Assignment 2

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Facebook - From Webpage to an Information Infrastructure

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Abstract

Facebook has since its inception been a place for people to communicate in different ways. Throughout its development, Facebook has undergone massive changes, and have become most people's primary source for news, advertisement and publicity. Through our analysis, we draw upon established concepts within information infrastructure theory to show how a single, standalone web service can evolve into a generative infrastructure, focusing on third-party development.

Contents

1 Introduction

In this paper we attempt to do a systematic analysis of the evolution of Facebook as an infrastructure for third-party developers, as well as discussing how information infrastructure (II) theory coheres with the structure of the Facebook ecology. In just a few years, Facebook moved from being a small, localised website into becoming the biggest social network on the Internet. We will try to point at the different phases of Facebook that supported this evolution, as well as how Facebook's own strategy and governance backed this development. Following this we want to investigate how different characteristics of Facebook support third-party development, and what makes it an attractive infrastructure.

We will briefly explain the history of Facebook, its structure and the status quo. From this we can define core concepts in our analysis, before giving a thorough explanation of how the service has grown into an infrastructure. This includes the growth of an enormous user base as well as evolving through several stages of integration with third-party development. We will discuss how this evolution has resulted in an infrastructure that supports innovation and development, and what characteristics the infrastructure has.

Lastly, we will take a closer look at the architecture and the process strategies that resulted in a highly generative infrastructure that supports future innovation.

1.2 Method

Our paper is based on a literature review, drawing upon established concepts and frameworks within the research field of information systems and IIs. In order to bring in the perspective of third-party developers, we conducted an interview with a person working in a Norwegian start-up that has been using Facebook as a central component in their software. This has allowed us to see how their experience matches the theoretical framework derived from II theory.

2 Facebook as an II

Before starting our analysis, it is important to state how Facebook's characteristics match those of an II. Our definition of an II is based on the definition presented by Hanseth & Lyytinen (2010): *"a shared, open (and unbounded), heterogeneous and evolving socio-technical system (which we call installed base) consisting of a set of IT capabilities and their user, operations and design communities."* In the following table we present a summary of how Facebook in its current state matches the definition of II, as it has not always been an II. Our paper will focus on illustrating the evolution, and how Facebook at different points in time gained different characteristics from II theory.

Characteristic	**The case of Facebook**
Shared	Highly shared by an enormous user community with different sets of work processes. Also shared by other communities, such as third-party organisations.
Open	The information on Facebook is open for other organisations to use - anyone can develop *on* Facebook. However, Facebook is today not open to develop *within*.
Heterogeneous	Facebook consists of a large number of components of different nature, both technical and human (people, governance bodies, communities etc.)
Evolving	Because of its openness and generativity, Facebook has evolved from a simple web page to a platform to an information infrastructure. It still continues to evolve incrementally.
Socio-technical system	The heterogeneous number of components interacts in unpredictable ways, encompassing human, technical and organisational factors. This includes Facebook employees, third-party developers, users, standardization bodies and national and international law makers to name a few.
Installed base	Facebook is built upon a large installed base consisting of different user communities, technologies, operations, design communities, and other actants.

Table 1: Summary of how Facebook fits with Hanseth and Lyytinen's (2010) definition of information infrastructures.

3 The evolution of Facebook

Facebook saw the light of day at Harvard University in year 2004. The site was originally created as an online and more feature rich edition of the Harvard houses' paper based face books, focusing on the Harvard campus only (Facebook, 2015). In many ways, the students, paper artefacts and institutional structures can be considered as Facebook's initial installed base, as they did not per se start from scratch, but rather added a digitised component onto the existing social structure (Hanseth, 2015a). The site was widely popular at the campus, and it didn't take long before it was adapted to other colleges and universities in the Boston area, soon followed by all major colleges in the US. As the number of users was increasing, and popularity and demand rocketed, they opened up the site for the public in 2006, allowing anyone above 13 years with a valid e-mail account to create a profile (Facebook, 2015).

Figure 1: The initial Facebook site

Throughout its evolution as a public social network, Facebook has seen an enormous growth, both in number of users as well as complexity, making it a highly socio-technical system. Regardless, it keeps its position as the largest social network on the Internet, with a current number of 1.44 billion active monthly users (Facebook, 2015). It can be argued that the enormous user base has created an attractor (Hanseth & Lyytinen, 2010) for both user adoption and innovation from third-party developers.

In this report we will study Facebook as a social media platform, and how it over time has transcended into an II. A platform can be defined as *"building blocks [...] that act as a foundation upon which an array of firms [...] can develop complementary products, technologies or services."* (Gawer, 2009). Even though this definition describes a physical platform and lacks the material advantages of digitisation, we find that it is still relevant. As mentioned earlier, our definition of an II is based on the definition presented by Hanseth & Lyytinen (2010). The two definitions has similarities in terms of having the capability of supporting innovation and development, but differ in terms of simply being built *upon*, contra an *evolving* socio-technical system. As Facebook has grown in size and complexity, which we will go into further detail later on, it is no longer simply a lone standing service or platform to be built upon. We have chosen a particular focus on how it enables third-party actors to participate in the ecology as a highly generative infrastructure and emergent *de facto* standard for login and user information in many Internet applications.

In our attempt to cohere II theory attributes into the Facebook ecology, we will use a chronological and systematic approach for analysing the evolution of the II, derived from Nylén, Arvidsson, Holmström & Yoo (2015). Through evolutionary theory and a longitudinal content analysis Nylén et al. divides the evolution of Facebook into three distinct phases undergoing two major transitions. The states are defined as (1) *interaction* (years 2004-2007), (2) *integration* (years 2007-2010) and (3) *interconnection* (2010 - present). The study clearly illustrates the shift from being a pure service provider, through integrating and hosting third-party applications (Facebook Platform API), to status quo focusing on loose coupling and reduced complexity in terms of third-party integration (Open Graph API). We will not go into further detail around the use of evolutionary theory to describe the evolution of Facebook, but use the three phases as a framework for our analysis.

3.1 Interaction

In the early days of Facebook, there was not much that resembles either an infrastructure or a platform, as it was a closed, standalone web service. According to Nylén et. al (2015) the initial development focus was to implement features supporting user *interaction*, and to make sure they were tightly connected through the service. This focus was an essential part in building a service that supported both user behaviour and goals, and providing added value for the users. This resulted in the establishment of cornerstone metaphors like *profile* and *friends*. They eventually added *Wall* and *Groups,* two concepts derived from the needs of the small user community they had.

3.1.1 Bootstrapping and adaptability problems

As the number of users grows, the network starts to grow by itself, bootstrapping, as more users will enrol because of the already existing users and so on. An advantage of Facebook's solution was that it was free for the users to join the network, and therefore easier to attract users while the number of users was low. In addition it was useful even without the possibility to communicate with others. The establishment of the cornerstone concepts can be seen as a strategy to cope with *the bootstrapping problem*. This is a situation where the designers of an infrastructure have to address the needs of the very first users, before addressing the completeness of their designs (Hanseth & Lyytinen, 2010). Hanseth and Lyytinen describe three design principles for handling the bootstrap problem, and how to address these:

1. Design initially for direct usefulness.
2. Build upon existing installed base.
3. Expand installed base by persuasive tactics to gain momentum.

One of the design rules under principle number one is that you should target the IT capability to a small user group. Facebook's first target group was Harvard students, not users from all over the world as it is today. Facebook was also built upon an installed base of the existing practices and users of the paper versions. Regarding principle number three you should grow the user base before adding more functionality which is also in line with Facebook's development.

It's clear that the focus at this phase was not to create an infrastructural flexibility in the technical and social adaptation, what we call the *adaptability problem* (Edwards, Jackson, Bowker & Knobel, 2007). We will touch upon how adaptability problems have affected Facebook's evolution and integration towards third-party developers in the chapter *Adoption*.

At the current time, Facebook lacked the array of attributes defining it as an II, as it to a very limited extent could be considered as heterogeneous or evolving. Nevertheless, the focus on tight interaction and communication between users clearly made the service *“[..] shared by the members of a community, [...], users and staff”* (Hanseth & Bygstad, 2015). As mentioned earlier, the community was initially centred around colleges, and eventually high schools. This resulted in rapid growth, requiring more staff, and eventually funding from investors, which increased the complexity and sharedness of the service as a whole. When they opened up to the public, they also took their first steps towards being *open*, in terms of having *“[...] no limit on the number of users,”* (Hanseth & Bygstad, 2015) even though they were not open in a wider sense, i.e. allowing third-party development or integration towards the service.

3.2 Integration

3.2.1 Facebook platform API

The focus of the second phase of evolution was to assure that their large user base now would spend more time using Facebook (Nylén et al., 2015). This was done by adding more internal modules, such as Ads and Pages, and opened up the possibility of third-party actors to connect to the platform. The most important addition to Facebook at this time was therefore the deployment of the Facebook Platform API (FPA). The API allowed for third-party companies to develop apps that could be closely integrated with Facebook (Nylén et al., 2015), thus increasing the usage of Facebook. The API also opened for beneficial connections with these third-party companies, both in the sense of higher revenue (e.g. ads sold) and more users added to the platform. Nylén et al. (2015) also mentions that this integration-pattern increases the functional variety of Facebook, which enables a wider range of use cases.

3.2.2 The increasing installed base

Although the deployment of FPA had numerous positive consequences for Facebook, there were also consequences that possibly did more harm than good. These consequences were mainly potential effects of increased complexity in the infrastructure. Only six months after the launch of FPA, 7000 third-party applications were integrated onto the platform (Nylén et al., 2015). The applications were incorporated onto the existing Facebook platform, thereby increasing the number of components.

As mentioned earlier, information infrastructures consist of a heterogeneous socio-technical system. This heterogeneity is mainly a result of many different components acting together as a whole. When more components are integrated onto the installed base, the complexity of the installed base increases. Hence, the FPA-add-on increased the number of actors. This may result in more unpredictable interactions in the socio-technical system. The integrative strategy will therefore result in an even more complex system than in the initial phase of development, partly due to the increased number of heterogeneous actors.

3.2.3 Openness and consequences

The increasing number of heterogeneous actors may come as a result of the high degree of openness in the infrastructure. The deployment of the Facebook Platform API, resulted in a more *open* infrastructure with fewer limitations on the number of actors. This is positive, especially in concern to effects for further innovation of new solutions and forming a better system. However, the openness also has some back covers. When allowing third-party companies to be integrated as a part of the platform, Facebook will also automatically make themselves more vulnerable. Nylén et. al (2015) mentions that *"Integration enabled by FPA did also cause co-evolutionary tensions as it opened up for Trojans and spam"*, which is one example of the increased vulnerability.

3.2.4 Complexity in the integration phase

*"Complexity can be defined as the number of types of components*the number of types of links*the speed of change"* (Hanseth, 2015a), hence increasing the unpredictability of interactions within infrastructures (Hanseth, 2015b). At the integration-phase in Facebook's history, there are multiple factors that affect the complexity of the infrastructure.

There are particularly three areas that are important for investigating Facebook's complexity, namely the high amount of users, the high amount of connected components and the speed of change.

Users

First of all, Facebook has since the first phase had a very large user base. This large amount of users may have different consequences for the infrastructure. One technological consequence is that there will be a continuously larger demand for server-side resources in Facebook's systems. Another consequence is heterogeneity, a large variety of users and use practices. Different users are using Facebook for very different reasons; to communicate with friends or colleagues, manage work-related documents, selling stuff or to forward scam and viruses.

Connected components

Secondly, the large amount of third-party companies connected may also affect the complexity of Facebook as an infrastructure. The heterogeneity mentioned above also holds for third-party companies - they all have different reasons to make use of Facebook in their business. Ola Henfridsson and Bendik Bygstad (2013) have observed that the multitude of actors in digital infrastructures simultaneously enact their own goals. This is also the case when Facebook decided to open for third-party app-integration. The variety in usage goals between the companies results in a lot of different uses of Facebook. It is difficult to predict what may happen when the users' different goals interact. Another consequence of the integrated approach is that Facebook loses control over what happens when third-party companies for example is allowed to post on users Walls. Ciborra (referred in Henfridsson & Bygstad, 2013) points to the challenges of controlling a multitude of systems and technologies when more actors are involved, which also applies in the case of Facebook. All the new actors in this phase, such as third-party organisations, are increasing the infrastructural complexity - partially due to their contradictory goals in the system.

Third, in the integration phase, more internal Facebook-modules were added - such as Ads, Pages, Video, Marketplace. These modules may be interconnected to other third-party modules, making the architecture more complex and interconnected at this point in the history of Facebook. The network-like interconnectedness results in a strong coupling between third-party modules and Facebook's own modules. If one of these interdependent modules brakes down, there is a higher possibility of repercussions throughout the infrastructure. This makes it difficult to predict the effects of the interactions between components.

Speed of change

Finally, the speed of change of the Facebook platform is also an important aspect here. As mentioned earlier; 7000 third-party apps was launched in six months, a lot of new Facebook-owned modules were added (e.g. Ads, Pages), and the user base was steadily growing. It is important that the change of infrastructures is handled by an evolutionary cultivational strategy and not a fast-moving and more revolutionary approach.

During the integration phase, Facebook became more open, heterogeneous and shared, and thereby fit better into the definition of II.

3.3 Interconnection

3.3.1 Open Graph API

Facebook launched their Open Graph API in 2010. This API is a part of the Facebook Platform, and allows developers to write and read data from Facebook. Through this API any app or website can connect to Facebook, and get access to information about users, their relations, pages etc. (Facebook Platform, 2015). This standardized way of communication made it possible for anyone to use Facebook as a part of their application, without having to be an integrated part of Facebook.

Some of the services that we will highlight in our project is the authentication component and the Open Graph API's ability to provide user information. Facebook has evolved to be a register of people from all over the world, which can be used by third-party organizations to retrieve user information. This information together with Facebook's login solution can be used to verify a user's identity in solutions without high security requirements. As a user you can allow information sharing between Facebook and other applications. As a result of this data sharing the user does not have to type in the same identifying information (Facebook Platform, 2015), or make a new user profile every time he wants to access a new third-party solution. This is today being used by for example digital newspapers.

3.3.2 Implications of the Open Graph API

The launch of the Open Graph API and the new services can be seen as an event that made the infrastructure more open (Hanseth & Lyytinen, 2010) as it made it easier to connect new IT-capabilities and user groups to the existing solution. Anyone can develop *on* the Facebook platform. On the other hand, Facebook is still not completely open as it is not possible for everyone to develop *within* Facebook. As a result of the increased openness, the II became more shared (Hanseth & Lyytinen, 2010) as it could be used by more actors. There is no longer a defined user group, area of use or development organization, as it was in the beginning when it was only used at Harvard. *"The openness implies that during their lifetime the social and technical diversity and heterogeneity of IIs will increase"* (Edwards et al., 2007). In addition to new third-party applications with their users and operators, this heterogeneity may also include new standardization organizations, laws etc. This will be mentioned under *Legislation*.

3.3.4 Complexity in the interconnection phase

Facebook can be seen as the core of an ecosystem of third-party solutions. To discuss the complexity we will first separate Facebook in itself from the ecosystem, before looking at the ecosystem. An advantage of the API is that the number of and types of links between Facebook and the applications decreases, as the coupling does not have to go both ways. In regard to the definition of complexity as stated by Hanseth (2015a), the decreasing number of links between Facebook and third-party applications may have resulted in a less complex infrastructure. It is also possible to say that this distinction between third-party solutions and Facebook, where they are no longer part of the solution, has resulted in a "barrier" where the increase in diversity of actors no longer affects the complexity directly as the connection does not go both ways. On the other hand it is also possible to say that the complexity in the ecosystem of applications is growing. The API makes it easier to for new types of applications to connect to Facebook, and results in a great variety of usage.

4 A third-party organization using Facebook

As part of our investigation of Facebook as a service for third-party development, we interviewed a developer who works for a company (from now called company X) that operate in the digital marketplace sector. He works mainly as a backend developer, and he had responsibility for connecting the solution to social media at an earlier stage of the development. Company X use services from the Facebook Platform in their mobile application. In addition to their own application, they have several connected groups on Facebook. They use the Open Graph API to retrieve and write information to this group.

The developer describes their main reason to use Facebook as this (translated from Norwegian):

> *"Facebook is very large and attractive. A lot of users. It's natural for people to use Facebook for everything they want to do in their everyday life. We thought that the more of our stuff that happens at Facebook, the more people will use it. Because they are in an environment they know."*

This is in line with the view of Facebook as an attractor for user adoption.

In addition to their group Company X also uses Facebook's authentication component. The users can choose between creating a user account or log in with Facebook. Although it is possible to choose both solutions most people prefer to log in with Facebook, as the situation is today. The developer we talked with described the latter as easier for the user, and that the company prefers this method. Considering data storage, the company does not have to organize and maintain a huge database of user profiles. They also consider Facebook as a more suitable way to identify and authenticate a user, because of the possibility to show a person's name and not only a username to the buyer. (Translated from Norwegian) *"So we think, or I at least, that people have much more desire to buy from [name] than from (Company X) ID25000".* Their use of the authentication component supports the view of Facebook as a de facto standard for authentication and login.

The developer also mentioned a trade-off with using data from Facebook. When they get information from their own application they can collect and store it in the desired format. When collecting data from Facebook they sometimes have to reformat it, so it fits into their system. So you get a lot of data that you would not have access to without using Facebook, but it requires more work. (Translated from Norwegian) *"In most cases, I think people will be better off using Facebook, get lots of users, so be it a bit cumbersome to handle the data in a slightly different format than you wish"*. Although it is time consuming to reformat the data, it can be justified as it is a one-time investment.

5 Architecture and generativity

The shift from having applications integrated in their solution to the Open Graph API made the infrastructure more loosely coupled. It is also possible to see this as a shift towards a more Service Provider Oriented Architecture (Hanseth & Bygstad, 2012) with loose couplings between the applications and the communication system and tight coupling inside the system. Hanseth and Bygstad (2012) argue in their article that an II's architecture needs to change during its evolution, and that the requirements that make an II bootstrap may be different from or opposed to the ones that make the II continue to grow. Facebook's shift might therefore be a needed change to continue to their expansion, while the initial architecture was needed in the interaction phase.

This shift might have contributed to make Facebook's architecture more generative. Zittrain (2006) defines generative technologies as an *"overall capacity to produce unprompted change driven by large, varied and uncoordinated audiences"*. Looking at the evolution of Facebook, it is not difficult to argue that the definition stated above holds true, as they indeed have one of the largest number of uncoordinated audiences on the Internet - both third-party developers and active users. We argue that Facebook's almost unfathomable success is partly related to their infrastructure, but also to their strategies and governance. We will discuss their strategies and governance in further detail below, and first take a look at the generativity from an infrastructural point of view. Hanseth and Bygstad (2012) define a generative infrastructure as an infrastructure that is built on a generative architecture, which has the following characteristics:

1. It is bootstrappable, adoptable, adaptable and extensible
2. It fits with generative development collectives
3. It has a generative fit with user communities

Hanseth (2015c) defines an architecture as bootstrappable if it made it possible to build the II, and operationable if it is aligned with the structures of the organization. We would argue that Facebook fulfilled these requirements during the first two phases (interaction and integration). Their success in bootstrapping both the service in itself (number of users communicating via the service), succeeded by the immediate success in integrating third-party developers with FPA clearly illustrates this.

However, as they were integrating all the new services into their own platform, it became highly complex and integrated, making it less extensible and adaptable in the long run. We would argue that the launch of the Open Graph API made the II more adaptable and extensible, and made the architecture more generative. It also resulted in a more generative fit with the ecosystem of development collectives. This new way of a loosely coupled integration, in many ways resembles the structural logic of the Internet as discussed by e.g. Abbate (1994), where she presents the architectural differences between the Internet as opposed to traditional telecommunications. In the Internet, the logic of the infrastructure lies in the ends of the network, making it a highly decentralized structure, thus allowing for experimental development and innovation on top of the different layers. This is a contrast to telecommunications, where all logic and functionality is centralized, somewhat similar Facebook's first attempt when creating the FPA. Though the Open Graph API is a clear example of a Service Oriented Architecture, as most web-based APIs, we argue that the infrastructural implication of this shift draws many parallels to the overall characteristics of the success of the Internet.

The architectural evolution and generativity of Facebook is not something that has emerged from nowhere. In addition to the three phases of evolution, Nylén et al. (2015) points to the two shifts between these phases. Preceding these shifts we find motivated and necessary strategies, as well as a high degree of management, that has supported the generativity and innovation of, in and on the II. As strategies and governance also needs to produce generative II's, we will take a closer look at these issues in the following chapter.

6 Innovation, strategies and governance

6.1 Three process strategies

Analysing Facebook as an evolving digital infrastructure, we want to identify mechanisms that has contributed to its success as a highly generative II. Hence, we will take a closer look at three different, but still related, process strategies in order to explain some of the generative aspects of Facebook. These three process strategies are adoption, innovation and scaling, which is derived from Henfridsson and Bygstad (2013). All the process strategies are built on self-reinforcing mechanisms, and describe how information infrastructures can evolve over time. Even though our focus is on the past strategies, we find that they can be relevant for future change and evolution.

6.1.1 Adoption

Facebook's initial main focus was to attract users and make them adopt the new and interactive version of the paper based face books. Hanseth and Aanestad (2003) describe the challenges of attracting users to new networks. A main challenge is that networks become more valuable the more users they have, and it is hard to get the first users to adopt. We discussed issues related to bootstrapping and the bootstrapping problem in the chapter *Interaction.*

Henfridsson and Bygstad (2013) describe the adoption mechanism of innovation (figure 3). User adoption is a key for innovation, which increases the value of the II. This will lead to further adoptions, which again will lead to more innovation of new services and so on.

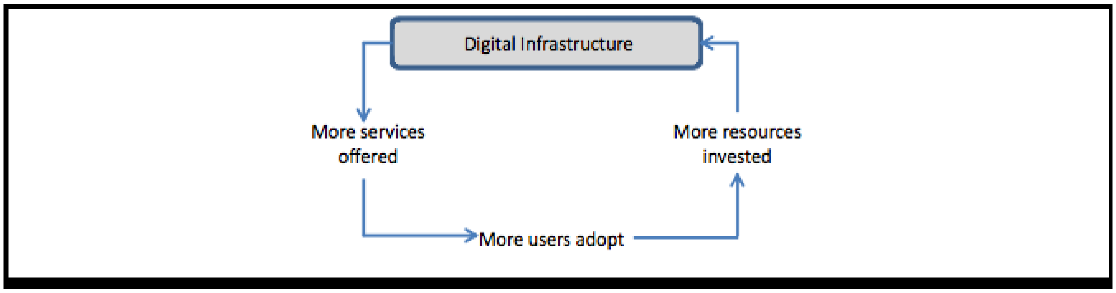


Figure 2: The Adotion Mechanism (Henfridson & Bygstad, 2013)

In regards to the third-party applications, they enroll more users to Facebook and contribute to new services in the II.

6.1.2 Innovation

Facebook gathers large amounts of information about their users; who attends what school, what events people attend and personal information like gender, age, location, political orientation and interest, to name a few. This large amount of information provides great opportunities through the Open Graph API, as third-party organisations can make use of this information to create new innovations. Not only are third-party developers extracting this information from the API, but they are also contributing to increasing the amount of data, thus making the API and II more useful to other developers and users.

Another process strategy described in Henfridsson and Bygstad's (2013) article is the innovation mechanism. This mechanism has three different aspects, namely technical malleability, recombination and new services. The innovation mechanism, illustrated in figure 3, is *"a self-reinforcing process by which new products and services are created as infrastructure malleability spawns recombination of resources"*.

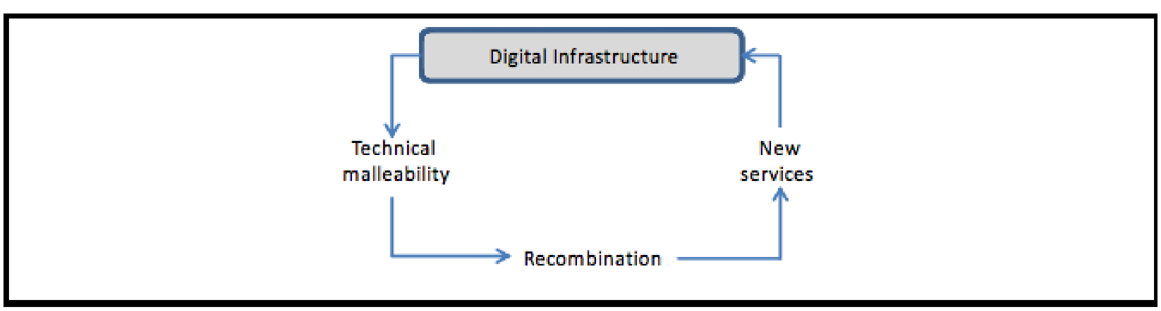


Figure 3: The Innovation Mechanism (Henfridson & Bygstad, 2013)

Henfridsson and Bygstad (2013) describes the malleability as the part of a service-oriented architecture that serves as a melting pot for innovation. In other words, malleability refers to the plasticity of loosely coupled service-oriented architectures, such as the Open Graph API. In the case of Facebook, the malleability of the Open Graph API makes it easier for both third-party organisations and Facebook to create innovative new solutions. When new solutions are developed, this will in turn create new services - which again can be recombined into new services.

The different possible recombination of services in the Facebook Open Graph API, leads to a more generative information infrastructure. In this now highly generative II, third-party developers may themselves produce new content to the system through the API provided. The generativity of the Facebook infrastructure results in new innovations that provide Facebook even more users, hence making the service better. The innovation mechanism therefore leads to a continuously improved version of Facebook, because of the even stream of new services through re-combinations of the existing technology.

Grisot, Hanseth and Thorseng (2014) identify three different types of innovation in regard to infrastructural architecture; of, in and on. In this chapter we have mostly discussed innovation *on* the Facebook infrastructure, where actors make new innovations *on* the information given from Facebook's Open Graph API. Another form of innovation in this case is the innovation *of* the infrastructure, where we have identified the three phases of Facebook's evolution through the history; interaction, integration and interconnection. In the latter phase, the innovation *of* the infrastructure resulted in many new innovations *on* the infrastructure.

6.1.3 Scaling

The last and closely related mechanism is the concept of scaling, which is also intrinsically self-reinforcing in its design. Henfridsson & Bygstad (2013) defines the scaling mechanism as *"[...] the process by which an infrastructure expands its reach as it attracts new partners by creating incentives for collaboration"*. This mechanism describes the process of attaching new actors and making the infrastructure more attractive (from a business-perspective) for third-party organisations.

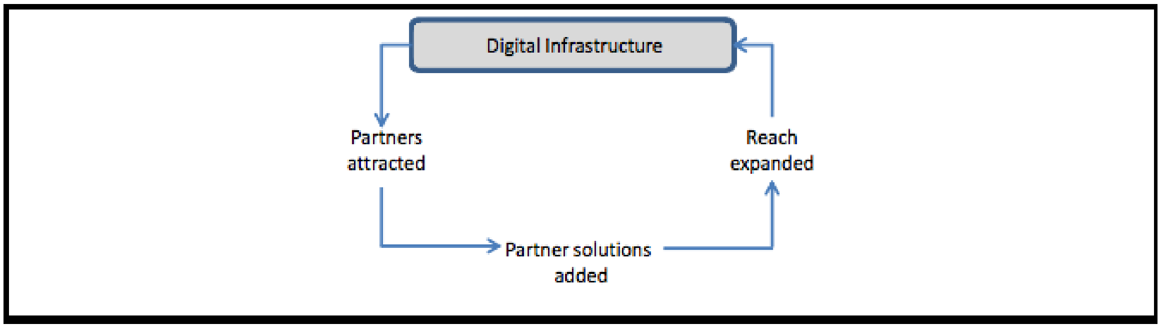


Figure 4: The Scaling Mechanism (Henfridson & Bygstad, 2013)

To ensure further growth, Facebook also has to continuously attract new partners, so that they contribute with new and innovative solutions. Examples of what may attract such partners could be the choices of data-transfer protocols and how simple the technology offered is. When partners are attracted to use Facebook's Open Graph API, they will develop new and innovative solutions - and the reach of the infrastructure is thereby expanded (referring to the self-reinforcing diagram in figure 6 above). It is therefore important to use new and popular technologies to ensure that as many partners as possible is attracted.

When new partner solutions are added and the reach is expanded, this will in turn attract even more partners to contribute to the infrastructure. This cyclic and self-enhancing mechanism is important for the further development of Facebook as an infrastructure, along with the other two mechanisms.

7 Governance

In this chapter we will look at how Facebook as an II is governed, both how they are influenced from the outside, but also how they manage their organisation.

7.1 Standards

There are many different standards developed for the web. *"Web standards are developed by standards organizations—groups of interested and often competing parties chartered with the* *task of standardization—not technologies developed and declared to be a standard by a single individual or company"* (Web standards, 2015). These standards are not rules/laws Facebook have to comply to, but by following them they make their solution more open for use. Often organisations are free to choose from a set of standards, which gives Facebook more freedom of choice.

As Facebook is a web solution they have to comply to the standards developed by W3C. The World Wide Web Consortium is *"an international community that develops open standards to ensure long-term growth of the Web"* (W3C, 2015). The standards are mainly concerned with the technologies used in applications on the Internet. For instance Facebook uses JSON for data serialization and as a messaging format. This is in line with the recommendations from W3C. The standards from W3C are developed by a large community, and we can therefore assure that they reflect best practices and knowledge in the developer society. By following W3C's guidelines Facebook ensure that third-party developers can use their API. New components can be connected with Facebook, and this leads to further development of the II.

7.1.1 Management

Control

Facebook initially had great control over their web page, since it was only a few internal developers who made the content. When they opened up for third-party applications to be integrated in their solution, they lost some control. They could decide which applications that should be integrated, but could not totally control its content. When they launched their Open Graph API they opened up for everyone to use their solution, which required centralized control over who was allowed to be a part of the infrastructure and not. This is not is a common feature of IIs, and is a characteristic where Facebook diverge from II theory: *"Since the control of an infrastructure typically is distributed across multiple actors, infrastructures are - for practical and economic reasons - difficult to govern."* (Henfridson & Bygstad, 2013).

Innovation

The emergence of Facebook as an II did not come from "nowhere". It is a result of a management strategy where loose control and openness was important factors. Instead of trying to do everything they focused on important features for sharing and communication, and outsourced games etc. to other companies. This led to increased heterogeneity, and made the II grow.

7.1.2 Regulations

Market

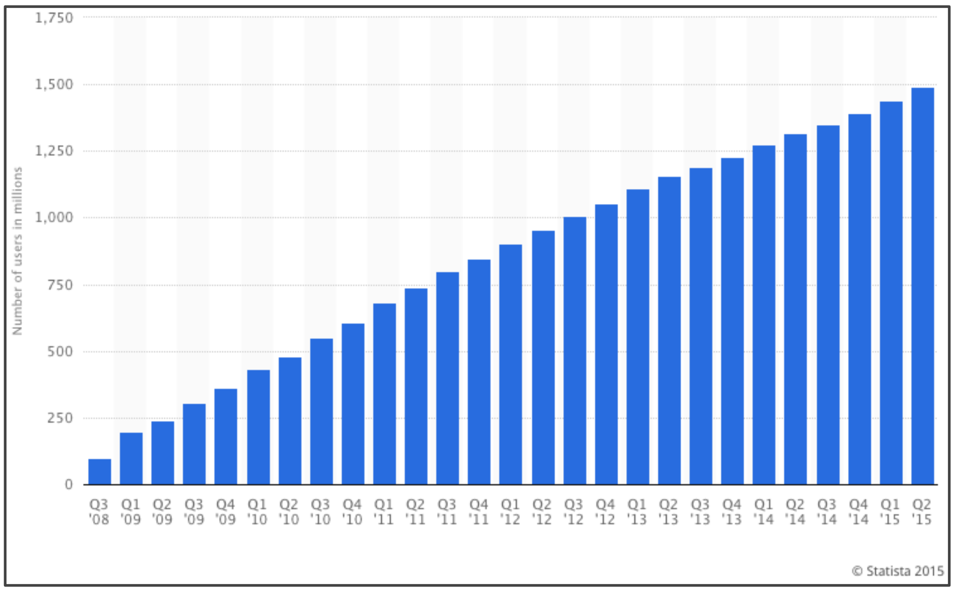
Facebook is dependent on their users because a social network without people is useless. So everything they do will have to be based on the user’s needs and approval. The same goes for third-party organizations. Facebook is free to do what they want with their own solution, but relies on these organizations to get users and extending the network.

Legislation

In addition, they have to comply to American laws. For instance, when they decided to create an authentication service, they had to comply to laws concerning security and privacy, which made the II more heterogeneous. They also have to follow social norms, and users reactions to their implementations. An example of this is users’ requirement to easily take control over their own privacy settings, especially related to which third-party applications are allowed to post on their walls.

8 The future of Facebook

It’s clear that the evolution of Facebook, as of now, is a highly successful story. As the number of users is still increasing, we can see how the adoption processes and bootstrapping strategies have led to a self-reinforcing installed base (see graph 1), as they have a steady cumulative growth.



Graph 1: Number of monthly users (in millions), between Q3 2008 - Q2 2015.
Source: http://www.statista.com/statistics/264810/number-of-monthly-active-facebook-users-worldwide/

Even though it is difficult to predict, Facebook founder Zuckerberg (2015) has provided his own personal thoughts in regards to what the future will bring for the company.

> *First, people are gaining the power to share in richer and richer ways. [...] One day, I believe we'll be able to send full rich thoughts to each other directly using technology. You'll just be able to think of something and your friends will immediately be able to experience it too if you'd like. This would be the ultimate communication technology.*

Though highly ambiguous and futuristic, the direction Zuckerberg implies, is coherent with their initial history of evolution, comprising the phases of interaction, integration and interconnection.

8.1 Back to the beginning

What we may see, is a repetition of the Nylén et. al. (2015) framework where they once again enter the interaction phase. As initially, they now have their core concepts fundamentally rooted within the infrastructure, and can start focusing on improving the user experience and cater to the user's new needs for improved communication and interaction. Even though they might not need to create a new attractor or focus on adaptability and bootstrapping strategies of their infrastructure as a whole, developing new ways of interaction always requires the two strategies to a certain degree. Regardless, we might have seen a shift where most of the innovation, trial and error can find place at third- party developers creating new use areas, which are eventually standardized, integrated or interconnected through the Facebook II.

One example of this strategy is the purchase and interconnection of the wildly popular picture sharing service Instagram in 2012 (List of mergers and acquisitions by Facebook, 2015). The acquisition of the mobile backend company Parse (www.parse.com) shows how they use innovation from third-party developers and integrates their service as a standard that extends the capabilities of the infrastructure (Cutler, 2013). Parse now allows businesses to easily develop mobile apps in React, a JavaScript-framework maintained by Facebook amongst others (React, 2015), contributing to the further generativity and adoption of the Open Graph API and Facebook development tools. A good example of integration is the mandatory Facebook-login attempted by the music streaming service Spotify, where all new subscribers to Spotify were required to login in with, and share their music live on their Facebook wall.

As follows from the events and strategies described above, Facebook are dependent on focusing on further generativity and loose coupling of the infrastructure, and increasing the use flexibility and change flexibility of the standards for communication exchange (APIs). We envision that the vast amount of information possessed by Facebook will become a new attractor, as all the interconnected services can take advantage of each other's information, binding it all together through the Facebook login module and infrastructure.

9 Summary

Through our article we have shown Facebook's evolution from webpage to infrastructure. By using II theory, we find that Facebook fit to a lot of the characteristics defining II structures and their related mechanisms. Facebook is in rapid evolution, and as more actors and stakeholders get involved, the II increases in complexity, making it more difficult to govern.

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