction of intelligent farms systems, following the Industry 4.0 systemic approach, customizing products, efficiency and mass-production [33]. Digitized Environment is linking to Digitized Anything tasks, respectively both refers to the interest to show IoT solutions as open challenges [34] where there are needs of connectivity of intelligent products, devices, services, technical solutions and developing new ways of interaction with the environment without negative impacts.

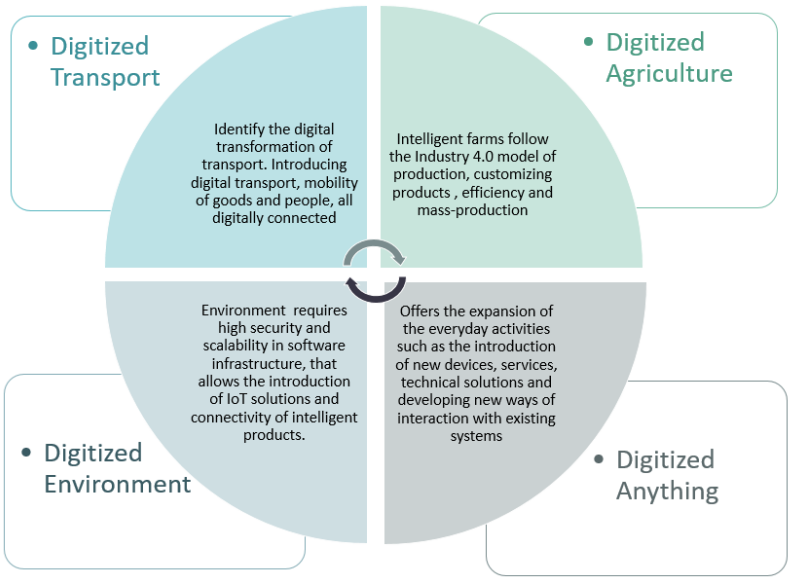

Fig. 1 SMAR4ALL four thematic digitized areas: *Transport*, *Agriculture, Environment and Anything* [55]

These activities pursue to create more value through collaborative activities and scientific support from competence centres who will provide access to tests and prototype in parallel with the business networks[56]. to find investment, partnership, identify potential clients and development of business models activities [57].

4.1 The Cross-border Experiments: Pathfinder Application Experiments

The SMART4ALL consortium introduces three relevant pathway methods through which it could be possible to implement specialized knowledge based on scientific and technological sources. The Pathfinder Application Experiments (PAEs)[49], [55] are technology transfer experiments that will be developed and promoted by the technology-based partners. It pursues that all PAEs content an intensive collaboration of scientific and technological activities, including the dissemination activities. Its objective is bridging technological solutions to the traditional industry activities. These activities involve the application of digital technologies such as Customized Low Energy Computing (CLEC), Cyber Physical System (CPS) and Internet of Things (IoT) in South Eastern Europe (SEE). All will apply in agriculture, transport, environment and the interconnection of anything [55].

The PAEs' knowledge transfers content co-opetition, co-evolution and co-specialization as ingredients that aim to robust the novelty with high value added

integrated by smart technologies, business and digital skills in a package. The co-opetition is embedded by collaboration and competition that create value, with the opportunity to improve the innovation under a practical and constructive approach[58]. The co-evolution as an approach in technology environments involves creativity, nature and effects of innovation processes such as exploration, development and exploitation [59]–[61]. Finally, cospecialization as an element that involves the diverse synergies added from the partners to accelerate the R&D processes such as design, development, prototyping and manufacturing phases. The knowledge transference services are possible throughout the training, coaching and expertise guidance providing new skills development to SMEs [17], [62].

The consortium complements cross-board knowledge transfer. The PAEs' calls' are divided in three types: (1) KTE: Knowledge Transfer Experiments, (2) FTTE: Focused Technology Transfer Experiments and (3) CTTE: Cross-domain Technology Transfer Experiments winners will be accompanied during their prototyping processes to be launched into the market and being available to the SMEs [55].The PAE's program foresees the solution -product-service- development in three stages: 1) the concept/solution description: responsible person/team, objective, processes and activities; 2) second stage, focus on the development and definition of the solution; and 3) third stage, the market launch of the solution. The expected participants shall perform cross boarder activities with their respective partners, then they should belong and established in one EU member state o any EU associated country, because of the PAEs' nature they require the participation of at least two different EU countries and/or associated countries. The participants could be Universities or Academic Institutions; SME and Slightly Bigger Companies and System Integrators and/or Technology Providers.

SMART4ALL will carry out 9 open calls throughout 2020-2022 with the aim of selecting 66 most relevant projects. The selection process will be carried out under an impartial and competitive procedure to evaluate and select the best technological proposal, as part of the SMART4ALL programme. Initially participants will be accompanied by SMART4ALL partners, who have two roles, firstly to support them with complementary expertise and their network during the PAEs and their preparation for market launch. During the experiments performance there are special interventions that will address the development of new products and commercial development. They include access to specialized coaching related to the development, attract investment and identify market growth strategies.[47].

Table 1 The PAEs' processes involve [55]

PAEs	Brief description	Scheme	Budget	Duration
KTEs Knowledge Transfer Experiments	Support small projects, or less mature ideas to be presented, tested and thus potentially find the fertile ground to grow and reveal its product potentials. KTEs act as internships / traineeships, apprenticeships and short-	Internships projects between two different entities from two different EU Countries: one Academic or Industrial partner.	up to 8,000€ to cover mobility allowance for implementing the internship	Short-term (3 months)

	term training programs for unemployed people for vacant digital jobs.			
FTTEs Focused Technology Transfer Experiments	This one party transfers to the receiving partner a specific HW or SW technology in order to enable improved product or processes.	Two different entities from two different EU Countries: one Academic and one Industrial or two industrials.	up to 80,000€ to cover staff, travel and equipment	Short-term (up to 9 months)
CTTEs Cross-domain Technology Transfer Experiments	Complex multidisciplinary transfers and prototyping the novelty from CLEC CPS and the IoT technologies to wider markets.	Three (3) entities from at least two different EU Countries (at least one SME; the experiment should be led by the SME)	up to 80,000 € to cover staff, travel and equipment	Short-term (12 months)

5 Methodology

The SMART4ALL consortium's cross-board experiments will be combined with specific training and couching of diverse capabilities building around new technologies adoption and organizational adaptation. This is aiming the identification of those capabilities that could be directly and indirectly related to digital capabilities. The development of digital innovation in the different identified areas, anticipating the high potential for adoption of emerging e-products and services, but also the creation of more e-businesses and more new jobs as a result.

A survey design integrates different theoretical indicators, values assigned on ordinal scale. We consider the Likert scales from 1-7, where 1 represented the lowest or most negative value, and 7 represented the highest or most positive value. These numeric values will represent their opinions allowing the quantification of their responses will be distributed among PAEs' participants, such as SMEs and technology-based companies, involving the SMART4ALL partners involved in each PAE. The sample will cover a wide range of stakeholders involved with the aim to analyse the data collected in relation to the process of digital capabilities building through the PAEs' experiments' participants, considering the dates of the Open Calls.

Table 2 Open calls program

PAE Type		Call 1	Call 2	Call 3
Knowledge Transfer Experiments (KTE)	Call Announcement:	Apr 15th, 2020	Mar 2021	Mar 2022
	Submission Deadline:	Sep 15th, 2020	May 2021	May 2022
Focused Technology Transfer Experiments (FTTE)	Call Announcement:	Jul 1st, 2020	Jun 2021	Jun 2022
	Submission Deadline:	Sep 30th, 2020	Aug 2021	Aug 2022
Cross Domain Technology Transfer Experiments (CTTE)	Call Announcement:	Dec 2020	Sep 2021	Sep 2022
	Submission Deadline:	Feb 2021	Nov 2021	Nov 2022

The study will be a complementary part of mixed-method research, in which qualitative data collection will be considered ensure the specificity of the sample purposes and quantitative data will be necessary to undertake the model estimation to assess each hypothesis through constructs. We are considering the data analysis through the Structural Equation Model (SEM), which is a component-based estimation for cause and effect modelling with latent variables through least squares (PLS) system using the Smart PLS 3 software.

6 Expected Benefits

This paper pursues to introduce a new concept about the digital capabilities building, which requires a systemic understanding of the digital market framework. The digital transformation of SMEs and the launch of emerging technologies require important internal organizational efforts from the PAEs participants and collaborative behaviour from SMART4ALL's partners. This research proposal aims to contribute to the innovation and strategic management literature regarding the digital capabilities building as a new paradigm that require a broad and systemic understanding to build the future of the new industry in the EU. The SMART4ALL consortium's cross-border experiments pursue to diminish the risk between innovators and their potential customers by helping them in their journey of adaptation to change. It should be noted that PAEs are an instrument that encourages and supports cross-border interaction between different actors and their respective networks, forming a supranational innovation ecosystem in the EU.

The SMEs' challenges are pointing to fast tracking digital solutions and building up new technological capabilities that can be economical and environmentally sustainable, but also social and cultural inclusive. The multi-actor collaboration requires a collective effort and commitment, particularly in collaborative environments, which essentially pursue building new capabilities and create more value between the partners involved. Also, the role of the SMEs is to assume huge compromise to continue the efforts of collaboration and influence in their ecosystems

through their activities supporting similar companies and providers. Considering that it is expecting that they pursue their sustainability in the long term.

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7 References

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