How to build a successful business model with big data platforms?

A product lifecycle perspective

Jos A.A.M. Verstegen
Wageningen University and Research
jos.verstegen@wur.nl

Bart Doorneweert
Source Institute
bart@source.institute

ABSTRACT

A product lifecycle approach is used to describe the origin, history and development of current big data platforms, using literature sources, business case descriptions, interviews held with founding team members of platform businesses, and experiences in action research projects on big data platform development in Dutch agriculture. The paper concludes with an outlook on future developments and business models.

CCS CONCEPTS

Human-centered computing → Collaborative and social computing → Collaborative and social computing theory, concepts and paradigms → Social content sharing

KEYWORDS

business models, big data, platform development

1 INTRODUCTION

Thanks to great developments in sensor-, information-, and communication technology large quantities of data are becoming available at real-time and at low costs. This opens the door for businesses to receive information on supply-chain variables such as delivery status, processing failures, quality control, etcetera. On top of that, the granular usage data, coupled with direct communication with end-users allows to evaluate user satisfaction and to provide them with more personalized products and services.

Platform opportunities emerge when the accumulated data on a specific customer or user group becomes so insightful, that it is possible to develop related services for a second complementary customer or user group who wants to gain access to the prior. For instance, search engines or social media users generate profile data, which can service a group of advertisers who seek to target those specific users. Positive network externalities (also referred to as the network effect) arise meaning that a good or service becomes more valuable when more people use it [1]. The detailed information about user preferences itself offers a resource for new business opportunities. It is for that reason that data is something referred to as the new oil [2].

Ignited by the promising market opportunities, the number of big data platform initiatives are numerous. Many companies are looking for ways to ensure long-term access to big data. For this reason Monsanto, a large crop protection company, acquired The Climate Corporation, a digital agriculture company that examines weather, soil and field data for $930 million to "unlock new value for the farm through data science" [3]. Many other companies, either seeing great opportunities or fearing to be disrupted, want to follow suit and aim to develop their own platform. Yet, developing a big data platform is no easy ride, and there is no clearly set path to build a successful platform.

The objective of this paper is to describe the patterns and stages that can be distinguished studying the origin, history and development of current big data platforms, in order to provide a context and inspiration to (clusters of) companies and other institutions that consider or are in the process of developing a big data platform.

2 METHODOLOGY

In this study we combine industry & academic (grey) literature resources, including business case descriptions, with interviews held with founding team members of platform businesses, and our experiences in action research projects on big data platform development in Dutch agriculture [4-6]. In these public-private partnership research projects Wageningen University and Research acts as a knowledge broker providing both technical support on data exchange protocols *and* support on business model development and related governance issues.

We will use the product lifecycle perspective as an outline to describe the patterns and stages that can be distinguished studying the origin, history and development of current big data platforms, building on the business model lifecycle perspective on two-sided internet platforms of Muzellec et al. [7] and the preparation, spread, evolution (PSE) framework of Han & Cho [8].

The paper will be structured according to the original product lifecycle categories of Raymond Vernon [9]: "new product", "maturing product" and "standardized product". We argue that the ultimate form of a big data platform is not a simple question of choice, but the result of the intent of the owners of the platform on the one hand, and the experience that participants to the platform allow to be expanded on the core value of the platform on the other hand. Both factors shape the extent to which a platform can feasibly grow to in size, and scope. In the final section we will discuss the implications of historical development patterns and stages for current platform initiatives and elaborate on alternative roles and business models for companies and other institutions that want to engage in big data developments.

3 NEW PRODUCT – THE ORIGING OF BIG DATA PLATFORMS

Looking at the earliest phase of the lifecycles of today's big data platforms, two types of origins can be distinguished, namely 1) emerging platforms where a platform opportunity revealed, only after a product or service has gained traction with a single participant group, and 2) intentional platforms, where the outset was to involve two or more participants groups from the beginning.

3.1 Emerging Platforms

Many of today's platforms did not start-off as a platform but evolved to it after realizing that the user base, e.g. accumulated through a popular app, has potential for a platform function. When the platform's origin is a conventional pipeline business model with one user group or customer group, it means that another group should be 'seduced' to use the platform as well. Usually there is no imminent need for the first members of this peer group to join the platform; they can be contacted with the same ease through other channels. Yet, with a growing number of peer group members joining the platform it will evolve into a more important channel increasing the urge for other peer group members to join as well. Think how LinkedIn used its website as a professional profile formatting service, before it was useful as a professional networking service. (choosing focus on one vertical).

The case of Glooko: Initially Glooko was launched as a smartphone-based log of blood-sugar metrics for diabetics. Before, diabetics had to read out the glucose levels from their blood testing meters by hand. With Glooko this process is automated using a smart cable connecting the glucose meter and the smartphone. Glooko's first bet was that they could provide such a service via an app on the Apple App Store, and generate revenues from app sales, as well as from sales of the cable. Important part of this value proposition to diabetics was that the cable was device agnostic, enabling users to read out glucose data from a variety of device brands (at the time, each glucose meter had its own cables, and data-entry software). Once Glooko's launching business model gained traction with this early group of diabetics, it opened the gateway for platform opportunities, where Glooko went to look for ways for diabetics to share their data with their physicians. Ultimately, it was aiming to tap into the multi-billion dollar opportunity of the insurance market. However, none of these opportunities would be of any real value if Glooko wasn't able to onboard a substantial user base of diabetic patients with a self-standing service that helped them with the basics of managing their disease. Consequently, Glooko's next challenge was to have these diabetic patients migrate to connect with other users on the platform using the logbook functionality. The company had no way of saying that their customers would be willing to do that for certain, until they arrived at that point when they could test it.

3.2 Intentional Platforms

There are always two or more participant groups to a platform. But one of those participant groups is typically more essential, and also decidedly more difficult to attract to the platform than the other. Fishingbooker is an example of an intentional platform, which can only work when two parties are involved from the beginning. Our interview with co-founder of Fishingbooker.com, Nemanja Cerovac, for instance revealed how that platform had to deal with the challenge of connecting people who wanted to book fishing trips, and boat captains, who offer those trips.

There's no rule to either supplying, or demanding platform participants being the most critical to attract to the platform. This varies according to context and platforms. Also, the new roles that participants assume can be either accretive or depletive. For example, consumers and producers can swap roles in ways that generate value for the platform. Users can ride with Uber today and drive for it tomorrow; travelers can stay with Airbnb one night and serve as hosts for other , e.g. customers the next [10]. But spotting the most difficult party (side) to the platform can be done from the drawing board, Cerovac said. You can imagine being able to attract people who want to book fishing trips. But then to engage them with the platform, there would need to be a credible offering of boat captains on site who offer trips.

In Dutch agriculture we see that an intentional platform is formed by a farmer organization and agricultural cooperatives to facilitate farm data exchange and retain data ownership at the members of the cooperatives, i.e., the farmers [4]. Because most Dutch farmers already exchange data with (one or multiple) of these cooperatives, there is already a solid user base to start with.

3.3 Development of the platform's business model

In the earliest phase of a product lifecycle a business model, describing the underlying economic logic of how a business

can deliver value to its customers, has to become clear. The same is true for a platform, where a two-sided (or multi-sided) business model has to be defined. The biggest challenge of creating a platform, regardless of whether it is an emerging or an intentional platform, is to have appealing value propositions for (at least) two groups of users. The so-called chicken-or-egg problem [11] is a critical balancing act, where first a group of the most hard-to-retain group of users' needs to be convinced to use the platform. That group then needs to be suited with a matching engagement from their matching parties. Each increment in the prior, needs to be met with a proportional increment of the latter. This balancing act is handwork at first, Cerovac said. Fishingbooker onboarded its first fishermen through direct contact, even going so far as travelling to the Florida Keys, to have them sign up to the platform. Also Airbnb had initial problems to get a good matching because the pictures of accommodations of Airbnb listings were too bad to convince anyone to book these. Having professional photographers visit the hosts and make pictures turned out the solution. Also, to develop the market in France Airbnb sent out teams of people to organize parties, info sessions and other "on the ground" activities to convince people to list their accommodations on Airbnb [12].

3.4 The transition from push to pull

Platforms generally come to life, putting a lot of effort in serving a specific small user group of early adopters, before they can grow out to become the default of the market. The first users are brought onto the platform by an active value proposition push to on-boarding them. At a certain point, data, and/or users will be accrue in the business model, and can be used as a new productive resource, which enables a new value proposition to be created [13]. Google for instance, needed to collect enough users, and relevant data before it could provide a targeting service to advertisers. Typically the value proposition, e.g., the functionality of the platform, evolves over time, e.g. as new insights based on user behavior become available.

4 MATURING PRODUCT – THE GROWTH AND MONETIZATION OF BIG DATA PLATFORMS

After the "new product" phase, the platform concept has become visible and has proven to respond to the needs of the (two or more) participant groups. Now the challenge becomes to find a cost-effective way to grow the user base, and create revenue streams that are substantial enough to generate a profit.

4.1 Critical resource accumulation

In the maturing phase one can expect that competitors may want to copycat the concept. Therefore, the prerogative is to

find a sustainable basis for business growth, i.e., to accumulate critical resources by finding enough participants to expand the platform, and build its clout amongst internet users. Bringing on a critical user group to the platform increases the stickiness of the platform for others. Only after stickiness is nearly instituted will most successful platform owners think of harvesting value from it [14].

The case of Fishingbooker: "Growth is not an implicit consequence of a platform demonstrating its value, but of careful, and thoughtful engineering of a growth engine", as Nemanja Cerovac of Fishingbooker.com stated in his interview. In the case of Fishingbooker the challenge after successfully matching the first fishing boat captains with fishing tourists was to find more captains to sign onto the platform. Previously this was handwork, with cold-calling, and in-person visits. But in order to grow sustainably, this process needed to become more scalable. Naturally, Fishingbooker turned to online advertising, targeting fishing boat captains through Facebook. However they soon realized that their targeting, and call to action in the marketing message were not optimized yet, resulting in a cost per sign-on that was too high to sustainably grow the business. In response to this dilemma, the Fishingbooker team changed their focus to Mauritian fishing boat captains, as recreational fishing is also a big activity there, yet Facebook advertising there only costed a fraction of advertising in the United States. This move allowed the team to experiment with their advertising message, and optimize it for conversion to sales online. Once the message had been tested, and showed results, the team then opened the advertising to the United States again, but this time with result. It proved to be the basis for Fishingbooker's exponential growth, making it the current go-to booking site for fishing trips in the United States.

Like Fishingbooker, many other platforms have faced the challenge of finding a cost-effective growth engine. Notably Airbnb used the classifieds website Craigslist, as a growth channel, where Airbnb users could easily post their rental homes on a platform with a huge audience [12].

Emerging platforms may have the option to revert to their pipeline business model but intentional platforms that start from scratch building a user base face the risk that they never reach enough credibility for their offering. If they aren't able to crack the challenge of onboarding of their hardest customers up till a certain velocity, they will never be able to attract enough people from the other side of the market to that platform.

4.2 Sustainable revenue streams

Wessel et al. [14] argue that "digital companies should delay profitability for as long as they can". Because of the network effect "it will always be better to harvest value after further increasing the stickiness of the platform". Yet, only a limited

number of platforms receive sufficient funding from investors to actually fuel their growth, but under very specific conditions. Notably the taxi ride hailing app Uber has received a lot of funding to fuel its growth. The condition it met for this was that it had a great organic growth engine to attract drivers, and passengers, and service them with a profit [15], but that this model wouldn't easily spread to other geographies. Therefore it needed to be subsidized to achieve this, spending an estimated $1,55 on every $1 it makes [16]. Therefore Uber is applying a lot of investor money to settle in a region, and then get its regionally profitable business model implemented [17].

Most companies can't follow Uber's path because they have investor bases demanding profit maximization today. As for the cost-effective growth, this is a major hurdle for many platforms. Most have to bootstrap fund their growth engineering, and will either remain a niche or lose the business if they fail to attract enough funding. That's why companies look for ways to draw value from the platform thereby changing functionalities, introducing subscription fees or including advertisements. However, these changes are not without risks because they are frequently met with scorn from user groups, who dislike the change in user experience. Popular platforms like Twitter and Quora also face this delicate balancing act as they search for ways of generating revenue through the core value that they provide. The challenge (and danger) here is to not lose grip on the core utility, and user base in the process. Changes are constrained by where the users want or permit value creation to travel. Finding the right balance requires experimentation, e.g., agile development using minimum viable products [18], to find out what mix of participants, and platform services can be combined together to create or maintain an optimal platform experience. At the same time, frequently upgrading the platform's value proposition is essential as well. Otherwise users may defect to another platform e.g., with a more international scope, superior functionality or other appealing features. In the case of social networks, it may be wise for companies to have alternative platforms and communities because typically young people tend to defect a certain social network after a while, e.g., when their parents have joined the social network [19-20].

The case of Instagram: Instagram was initially a platform where users could share their photo's online with their followers. The attraction to users was the ability to apply various kinds of filters on photographs to give them extra effect. During the several years Instagram's user base has grown, it is increasingly being used for lifestyle marketing, to promote personal brands. This evolution towards marketing happened autonomously, driven by users themselves. This despite the fact that Instagram is not fully equipped as a marketing service. For instance, the use of URL's in comments, and in photo captions is prohibited, making it hard to convert traffic to other destinations.

There's no doubt that Instagram was a great hit to its users. With its launch in 2010, it grew to one million users in two months' time [21]. Yet the business model didn't have a solid revenue stream yet. To mediate this, Instagram has been working with different options for advertising revenues. A notorious move by the company to strengthen itself as an advertising platform was the change in the terms of service in 2012, In this change Instagram provided for some essential provisions to enable them take ownership of content provided to the platform, and to show advertisements in conjunction with users' content. This raised a big backlash from users [22]. As a consequence Instagram tweaked its policy, and didn't start with advertising until 2013 [23]. Currently even, it is still experimenting with new advertising products, like the most recent one for business accounts with which it is backtracking on some of the ways that leading accounts use the platform for online marketing [24].

5 STANDARDIZED PRODUCT – ALL SET FOR FURTHER EXPANSION BY FANNING OUT OVER MULTIPLE INDUSTRY VERTICALS

Once a company has tackled the complexity of offering a platform at scale, effectively captured an interaction between participants and firmly established stickiness to the platform, the quest then turns to applying the resources that are accruing to the business model (user bases, data, infrastructure) to fan out over multiple industry verticals. This may take the form of expanding to new markets, or fulfilling a new role in the market. Even at this late stage, the right step to expansion is still found through business experimentation [25]. Eisenmann et al. [26] refer to the "fanning out" phenomenon as platform envelopment: entering another platform market combining its own functionality with that of the target market in a multi-platform bundle. For instance, Microsoft used its dominant position with Windows operating system to promote Windows Media player in the same bundle thus attacking the till then dominant streaming media platform of RealNetworks (Real) and Google used its dominant position as a search portal to launch Google Shopping thereby attacking the price comparison and market outlet services by platforms such as Ebay and Amazon.

At a subsequent stage you can typically observe that the earnings from offering web services (e.g. infrastructure and access to user bases) to affiliated companies and developers are becoming a more vital element of the big data platform business model than the revenues from actually selling own commodities on the platform. Industry experts are hypothesizing that this is the final status in development of the company, where it focusses on being the fertile landscape on which other ventures can grow. Thompson [27] expresses the evolution that is taking place at Amazon as follows:

"Amazon may have started as *The Everything Store* but its future is to be a tax collector for a whole host of industries that benefit from the economies of scale, and AWS (Amazon Web Services) is the model."

Uber is progressing along the same line of development as Amazon. The algorithm used to connect drives, and passengers can potentially be used for a whole range of other services. Starting with a specialized offering of offering taxi rides, the company is experimenting [28] with other logistics applications like food delivery (UberEATS), and local parcel delivery (UberRUSH), which potentially hold more revenue for the company.

The case of Amazon: News of Amazon's acquisition of food retailer Whole Foods made headlines for 2017 [29]. For many in the food industry this came as a revelation. But when one looks at Amazon's track-record with spreading over different industry verticals, the acquisition is part of how the business intends to develop over the coming time. Amazon's approach to industry has been systematic, and backed by solid business experimentation rigor. Starting off as an online bookstore in 1995, Amazon built a company model that is able to continuously try-out new propositions, and test new business models, whilst executing on existing successes. Upon founding the company, Amazon immediately took off on the market. It provided its users an experience of huge selection of book title to choose from. Through loopholes in the procurement system of large book wholesalers, which would still ship small volumes of books if they were part of large orders of books that were out of stock, Amazon was able to keep inventory costs low, and still offer a wide variety of choice to its customers. The company was such a hit, that after launch, it only took Amazon 2 months to make sales from all states of the United States, as well as 45 other countries. Early growth was realized by listings on search engines like Yahoo, and Netscape, citing Amazon as a great resource on the tips these sites used to suggest to its user on their landing pages. Also Amazon built affiliate programs as early as 1996, where people who shared their reviews of books online, could offer an Amazon link to their readership, where they could buy the book. Affiliates were then offered a commission on those sales. These measures, along with a host of other features that boosted customer conversion to sales, and retention to the platform, generated Amazon's sticky growth engine. The platform grew to a million served customers in 27 months, and became the United States' 3rd largest book seller by 1998 [30]. From 1998 onward, Amazon went into sales of a broader range of products, starting with music, but also adding categories like toys, garden furniture, and apparel over the subsequent years. With every step in expanding their product range, they also were attracting a broader range of participants to the platform (even opening the platform to 3rd party resellers in 2000), and deepening the development of its technology, and data infrastructure. This progression

as a platform has enabled Amazon to take a different look at its technology resources. Amazon has the data and the infrastructure to develop new offerings for a wide variety of different markets. This technology infrastructure comes at a very high fixed cost, and is only economically feasible at scale, which keeps competitors from duplicating this model. But the technology infrastructure has become so extensive that it can support other business to run on it as well. Amazon discovered this ability when it was working with larger 3rd party vendors like Target, and Marks & Spencer's online efforts. It even contributed to a more optimal utilization of resources [31]. This realization gave birth to Amazon Web Services, which is an operating system to the internet for other developers.

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6 DISCUSSION AND OUTLOOK

Above we have described the patterns and stages of development of big data platforms. The product lifecycle categories of Vernon (1966) offered an adequate structure to discuss the development paths of the big data platforms we have today. But what does this mean for organizations that are now looking for opportunities to start building a big data platform? Is this still feasible or has the world market been divided by the large corporations such as Amazon, Google and Facebook who are very keen not to lose their dominant positions and make sure to take over the companies that may become a threat to them such as WhatsApp, Instagram, YouTube, etc. And what if you do not want or cannot generate the resources to build your own platform but still want to benefit from the large market opportunities of big data. What alternative business models are available?

6.1 Does the winner take all?

Today we see big data platforms highly dominating certain markets: Alibaba accounts for over 75% of Chinese e-commerce transactions, Google accounts for 82% of mobile operating systems and 94% of mobile search, and Facebook is the world's dominant social platform [10]. It is obvious that those companies have a strong position but there will always be room for new entrants, especially when those new entrants manage to develop a distinctive value proposition and generate or collect enough funds to build market share. Back in 2007 the five major mobile-phone manufacturers—Nokia, Samsung, Motorola, Sony Ericsson, and LG—collectively controlled 90% of the industry's global profits. Nokia and the others had classic strategic advantages that should have protected them: strong product differentiation, trusted brands, leading operating systems, excellent logistics, protective regulation, huge R&D budgets, and massive scale. For the most part, those firms looked stable, profitable, and well entrenched. Yet, in 2015 Apple's iPhone singlehandedly generated 92% of global profits, while all but one of the former incumbents made no profit at all (Van Alstyne et al., 2016). Airbnb also started as a small company at a time that Craigslist was the dominant website for

offering private accommodations for rent. However, Airbnb managed to become the dominant platform for booking accommodations via the development of a stronger value proposition by avoiding the scam on Craigslist and arranging high-quality pictures, and by 'wickedly' piggy-backing [11] Craigslist's user base [12]. By doing this Airbnb unbundled the multi-purpose portal of Craigslist. A similar unbundling happened with AOL that offered clients a large bundle of services from dialup to all the information services that you use, all in one thing. Yahoo came along and unbundled all the content from the access. And then one of the features of Yahoo was search, Google came along and unbundled search. The fanning out on industry verticals and above examples show that bundling and unbundling of products and services is a continuous process, often facilitated by underlying technology change but always directed towards increasing customer value [32].

Incumbents from more traditional industries are also waking to the need for business model innovation, and experimenting with new ways to better service their customers. Recently Disney announced that it will be starting its own, dedicated movie streaming service, and is going to pull distribution licenses to other services, like Amazon, and Netflix by 2019 [33]. This business model innovation implies significant changes to competitive balances, as Disney movies, including big titles like Star Wars, and Toy Story, tend to draw large numbers of viewers. In the same way, the recent Whole Foods acquisition by Amazon, is also likely to provoke changes with incumbents, suggesting that the battle for supermarket retail has stepped up pace, and is not decided as of yet.

Another reason to believe that there will remain room for new entrants is the fact that ancient transaction costs theories [34] will also remain valid in this 'new economy' (although equilibria may shift considerably). Sure, positive network externalities exist meaning that a good or service becomes more valuable when more people use it [1]. This will fuel the emergence of large, international corporations with gigantic user bases and various industry verticals in different parts of society. Yet, these conglomerates will also face diminishing returns to management and thus increased costs of organizing a large firm, particularly in large firms with many different plants and differing internal transactions (such as a conglomerate). This is especially true when frequent innovations are essential to prevent users (producers, consumers, developers) from defecting to other platforms, making the conglomerates vulnerable to disruption.

Moreover competition authorities and societal resistance will limit the growth of conglomerates. Stickiness of a platform can also become too extreme when denying proper access to or listing of third parties prevents those parties from having fair competition. Platforms thrive on new ways of connecting participants, enabling them to share information, and organize business exchanges. Often these

ways of working are so novel that the legal implications of the platforms business mode are not clear yet during the earlier stages of the platform. But eventually as platform growth pushes on, and as it starts fanning out to different verticals, legal frictions start to become apparent. An increasing amount of lawsuits of competition authorities result in high penalties for platforms allegedly abusing their dominant position.

The European Union recently has fined Google a record-breaking €2.42 billion for antitrust violations pertaining to its Google's Shopping search comparison service [35]. In The Netherlands, law suits were held by real estate brokers to get access to and a proper listing on the dominant portal Funda.nl [36]. Uber's business model thrives on independent drivers as customers to its platform, not as employees. But recent labor lawsuits indicate that Uber has a significant employer responsibility towards their drivers, which would make its business model significantly less scalable than it currently is. Other legal liabilities, like Uber's infringement of local taxi transport regulations, would jointly have such a large exposure, that it exceeds Uber's valuation, and cash at hand [37]. The same goes for Amazon as it will face scrutiny from competition authorities following acquisitions like Whole Foods. Airbnb is another platform that has faced legal challenges, notably regarding city taxes. As the platform grew, it was able to do so without being noticed much by the city authorities. But as the platform grew, and existing hospitality services started pointing to the unfair advantage, Airbnb was faced with tax compliancy, and a significant administrative burden, and friction to the platform's growth. This uncertainty to growth comes at time, that Airbnb is also looking for new directions in which to expand the platform into the travel industry [38].

6.2 Other business models
What other business models exist if you do not want or cannot generate the resources to build your own platform but still want to benefit from the large market opportunities of big data? Chen et al. [39] describe a chain of big data applications that can form the starting point to develop alternative business models besides offering a platform. Kempenaar et al. [40] have summarized their chain in six chain stages. Business models can be developed around products and services on data capturing, data storage, data transfer, data transformation, data analytics and data marketing. It would take another paper to elaborate on all these models individually but it is clear that the market opportunities from big data platforms will also boost new market opportunities in other parts of the data chain, ranging from more requests for sensor companies to capture data to more trusted advisors who can filter, combine, analyze, and interpret big data flows to come up with relevant information to support specific customers. Such a trusted personal advisor would then no longer be exclusively for the very

wealthy people on our planet but thanks to big data could become available to everyone everywhere [41-42].

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