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From Digital Platforms to Ecosystems: A Review of Horizon 2020 Platform Projects

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Abstract. Digital platforms have, in the past decades, undergone a revolution, evolving from its technical roots so much that nowadays value is mostly generated, not by the technologies that power platforms, but by the ecosystem of applications, developers and users it is able to generate and support. In this paper, we seek to understand the importance industrial platform owners place on the community building and platform growth components of the platform development process by reviewing 50 Horizon 2020 financed projects that stand on the development of platforms. This evidence is leveraged for the case of a validation strategy definition for a platform ecosystem aiming at sharing production capacity. Key findings point to platform developing practices focused on the development of technical components to the detriment of the ecosystem generation element. We also shed light on how different business models and funding schemes impacted the steering of these platforms.

Keywords: Digital Platforms; Digital Ecosystems; Digital Communities; Horizon 2020.

1 Introduction

The concept of multi-sided markets that gathers consumers and producers together in the same environment has been around for a long time, coexisting in many industries with traditional product and service offerings [7, 8]. At its core, these analog platforms provide the infrastructure and base rules for the facilitation of interactions between different groups of users. These can vary from newspapers that join readers with advertisers, to record labels that link bands with listeners. Through the digitization of this paradigm, and with this infrastructure becoming software, the platform business model was rapidly propelled forward over traditional industries [14]. Digital platforms (DPs) became to allow for scalability and flexibility that would be very difficult to accomplish through traditional, even if already established, networks. Early examples of DPs thrived on this connecting of buyers and sellers, advertisers and consumers. In the last decade, however, platform owners have devoted more and more resources not just in the growing of user communities, but also in stimulating outside firms to create complementary innovations, in the form of their own products and services that make the core platform increasingly valuable [6]. Different authors see this phenomenon from different perspectives. [6] sees this as a

push from what the authors call innovation platforms and transaction platforms to blend and acquire characteristics from each other: innovation platforms (such as Apple's App Store) seek to not lose control over the distribution component of the business, by integrating typical transaction platform's characteristics; and transaction platform owners recognize that not all innovation comes from within and open its platform and user database to application developers. [19], drawing on the work of [9], go further by placing these complementary products and services as integral components of a platform's ecosystem and value chain. The authors point to how the platform itself is just a component of a larger bundle of systems and that the fate and survival of a platform hinges on the vibrancy of its downstream ecosystem. By opening its borders and taking software-based platforms as the infrastructure that powers an ecosystem of other products and/or services, platforms allow end-users to customize the platform to specific needs by bundling different sets of functionalities [1]. In sum: ecosystems, not platforms, attract and sustain users over long periods.

As part of its Digital Single Market package, the European Commission launched its first industry-related initiatives under the Horizon 2020 programme (H2020) with the combined EUR 50 billion mobilized from public and private investment for the digitisation of the European industrial sector. DPs take a central role in a variety of different calls that touch different sectors of the market. H2020 projects themselves pose an interesting research testbed for multiple reasons: (1) for many of the funding schemes, research, and technology organizations (RTOs) and industry are combined in the same working group; (2) strike a balance between pushing the boundaries of technological developments while delivering on market-ready products and/or services; and (3) bridge technology innovations with innovations on the business front. Leveraging these factors, this paper presents a review of how H2020 funded projects have adopted the platform paradigm for the industrial sector. More specifically, we set out to understand how these projects go beyond the technical understanding of platform and develop the user and application of ecosystems that complement the platform. In summary, the research question becomes: Have H2020 funded projects that stand on the development of DPs been able to generate and sustain user ecosystems?

2 Digital Platforms towards Digital Ecosystems

As with many complex sociotechnical systems, conceptualizations of DPs vary according to the context that surrounds them. [17], [15] and [5] are some examples of Management and Information Systems researchers that have in the past decade compiled and categorized lists of some of these definitions. The most denoted separation is seen in the view of platforms from a technical point of view or from a more sociotechnical perspective. This first perspective sees DPs as extensible codebases to which complementary third-party modules can be added through the use of different interfaces, while this second perspective adopts a view that combines the technical (software and hardware) with the associated organizational processes and standards. Examples of conceptualizations that fall unto these two perspectives are: (1)“An IT-platform is defined as comprised of a technological base on which

complementary add-ons can inter-operate, following standards and allowing for transactions among stakeholders, within the platform-centric ecosystem" [17]; (2) "Multisided platform (...) exists wherever a company brings together two or more distinct groups of customers (sides) that need each other in some way, and where the company builds an infrastructure (platform) that creates value by reducing distribution, transaction, and search costs incurred when these groups interact with one another" [13].

The concept of ecosystem suffers from some of the same conceptual ambiguity as DPs. While the term is often found close to DPs, the division between a technical perspective and a sociotechnical perspective is also prevalent. Having the metaphor originally been introduced to the IS field by [12], to describe the idea of a changing competitive environment, this division has more recently emerged on two fronts: an organizational perspective, exemplified by how [10] uses the concept of ecosystem to describe the way companies leverage platforms to become keystone actors in a specific sector of the market; and a technical view that points to ecosystem as a collection of the platform plus "apps" that interoperate with it and are more often than not supplied by third parties. Authors such as [9], and [19] place this vision of ecosystem at the core of the platform value chain. Ultimately, we can trace back some of the basic ideas of DP-based ecosystems in the collaborative networks community where competency management, value systems, system of metrics, and trust management are among the main elements for its success [2].

3 Methodology

The primary source of data utilized in this research was the main "Cordis - EU research projects under Horizon 2020" dataset, published by the EU Publications Office and retrieved on September 2019. We complemented the dataset by (1) collecting public project deliverables from each respective web page (when available); and by (2) querying standard scientific publications databases using each project's unique grant number.

An initial broad selection of projects was selected based on a range of terms, namely: "digital platform"; "multi-sided market"; "marketplace"; and "online platform". This phase resulted in seventy-four selected projects. During the second stage, we analyzed the short descriptions, topics and objectives of each project, excluding duplicates and non-related projects, reducing the number of projects to fifty-two. A third phase consisted of a careful assessment of extended descriptions and some of the initial (more mission descriptive) deliverables. During this phase, projects were selected based on a specific set of criteria. The selected projects all have to involve, in some capacity: (1) The creation of digital platforms for the industry in a business-to-business perspective; (2) the creation of digital platforms for the support of supply chains; and (3) the creation of digital platforms that support an ecosystem of users; We did not consider projects that concerned: (1) the development of non-digital platforms; (2) the development of single-sided platforms; (3) the development of digital platforms where the industry is not the primary target userbase; and (4) the

development of new tools or mechanisms for already existing platforms. For the projects selected in this third phase, we took three main components into account: (1) the metadata of each project; (2) the available public deliverables that depict the work involved for the development of the platform in question; and (3) scientific publications published within the scope of the project.

It is also important to note that of the fifty considered projects, only fifteen have ended. The analysis process previously described considered this fact, and it reflects, where relevant, the caused shortcomings. We took as few assumptions as possible regarding future directions of these projects by basing our review on the direction set by each consortium (reflected in the more technical and business-driven deliverables).

4 Results and Discussion

Distribution of Projects across Years. Since the beginning of the Horizon 2020 framework program in 2015, the number of projects that stand on the development of DPs for the industrial contexts has stayed relatively stable at around 9 per year, with a slight increase in 2018 to 14. This represents 0,21% of the entirety of the funded projects under the program in the considered time frame. These results are congruent with the time frame in which DPs started to become more and more prevalent in other sectors of the market. These numbers also seem to be in line with the review of research that focused on platforms across IS and Management journals conducted by [3]. Starting in 2009-2011 the authors point to the field growing, in terms of the number of publications, going from 1 in 2009 to 13 in 2015 and 22 in 2017.

Distribution of Funding Scheme across Years. Figure 1 shows the breakdown of funding schemes over the years. Here we can note the increase in research interest around this topic, with the majority of projects being funded under the innovation action (IA) and research innovation action (RIA) scheme. By 2017, however, this trend starts to reverse and we begin to see a growing prevalence of the SME instrument that focuses on the feasibility and economic viability of innovations and works much closer to the market-ready solutions. This switch sees the funding redirected from projects that have a heavy research component, to projects that, although not devoid of research interest, are led by industry organizations themselves. Projects funded under the coordination & support action (CSA) scheme on the other hand are distributed through 2015, 2017, and 2019. This scheme is primarily related to projects that involve standardization, dissemination, policy dialogues and awareness-raising, and many of the platforms that emanate from these projects fall under these two last topics, as the WATERINNEU project that aimed at the creation of a "*marketplace to enhance the exploitation of EU funded ICT models, tools, protocols and policy briefs related to water*" is an example.

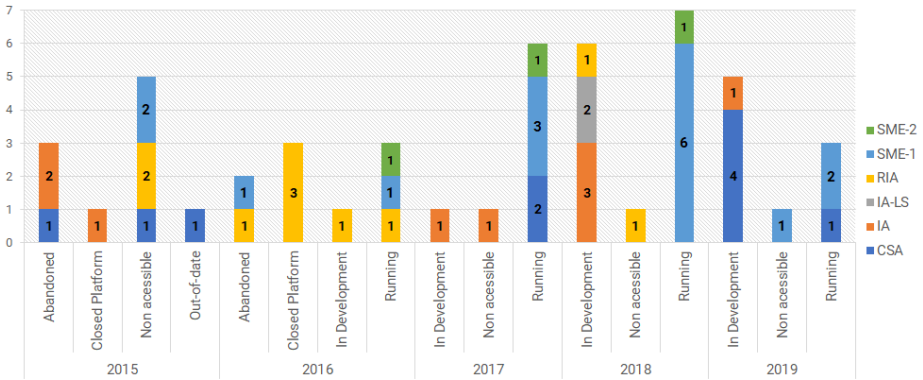

Figure 1: Platform status by funding scheme across years

Distribution of Categories across Years. The classification of DPs is another topic that is still not consensual between authors. Different authors have classified platforms according to model of governance or even ownership structure. Due to the nature of this review, we opted to categorize platforms according to its business model. This categorization divides platforms into three models: the (1) integrator platform, where the platform acts as a middle-man and intermediator between two entities (crowdfunding platforms such as Patreon are an example of this model) [4]; (2) in product platforms, where the platform acts as the technological infrastructure where external contributors build on top of (Shopify is a clear example of this model) [4]; and (3) multisided platform model, where external users can freely interact with end-users without the direct interaction of the platform owner (eBay is an example of this model) [4].

Figure 2 presents the distribution of platforms, by its classification, across years. Here we can note a clear preference for integrator type platforms in the first year of the H2020 programme, that shifted towards the multisided business model in the later years. Given the tight time constraints this nature of funding implies, these results are in line with the business development complexity of each of the categories of platform. Integrator type platforms require a high level of synergy between the different components of the platform and a level of ecosystem development and bootstrapping that is difficult to achieve in the early years of platform development. Most integrator type platforms evolve from one of the other types (mainly multisided platforms). Apple's App Store success has much to do with the pervasiveness of the iPhone platform, and the Amazon Kindle platform to the success of Amazon as an (e)book seller. In the case of product platforms, these are mostly abstracted to the end-users, which adds a step of complexity in the ecosystem building process. This does not only mean that the platform owner has less control over the interactions of end-users with the platform, but also that the growth of the platform is very much tied with the engagement of a specific type of users. In the case of Shopify, these are other organizations or users that intent to sell some product or service, in the case of Squarespace these are users that need a website. Multisided platforms rely heavily on the platform owner's capacity to kickstart the ecosystem and get the platform to a level where platform externalities become a factor. These typologies of platform also

lend themselves to dissemination through online and offline channels, which are most common in the projects of this nature.

Distribution of Platform Status across Years. Figures 1 and 2 also show a breakdown of the current status of the DPs in relation to its business model category and funding scheme. The status of each platform was determined from the point-of-view of an external user and six status were considered: (1) *Running*, where platform use is evident, and an alive ecosystem exists; (2) *Out-of-date*, where the platform shows sign of having been used in the past, but not in the last 6 months; (3) *Abandoned*, where no sign of platform use is present in the past year; (4) *Closed*, when the platform is not accessible to external users; (5) *Non Accessible*, in the cases where the platform is not reachable or not running anymore; and (6) *In Development* when the project is still ongoing, and no platform is available yet.

Overall we cannot consider these results as positive. For projects that started before 2018 only 33% (9 platforms) are running, with a large number of them being abandoned or closed. Of these 9 that are up and running, we can also say that they fall mostly under the multisided business model category (22%), and are funded under direct SME (Phase 1 & 2) instruments (22%).

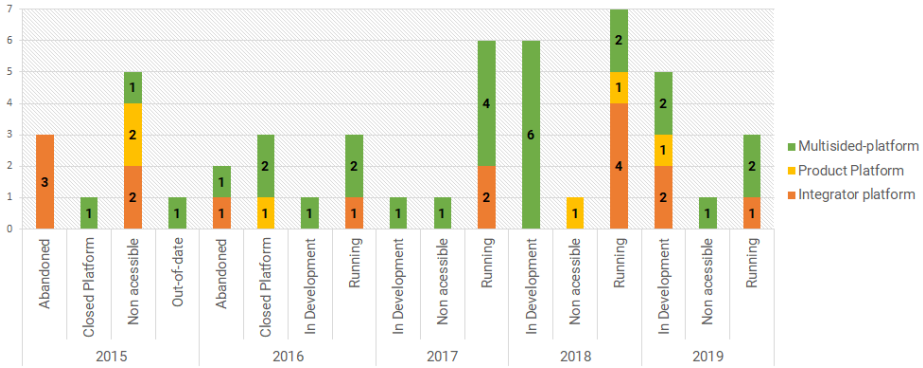

Figure 2: Platform status by category across years

It's also to note the high number of non accessible platforms for this time period. Platforms such as *Knowliah Community* place a high barrier to entry in the ecosystem by requiring that users use means outside of the platform itself to apply for membership, while *Amable*, requires potential users to go through an application type process to access the offered services. Although hurdles to entrance in an ecosystem can be useful as means of shaping the community of the platform, for platforms early in their lifecycle these can severely limit the capacity to bootstrap the ecosystem and get the network externalities that keep the platform viable in the long term. These need, then, to be paired with strong community engagement and dissemination activities, in order to get the intended user groups over these initial hurdles and into the platform's community. For the last 2 years, a large part of platforms are still in the initial development phase (13 platforms), and 10 can already be considered as running. In this group we still find the same prevalence of SME direct funding (for all

but one project), and for the multisided business model (4), although 2018 saw the start of four platforms that fall into the integrator platform model.

Publications and Deliverables. When we look at the total scientific output of each of these projects the results follow what is expected given the different types of funding. RIA projects total a number of 135 publications on scientific journals and conferences, followed by IAs with 44 publications and 12 for CSA. Both the SME instruments combined, for the five years, a total of 5 publications. From this group of 196 publications, only a subset of 26 are directly related to the technical development, deployment, and management of DPs for the manufacturing sector, while the remaining focus on other components of the projects. These numbers point to a prevalence of DPs as the technological infrastructure that is leveraged for the development of new and innovative products and services, but at the same time to the lack of focus that many of these projects put on the development of the platform concept for the manufacturing sector.

A similar situation can be seen in the deliverables specific to each project. In these we found that most of these projects begin with sets of deliverables that center the technical and business development of the platform in its sector of the market through standard tools. Stakeholder analysis, competitor capabilities analysis, and business model development through standard tools were transversal through most of the projects. For some of the projects, such as *EuTravel* these processes are not limited to the start of the project, but an ongoing effort that is evident through several deliverables. When it comes to community engagement and ecosystem development, deliverables show that much of the effort is devoted to conventional dissemination strategies: conference and workshop participation, webinar presentations, and social media presence. Although this strategy allows for the reaching of a wider audience, it is often not focused on the intended target userbase of each project's DP. For most of the considered projects, this results from a lack of separation from what is the dissemination of the project itself, the platform and its ecosystem. This results in platforms with landing pages that describe reference architectures but fail to convey the competitive advantage in its adoption, platforms that become one-sided catalogs of suppliers, communities that fail to gain enough traction to be sustainable without the backing of H2020 funding.

4 Creating and Shaping Communities for DP Enabled Ecosystems: The MANU-SQUARE Case

Building on the manufacturing as a service concept, the H2020 MANU-SQUARE project [11, 16] aims at establishing a European ecosystem of organizations and other relevant stakeholders that, in a marketplace environment, can act as both supplier and client. The platform moves available capacity closer to production demand, further disrupting the traditional linear value network, allowing for the rapid and efficient creation of local value networks for innovative providers of products and services and

the optimization and reintroduction in the loop of unused capacity that would otherwise be lost.

In order to develop an ecosystem that is able to outlast the H2020 funding stage, and based on the finding presented in the previous sections, the MANU-SQUARE project has focused its later stages (mid-2019 through mid-2021), in implementing a strategy for the growth of its ecosystem. This strategy leverages [18] high-level metrics to design validation strategies that focus not only on the technological constructs but also on the involvement of end-users and external developers in the platform development process and spans the three stages of the platform lifecycle: short, medium and long-term.

The short-term is the most inward step of platform development where platform owners establish the userbase, core components, and key functionalities provided. Despite its inward nature, dissemination and user engagement activities should start early on the platform building process. According to its target userbase platform owners can opt for online or offline strategies that leverage the press, social media, or already existing communities. To support these activities, on the technical and business side, platform owners have to focus on the scalability and composability of its main services. The focus on scalability will ensure that the platform functional and financial performance under different (higher or lower) levels of adoption while composability ensures the flexibility of the platform's components to be altered without affecting other components of the ecosystem. The interplay between these two characteristics allows for a flexible early platform that can be shaped by the use that end-user and developers give it.

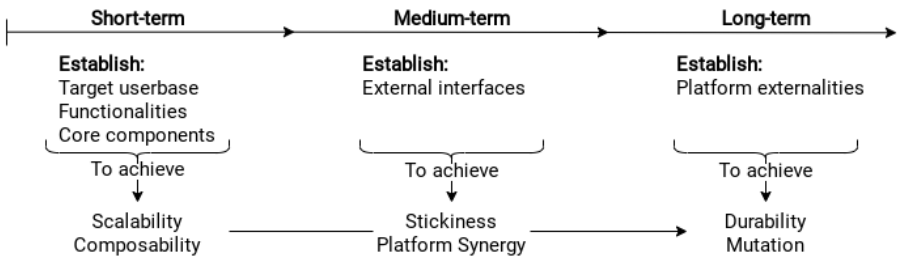

Figure 3: MANU-SQUARE ecosystem development process

In the medium-term, and with key functionalities in place, the main focus can change to prioritize the implementation of robust and standard technical interfaces for third-party services (crucial for industries where other software tools have become standard and many times hard to replace). This switch implies that the main target of dissemination and engagement actions are now developers and owners of other digital products/services. Overall stickiness and platform synergy are to be considered crucial at this stage. These characteristics ensure that the platform keeps incentivizing persistent usage over time while keeping up the integration with third-party platforms.

Over the long-term, to leverage the externalities that the standing community generates more and more prevalence should be put into the durability and mutation.

While durability ensures the capacity of the platform to be competitive in the market, mutation provides the community growth component by keeping alight the capacity of platform owners to pivot and generate new services based on the original platform or even to overtake the services of other platforms and absorb an existing community. These characteristics are to serve as guidelines for the shaping of the lifecycle of the MANU-SQUARE platform. By allying these with (1) the development of robust and standard technical interfaces and (2) the continuous engaging, online, and offline, of end-users we expect to invert the trend of H2020 funded platforms that fail to generate and sustain thriving communities.

5 Conclusion

This study shows that despite the prevalence of DPs as infrastructure in H2020 funded projects for the industry, there is still a lack of understanding of platforms as sociotechnical ecosystems that thrive on both developer and user engagement. Communication and dissemination activities often focus their efforts in the dissemination of the project itself, to the detriment of the growth of the platform ecosystem. We highlight how, under the H2020 umbrella, funding towards platform development has shifted to the direct funding of SMEs and how these funding schemes have resulted in platforms that remain active in the short term.

Horizon 2020 projects adhere to strict guidelines from the first proposal to the last formal review. Although this structure provides projects with clear goals and roadmaps, it can also narrow its growth potential. Although DPs are an integral component of today's market, how they can be deliberately designed and deployed is still a matter of debate. For many of what are currently considered the most successful and thriving platforms of different sectors, business models have changed drastically, core functionalities were added and removed, visions and missions were redirected. It is then crucial to, when designing and reviewing projects that focus on the building of DPs in its sociotechnical conceptualization, to factor in the room for the branching out of functionalities and goals that were not initially foreseen. DPs provide researchers and companies with unparalleled flexibility in the infrastructure and communities they are able to generate, the processes that lead the building of DPs need to also afford this same flexibility on the short, medium and long time-frames.

This research presents, however, several limitations. These include the difficulty in assessing the reliability of the data source used, the large number of projects that are still ongoing, with platforms in the development phase, and the lack of direct contact with both many of the considered platforms and the researchers and organizations involved in these projects. The process we introduce in Section 5 also lacks the required validation, as it still is an ongoing effort.

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