Big Digital Platforms: Growth, Impact, and Challenges

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In recent years, we have witnessed the rise of the platform economy. The world's most valuable public companies are five American technology firms: Microsoft, Amazon, Apple, Alphabet (Google), and Facebook. These companies are closely followed by Chinese tech giants such as Alibaba, Tencent, Baidu, and Xiaomi and many more US-based internet companies such as Netflix, eBay, Uber, Salesforce, and Airbnb. Most of these organizations are young (Apple and Microsoft being the adolescents) and were able to grow extremely fast due to the digital platforms they provide. The most common types of platforms are *transaction platforms* that match supply and demand (e.g., Amazon, Alibaba, Airbnb, Uber, and Baidu). Other examples are *technology platforms* that provide a technical infrastructure that other people can build upon (e.g., Microsoft's software platform and the App stores of Google and Apple). These digital platforms radical changed the way we work, do business, socialize, learn, move, produce, etc. Such platforms can be found in any domain, ranging from learning (e.g., Coursera, EdX, Udacity, and FutureLearn) to smart homes (e.g., Amazon Alexa, Apple Homekit, Google Assistant, Philips Hue, and Samsung SmartThings). The rise of these digital platforms is highly relevant for BISE (Business & Information Systems Engineering) authors and readers, because they combine new business models with technological innovations (e.g., machine learning).

The winner takes it all

For sure, large-scale digital platforms make our lives easier [6,8,10]. Products and services are delivered faster and cheaper. These platforms also made it easier to connect people and businesses. Uber is connecting drivers and passengers that would otherwise never find each other. We find information that we would have never found thanks to Google. We may establish valuable connections through LinkedIn. We are able to buy almost anything using Amazon at a lower price and in a more convenient manner. Amazon Marketplace enables third-party sellers to sell products alongside Amazon's regular offerings. Imagine that there would be 50 competing Ubers, Googles, LinkedIns, and Amazons, all covering different segments of the internet, professions, or product types. This would lead to inefficiencies and frustration. Therefore, as a consumer, we tend to benefit from these big digital platforms.

Successful platforms have the characteristic that they grow very fast and in the end, often one winner remains. After a platform becomes the market leader, it is very difficult to compete for organizations that started later. IBM is still dominating the computer mainframe market after 60 years. Intel and Microsoft are still dominating the processor market and the software market for personal computers. It seems that Google, Amazon, and Facebook will dominate, respectively, search, shopping, and social media in the years to come. A rule of thumb is that successful platforms can be "eclipsed" but not "displaced" [1,2]. For example, Kodak had a market share of 85% in camera sales and 90% in film sales. It was not the direct competition, but the shift to digital that caused the decline of Kodak. The traditional camera business was eclipsed by digital cameras which in turn were eclipsed by smartphones.

Why do successful platforms evolve into monopolistic platforms where the winner takes it all? There are several reasons for this [9,10]. First of all, the traditional economy of scale applies. Digital products and services tend to require huge fixed costs and low marginal costs. For example, developing machine-learning techniques that scale may be very costly. However, applying the learned model to a new batch of customers is cheap. Note that the marginal transaction costs for Airbnb and

Uber are close to zero. If there are losses, these are caused by fixed costs. Second, there are often so-called "network effects". The more people or organizations join, the more valuable the platform becomes. If only one of your friends is on Facebook, it is less valuable than when almost all of your friends are on Facebook. When Airbnb offers just one room in Amsterdam, it is less valuable than when thousands of rooms are offered. Also, machine learning techniques work better when there are more data. Hence, as the platform usage increases, automatically the quality of the platform increases. Next to these network effects, technology companies use a range of approaches to lock-in users and avoid lowering switching costs.

Data protection is just one element

The success of the big digital platforms triggered quite some concerns. The EU General Data Protection Regulation (GDPR) is the most important change in data privacy regulation in 20 years and was triggered by concerns about the rise of the big digital platforms. Mark Zuckerberg, the chief executive of Facebook, was scrutinized by members of the European Parliament because of privacy breaches in May 2018. For a long time, the leading American technology firms were not hindered by regulators and politicians. However, this changed recently. President Trump recently accused Facebook, Google, and even his preferred communications outlet, Twitter, of a bias against conservative opinions. This fueled antitrust investigations of Facebook, Google, Apple, and Amazon. Hence, big digital platforms have been put under scrutiny for very different reasons [3,4]. Some of these arguments against big digital platform are rather artificial. However, there are clear negative side-effects.

Figure 1 highlights four potential problems caused by successful digital platforms. First of all, there is the problem that competition becomes difficult after there is a clear market leader ("the winner takes it all") and dominance may stifle innovation. Second, the platform may collect lots of confidential data. For example, the Facebook - Cambridge Analytica data scandal in 2018 revealed that the personal data of millions of people's Facebook profiles were used for political advertising purposes. There are also more subtle uses of user data by the platform, e.g., recommending things your friends buy. It is often not so clear where the ethical and legal boundaries are. The third problem shown in Figure 1 is a possible bias in the rankings created by the platform. This may range from filtering out certain opinions (e.g., for political purposes) to ranking products in an unfair manner. In such cases algorithm are manipulated to provide a different outcome, giving advantage to a third party (possibly being the platform itself). For example, Google was accused of promoting its own comparison shopping service in search results. Amazon is both a digital platform and a supplier of products (smartphones, televisions, speakers, TV-series, diapers, etc.), automatically leading to conflicting interests. The fourth problem is that large digital platforms tend to integrate the market horizontally, sometimes even vertically, using their user base as an asset. Moreover, the revenue generated by a dominant platform may be used to subsidize expansion in other sectors. For example, Google is using their profits from search engine marketing to invest in many other services and products. As a result, competition in upcoming markets is difficult.
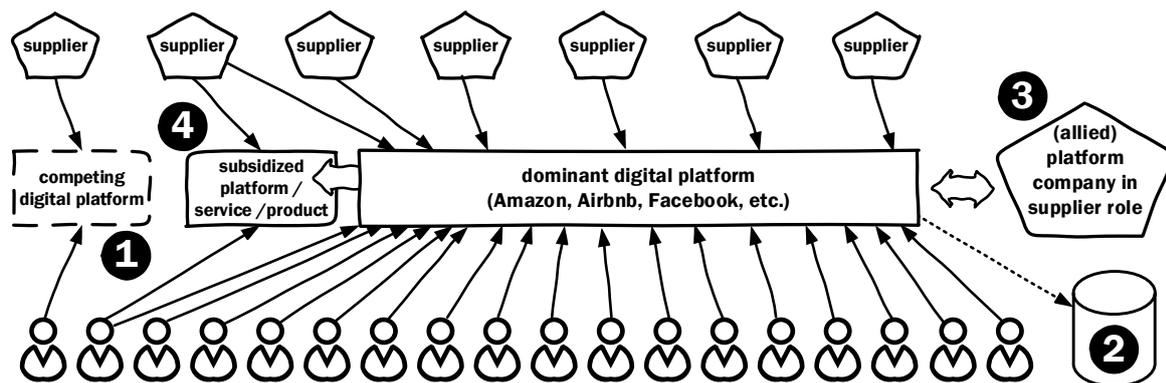
Figure 1: Four possible problems of big digital platforms: (1) no real competition is possible because of the scale needed, (2) confidential data is being collected and used to get competitive advantages or additional revenue, (3) the platform may be biased (e.g., because the supplier role and platform role are combined), and (4) the revenue and user base generated by the dominant platform are used to expand horizontally or vertically.

The focus in Europe seems to be on the second problem in Figure 1 (i.e., privacy and confidentiality). The GDPR is a prime example of this. However, one could argue that complex regulations such as the GDPR are only strengthening the positions of large tech companies (that have strong legal support and ways of handling advanced technological challenges). Moreover, is privacy the biggest problem we are facing? The search-engine market-share of Google is estimated to be 92.6% (July 2019). The second search engine (Bing) has only 2.5%. Amazon is selling 84% of all e-books purchased [4]. However, companies are allowed to have such complete market dominance according to the current interpretations of antitrust laws in most countries. The dominance of a platform in one sector may also jeopardize competition also in other sectors (fourth problem in Figure 1). Hence, a monopoly in one sector can easily lead to additional monopolies in other sectors.

Transportation as a platform

The significance of digital platforms is underestimated because they appear to be virtual ("in the cloud"). However, these platforms are not only influencing the digital world. For example, retail shops in city centers are struggling to survive. The platform economy will increasingly impact the physical world. For example, we anticipate that platforms will increasingly impact transportation and the use of public spaces. Autonomous self-driving cars may exist only in a transitional phase. To best use the scarce space, autonomy may be counterproductive (autonomous self-driving cars driving a different speeds all looking for parking spots in a city will not solve the challenges cities are facing). Roads could become part of a digital platform with standard interfaces and services. Platform companies could bid to be able to manage all the roads in a particular city or region. This is comparable to today's 5G spectrum auctions where companies can bid for frequencies. For example, in June 2018, the 5G auction in Germany raised €6.6 billion from four telecom operators. Frequencies can be compared to roads and other public spaces, and may be auctioned in the future. Viewing the roads as a digital platform would allow for a much better use of public space (matching supply and demand and optimizing the throughput) and a range of new services. However, such developments will also trigger a range of questions, both of a technological and a regulatory nature.

Relevance for BISE

The uptake of big digital platforms is changing the way we analyze, design, implement, and manage information systems. Hence, this is highly relevant for the BISE audience, but only a few publications exist on the topic [5]. Moreover, digital platforms based on network effects are difficult to replicate, e.g. in a laboratory. This makes it difficult to explore features or mechanisms that are not already implemented by the platforms. It is even difficult to conduct surveys based solely on hypothetical questions and intentions without framing the participants. An opportunity may be provided by open data. For example, in [8] the authors state that "data-driven" approaches can inform research on digital platforms due to the increasing availability of openly accessible data. Forcing organizations to provide anonymized open data, may help to address the negative side effects mentioned.

It is also interesting to see the role platforms play in our research. We store our code on GitHub or SourceForge and publish our papers via the platforms of Springer and Elsevier. For machine learning, we build upon ecosystems such as Python (with libraries such as Scikit-Learn), R, RapidMiner, Knime, and TensorFlow. However, these very different from the transaction-oriented digital platforms mentioned before (Amazon, Alibaba, Airbnb, Uber, and Baidu). Also, Google, Amazon, Apple, and Facebook are heavily investing in machine learning (in particular deep learning). They do this because of the importance of machine learning for the effectiveness of their platforms. However, by grazing away talent from universities, they may also threaten the training of the next generation of academics [7]. This shows that the impact of big digital platforms is multifaceted and cannot be left to politicians. Hence, we encourage BISE researchers to actively engage in debates on the boundaries of these platforms.

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