# Technology Through the Trough

*How hype and changing expectations affect the future of Bitcoin in Norway*

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*Attempted technological innovation may or may not be successful.*

Watts and Porter 1997, 26

# Abstract

This thesis explores how, through the patterns of expectations surrounding Bitcoin as how they were voiced by different actor groups (entrepreneurs, incumbents, knowledge institutions, policy makers, users, and the media), expectations affect the developmental direction of new technology. A greater understanding of how attention and expectations, sometimes in the form of hypes, influence technological trajectories, makes it easier to differentiate between expectations that are realistic to achieve and those that are not. This way investors, businesses, and policy makers can be better prepared to meet the societal changes that follow.

Using the Hype Cycle, Google Trends, the price of bitcoin, and content analysis of articles procured from Atekst, this thesis describes the expectations given to Bitcoin technology, and how changing expectations can give us an idea of the future of the technology; research has suggested that different types of expectation dynamics can lead to different types of disappointment after a hype, which in turn affects technological development.

The findings suggest that while there is immaturity in the voiced expectations, with few instances of project- and time-specific expectations, the attention given the technology follows a recognizable hype pattern up to a certain point—there has been a peak and a decline, but within the time frame looked at here, no upward slope again. For that to happen, this thesis finds that a reorientation of expectations relating to technological capabilities is necessary.

# Acknowledgements

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Third, my family, for their support. Especially Beate, whose enthusiasm for technology and the future inspired me to start my Master's in the first place, and Anna, who kept me sane by reminding me that I am not, in fact, my thesis.

Last, my flatmates, Josh, Mikkel, and Astri Marie. Yes, I have now finished my thesis, and can finally come home and beat you in Mario Kart with a clear conscience.

Oslo
September 2018

# Abbreviations

BCT: Blockchain technology

Bitcoin: Uppercase "B", refers to the protocol/software

bitcoin: Lowercase "b", refers to the currency and units thereof

BTC: Informal currency code for bitcoin

DAO: Decentralized autonomous organization

DLT: Decentralized ledger technology

ICO: Initial coin offering

PoW: Power-of-work

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# 1 Introduction

## 1.1 Research area and topic

Innovation is an inherently uncertain, future-oriented field. Whether an innovation succeeds or not in creating a new technological future depends on a wide range of factors: the zeitgeist of the times, a neglect of social and psychological aspects surrounding existing practices, or a lack of attention to human biases when faced with a new technological paradigm (Geels and Smit 2000), to mention a few. However, the way a technological future is viewed is decided by what different actors promise them to hold. As novel innovations often lack empirical technological performances (Alkemade and Suurs 2012), they compete on the basis of different promises made by different actors; expectations take part in defining a technological future.

Expectations can create incentives for new actors to enter a field (Bergek et al. 2008, 415), bringing resources and legitimization to the development of the technology. They do also, however, pose a risk: expectations that are not aligned with technological performance—or in other words, promise more than they can keep—can cause policy makers and investors to pour time and resources into a technological future that may eventually fail (Geels and Smit 2000). Investing in a future that is based on extreme manifestations of expectations (Bakker and Budde 2012, 552), or hype, is also a risk for the development of the technology. The disappointment caused by a failure of the technology to live up to the promises made can lead to a loss of funding and legitimization, potentially causing the involved actors to abandon the technology. As such, there is a growing consensus that there is a need to understand the workings of expectations, both in how different actors' expectations affect each other's, and how the expectations affect the development of the technology (Borup et al. 2006, 285; Dedehayir and Steinert 2016).

To study expectations to novel technology, one needs a technology to study. This thesis uses Bitcoin, the largest and perhaps most famous of the group of decentralized ledgers which have emerged the past ten years collectively known as cryptocurrencies. Or, to use the more general terminology, blockchains. The reasons for this choice are elaborated on in the next sub-section.

Different actor groups can have different expectations, based on differing traditions, values, practices, and interests (Borup et al. 2006). Seeing as how the future has not yet arrived, expectations are how actors constitute and engage with the future (Brown and Michael 2003), or, in the words of Berkhout (2006), how they "construct, make sense of and shape their futures by making them more concrete in the form of images and visions," (p. 299). Actors with different interests will likely align with different expectations, and some actors can use expectations strategically: using them to attract resources or legitimization, or using them to influence and reorient other actors' expectations to align with their own. Expectations are thus often moralized (Berkhout 2006), playing up positive consequences of following them or negative consequences of not, in order to put force behind them. But expectations also act as coordinating devices (Konrad 2006), aligning different actors' expectations. When this occurs, there is an increased chance of collective—shared—expectations emerging, which are more powerful than individually held expectations, and can contribute in establishing protected spaces for further development (Alkemade and Suurs 2012). In studying expectation dynamics, looking into which actors are voicing the expectations allows for a greater insight into how the social dynamics in technological development work.

An understanding of what leads to hype, how to identify them, and how to cope with eventual disappointment is the study of this thesis; it attempts to understand what happens when a technology is hyped and suffers a disappointment. An understanding of how expectations are voiced, how they change in response to events and other actors' expectations, and what changing expectations in the face of disappointment can mean to the future development of the technology, helps us make smarter decisions when investing in different technological futures. Both with regard to which future to invest in, and how, if already deeply invested, to recover after a disappointment.

Several authors have already tackled different areas of these questions (Ruef and Markard 2010; Konrad et al. 2012; Bakker and Budde 2012; van Lente, Spitters, and Peine 2013), but have called for more than just a quantitative analysis of changes in the amount of expectations. In order to understand the changes in expectations, it's conducive to analyze the content of the expectations as well (Ruef and Markard 2010, 335; van Lente, Spitters, and Peine 2013, 1623; Dedehayir and Steinert 2016, 28)—a qualitative analysis of expectations allows for identifying key characteristics and changes in them over time. In doing this mixture of quantitatively identifying hype and qualitatively analyzing the expectations, this thesis aims to further the understanding of the dynamics between changing expectations and technological disappointment, contribute to the methodology by looking for agreement between the results and existing theories, and contribute to the understanding of the technology's possible future trajectories (Dosi 1982).

Based on this, the main research question is as follows:

**RQ:** *What do key actors' changing expectations in the face of hype and disappointment tell us about the current state and possible future trajectories of Bitcoin technology in Norway?*

In order to answer this question, there are a couple of sub-questions that need answering, and which each look at a different part of the problem tackled. First, in order to study hype, it's necessary to be able to identify it. Perhaps the most widespread method of identifying and analyzing hypes is by using the consultant firm Gartner's classic Hype Cycle (Fenn and Raskino 2008), which labels different stages in the patterns expectations to novel technology often follow. The peak of the hype is here followed by a depression in attention and positive expectations—a trough—which is necessary for the technology to get through if it is not to be abandoned.

As different actors can react differently to hype and disappointment, the first sub-question looks into how each actor groups' expectations hold up to the hype cycle pattern:

**SQ1:** *How do the expectations to Bitcoin from different key actor groups hold up to the classic hype cycle pattern?*

Second, previous literature has shown that shared expectations between actors are more powerful than differing expectations (Konrad 2006); when expectations converge and different actors pull in the same direction, there is a higher chance of developing protected development spaces for the technology (Alkemade and Suurs 2012). This aids in the emergence of a dominant design, and can be an aid in the development of a new technological innovation system (Bakker, van Lente, and Meeus 2011). On the other hand, collective expectations can hinder development if the technology experiences a disappointment; when a broad range of actors agree on a path, a reorientation in the face of disappointment is challenging (Ruef and Markard 2010; van Lente, Spitters, and Peine 2013). In order to analyze the current state of Bitcoin technology, it's thought to be fruitful to explore the existence of converging expectations, which is the second sub-question:

**SQ2:** *Do changes in actor groups' expectations show any indication of a convergence of expectations?*

Third, Ruef and Markard (2010) have developed a typology of different types of disappointment, which posits different ways a technology can survive a disappointment, depending on what types of expectations have changed. A part of this thesis' analytical framework, this typology is used to answer the question of current disappointment and future paths for the technology. This is the basis of the third sub-question:

**SQ3:** *What do changing expectations and attention at different levels say about possible disappointment in the technology, and how does this relate to possible future development of the technology?*

Last, as expectations in this thesis will be analyzed not just by their characteristics, but also their contexts, it attempts to identify key events that may have contributed in changing the actor groups' expectations. If there are general events that are found to change a group's expectations, these can be used in the future as an indicator of coming change of expectations in that group. The fourth sub-question is as follows:

**SQ4:** *Are there any identifiable key events that explain the actors' change in expectations?*

In understanding how our expectations of new technology affects the course of the innovation—and they are seen as having a considerable influence on technological change (Alkemade and Suurs 2012, 286)—we can better understand how to use expectations to our advantage, as well as see past the hype. Predicting which new technologies will stick around is notoriously difficult (Brown and Michael 2003), but seeing common pitfalls, and paths expectations to new technology take, allows us to better understand which technologies are something to invest in, and which are not. Furthermore, trying to be ahead of the curve allows us to better facilitate for diffusion of new and helpful technologies.

## 1.2 Bitcoin

Blockchain is a technology that has no lack of advocates and critics (e.g. Vigna 2015; Tapscott and Tapscott 2016; Hackett 2018), and with no lack of promises surrounding the technology (e.g. van Valkenburgh 2016; Ølnes and Jansen 2017), and is the technology most cryptocurrencies are built on. The workings of the technology will be explored in greater detail in Chapter 4, but for now let it suffice that the biggest of the cryptocurrencies (CoinMarketCap 2018b), and the one that started it all, is Bitcoin. It was introduced in a white paper written by someone calling themselves Satoshi Nakamoto in 2008(Nakamoto 2008), and will be used as a proxy for all cryptocurrencies in this thesis.

Blockchains, and Bitcoin in particular, have received a lot of attention in later years. In part, this is due to what they promise of technological futures, but also their price. Blockchains such as Bitcoin use tokens as a currency to perform transactions on the network. In the Bitcoin protocol this token is simply called *bitcoin*, and is bought and traded on an open market. In 2017, bitcoin and other cryptocurrencies experienced a price surge, which peaked in December of that year (bitcoin had by then increased by 1,300% (Corcoran 2017)) before the price fell. This specifically posed a problem to many users of the technology, who invested in bitcoin based on a price that rose due to overblown expectations. The subsequent fall in both attention and price, as we shall see in Chapter 3, is interpreted as a disappointment in the technology.

As Bitcoin is a decentralized ledger that can record any information on it—including university diplomas (Ølnes and Jansen 2017) or research protocols (Carlisle n.d.)—not just that concerning value exchange, studying Bitcoin as a technology that has more aspects than being a currency is deemed fit for this thesis. On the other hand, the currency aspect of Bitcoin is impossible to ignore, and as such the price of a bitcoin, which is determined on an open market and thus is only affected by demand for it, will be used as a proxy for determining global interest in the technology.

## 1.3 Structure

The structure of the thesis is as follows. Chapter 2 lays out the theoretical background in hype and expectation studies, which will lay the groundwork for analyzing the expectations surrounding Bitcoin. Chapter 3 concerns the methodology used in this thesis—the collection of data, the coding of it, and the analytical framework used to enable answering the research questions. Chapter 4 delves into the technology of Bitcoin itself; the better one understands the technical workings of the technology, at least up to a certain point, the better one is able to understand why there are a myriad of expectations relating to it. Chapter 5 presents the finding of the data collection and coding, and Chapter 6 discusses these results in an attempt to answer the research questions. Concluding remarks and final thoughts follow in Chapter 7.

# 2 Theory

High levels of uncertainty follow the introduction and development of new technology. New innovations compete for the limited resources and attention of policy makers, funders, and potential users not on the basis of performance, as there rarely is much performance to show to, but on the basis of expectations to future performance (Brown and Michael 2003; Borup et al. 2006; Kriechbaum, Prol, and Posch 2018). An understanding of how expectations are formed and communicated by whom is necessary to understand which promised performances are feasible, and which are not. This thesis explores the expectation dynamics concerning Bitcoin. This chapter expands on central concepts and theories used in the methodology and analysis sections.

## 2.1 Expectations

Innovation is a highly future-oriented field, and what novel technologies lack in performance, they make up in promises and expectations for different technological futures (Alkemade and Suurs 2012, 448). Following Borup et al. (2006), these expectations are understood as "real-time representations of future technological situations and capabilities" (p. 286). In other words, expectations to novel innovations are voiced ideas of how the innovation will perform in the future when the innovation has matured. This projection of future capabilities is what Brown and Michael (2003, 6) refer to as colonizing the future

(Berkhout (2006) refers to it as a "bid" on a future. Van Lente et al. (2013) point out that once expectations become broadly shared, they become requirements of the technology, thus guiding the innovation activities.

On the other hand, an overstating of positive expectations to the technology can lead to overlooking risks it brings, and it is important to have a sober understanding of which future capabilities are feasible as well as attractive. Failed expectations are not necessarily a risk for developers of the technology, but do pose a risk for policy makers and others who make decisions about investment, as they can either implement ineffective policies or lose returns on their investments.

Alkemade and Suurs (2012) have shown that the actor expressing an expectation and the specific contents of the expressed expectation are characteristics that convey a lot about how far a technology has come along and how mature it is. When different actor groups—e.g. entrepreneurs, incumbent firms, policy makers—are not aligned, the expectations lose strength; individual expectations are not as defining for a technology as collective expectations, although they do need to be exchanged in order for collective expectations to arise (Konrad 2006).

While collective expectations can lead to the creation of niche protected spaces for the technology to develop (Konrad 2006; Geels and Raven 2006), when actors disagree on technological expectations the development of the technology can be stymied and at worst abandoned. Indeed, overblown expectations which lead to hype can cause confusion for potential customers and in the terminology used for the technology (Järvenpää and Mäkinen 2008a, 2). There are arguments for keepings expectations to new technology unaligned: confusion creates interpretive flexibility, which allows different actors to attempt at defining the technology and shaping it in their advantage (Konrad 2006; Vincent 2014). On the other hand, without a convergence of expectations, it will ultimately be difficult to impose standards and see the rise of dominant designs.

The wish to draw attention, new entrants, and legitimize the innovation, however, may be too strong. In the pursuit of aligning expectations, actors may end up overstating the innovation's case. These high expectations, coupled with high visibility and fueled by people's general like of novelty and not wishing to be "left behind" (Fenn and Raskino 2008, 27–33), can result in a "hype". As mentioned above, a hype has certain upsides, including spreading knowledge about the innovation, and certain downsides, including confusion in terminology or a temporary increased critical view of the innovation. But being able to shape the direction of the technological development in a group of actors' favor, define which future techno-visions reign; colonizing the future (Brown and Michael 2003).

Expectations differ in their characteristics. For one, it can be either positive or negative in regards to the innovation. As mentioned, expectations are often moralized (Berkhout 2006), painting a positive or negative picture when imagining future capabilities and performances. This puts force behind the expectations, and can attract new entrants as well as put them off, depending on the interests of the actor voicing the expectation. This leads to the second characteristic: the actor voicing the expectation matters. A positive expectation from an entrepreneur may be countered with a more negative expectation from a threatened incumbent, and will carry different weight than a casual user's expectation. Bakker and Budde (2012) call those who voice alternatives for "enactors", and those choosing between alternatives for "selectors". These groups have differing goals—enactors to get chosen, selectors to get a "best deal"—and so they will voice different expectations.

Third, general expectations carry a different meaning than more specific ones, as they are easier to interpret and adopt by different actors. This makes general expectations good at creating shared visions of the technological future, but they are also an indication of a lack of maturity in its development—more project- or application-specific expectations indicate a technology further along in technological development. Lastly, there is a difference between expectations expected to be met in the short term or in the long term. This ties in to the generality of the expectation—the more short-term the expectation is, the surer it is of being realized soon. Unspecified time frames as such are also an indication of immaturity in technological development. All these characteristics (as identified by Alkemade and Suurs (2012)) influence the effect an expectation has. The more specific and short term the expectation, the greater the indication of a maturing technology, or at the very least of a technology which has zeroed in on some dominant expectations.

When these specific expectations are shared by different groups of actors, and converge, we get collective expectations that are more robust and may lead to the cooperation between actors and creation of protected spaces (Konrad 2006, 438); different actors pulling together in the same direction allow the technology to develop further and get closer to a dominant design that can be diffused and spread through to relevant actors (Konrad 2006). On the other hand, shared expectations may also be a hindrance to a technology's development; van Lente et al. (2012, 1626) conclude that collective expectations may delay a reorientation of expectations after an eventual disappointment. So the appearance of collective expectations—or the lack thereof—can be used as an indicator for how a technology develops after a disappointment following the failure of technological capabilities to live up to hyped expectations.

## 2.2 Hype

Strategic management of expectations can help an actor either play to the technology's strengths which align with the actor's interests, or counter other actor's expectations (Alkemade and Suurs 2012, 450). Conversely, it can contribute to hype. Increasing attention of an innovation can lead to increasing attention of the innovation, resulting in media resonance; stories of an innovation prompt more stories on the innovation and so forth, making the attention numbers sky-rocket due to a self-fortifying chain reaction (Järvenpää and Mäkinen 2008a, 2). Hypes are a field of study in and of themselves, as they can not only help an emerging innovation get attention and funding, but also lead to confusion and potentially loss of legitimacy (Geels and Smit (2000, 879) identify expectations which promise too much as one key explanation of failed technological features).

Bakker and Budde (2012, 552) identify a hype as an extreme manifestation of expectations. Combining positive expectations with a high level of visibility results in a hype, and this is the definition used in this thesis. Another way of viewing hype is as an indication of "exaggerated growth with respect to a benchmark" (Dedehayir and Steinert 2016, 37), and is perhaps most famously seen in finance, where hypes press the price of a commodity far above the value of the product itself, creating a speculative bubble. One of the most famous examples of this is the Dutch tulip bubble of the 17th century, where the price of tulip bulbs rose to extraordinary high levels before plummeting. This is analogous to how novel technologies can be allocated a lot of attention, before receding from view if the expectations are not met—a disappointment follows the hype. This disappointment is almost sure to follow any hype before the technology can develop and begin to mature, and is part of what the research and consulting firm Gartner calls the Hype Cycle.

Introduced by Jackie Fenn in the 1990s, the Hype Cycle has been used by analysts to identify and describe the over-enthusiasm and hype of new technology, as well as the typical disappointment that follows (Fenn and Raskino 2008). This is done by dividing the cycle into five phases: an "innovation trigger", an event or development which leads to the increase in expectations; a "peak of inflated expectations", where the hype is at its peak and either negative expectations begin to rise or positive expectations begin to fall (Alkemade and Suurs 2012, 454); a "trough of disillusionment", where the attention to the innovation has all but disappeared; a "slope of enlightenment", where there is an increase in understanding about the innovation's true capabilities, risks, and benefits; and a "plateau of productivity", where the innovation begins to be adopted and gain legitimacy amongst a broader audience. The usual graphic depiction of the cycle puts time on the x-axis, and visibility—as the proxy for attention—on the y-axis, which can be seen in Figure 1.

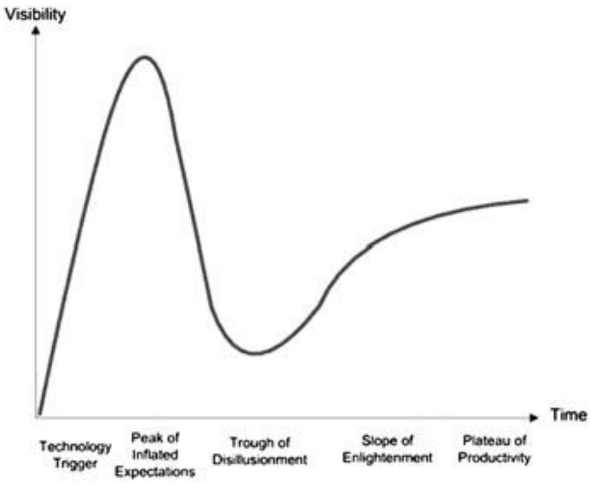



*Figure 1: The Gartner Hype Cycle (van Lente et al. 2013)*

During the rise and eventually the peak of the hype, expectations are necessarily not in line with the performance of the technology. This is the part of the technology's life cycle where it has interpretive flexibility and discussions about its possible capabilities and performance are held, while its development lacks behind. Combining the attention level with the classic S-curve of technological maturity is what gives the Hype Cycle its shape, as seen in Figure 2.

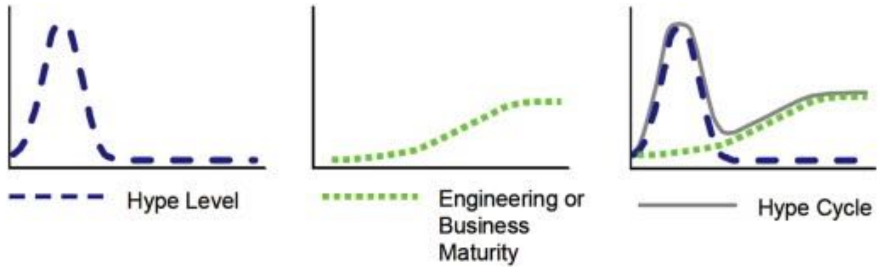



*Figure 2: The two curves of the hype cycle (Dedehayir and Steinert 2016)*

Empirical studies of the existence of a hype cycle has been conducted many times (see for example Järvenpää and Mäkinen 2008a, 2008b; Ruef and Markard 2010; Jun 2012b, 2012a; Dedehayir and Steinert 2016), and while the conclusions differ on the specific existence of a cycle, they find clear indication for the existence of hype. Ruef and Markard (2010, 319) identify the hype as a period of largely uncritical or optimistic expectations, giving a rise in visibility, with an increase in critical or negative expectations right after the period. As such, certain characteristics of a voiced expectation are important; positive expectations are expected to be voiced to a larger degree than negative expectations in the period leading to the peak of the hype, while it is the other way around just before and after the peak.

Furthermore, as Fenn and Raskino (2008) and others have pointed to, since a hype is difficult to spot unless there comes a downturn in attention given to the innovation, they are only detectable after the fact (Ruef and Markard 2010, 319). Identifying a hype while it is ongoing is hard precisely because if there is no downturn in expectations, there is no pronounced peak to point to. Still, working with expectations can be fruitful even if one is not trying to identify a hype *ex post*; Alkemade and Suurs (2012) point to converging expectation patterns (that expectations between actor groups become more and more aligned) as a sign of a maturing technology in which the defining of the technology, or rather its interpretive flexibility, is in its final stages. This reduces uncertainty for the technology, and may lead to the development of a dominant design which can spread to a larger group of consumers. Managing expectations is also important in managing disappointments which follow the failure of a field to materialize highly held expectations, as this may lead to damaging the technological field as a whole (Brown and Michael 2003).

A decline in visibility—e.g. media attention—however, does not *necessarily* imply a disappointment in expectations, as Ruef and Markard (2010) point out; they refine the definition of a hype by coupling *positive* expectations with high visibility. Including the content of an expectation in the identifying of a hype is relevant to this thesis, as the content of an expectation is used to analyze its effects and pattern.

## 2.3 Characteristics of expectations

In analyzing the characteristics of the voiced expectations, this thesis expects to find different types of expectations. Ruef and Markard (2010) identified three types of expectations: *specific* expectations, relating to products or projects; *generalized* expectations, relating to general features of the technology in question; and *frame* expectations, relating to overarching societal visions or problems (pp. 323-324). The first two are similar to the characteristics used by Alkemade and Suurs (2012), while the last type is what Ruef and Markard focus on.

Ruef and Markard find that during the hype period of the technology in question there was a strong increase in specific statements about the applications of the technology, as well as an increase in optimistic (i.e. positive) and vague (i.e. general) expectations. After the hype period, however, in what they refer to as the "disillusionment phase", they found a clear downscaling of generalized expectations, which in turn were interpreted as a form of disappointment (Ruef and Markard 2010, 333). That innovation activities were still carried out was attributed to a constant and positive framing of the technology—that is, the societal visions of the technological promises were still positive—and the emergence of institutional structures. Innovation activities within Bitcoin is outside the scope of this thesis, but the role of the frame expectations is relevant for understanding how expectations and their nature impacts the emergence of an innovation system. Analyzing the change in expectations and the frames they are voiced in can indicate which effects an eventual disappointment will have on innovation activities.

Following Ruef and Markard (2010), this thesis will analyze the changing patterns of expectations in different actor groups in an attempt to understand how the future direction of Bitcoin technology may develop. Assuming positive general and frame expectations at the outset of the hype, the different directions an expectation pattern may head indicates potential effects on innovation. Figure 3 below shows a stylized version of the patterns of the expectations may take, while Table 1 indicate the effects of the different types of disappointment after a hype.

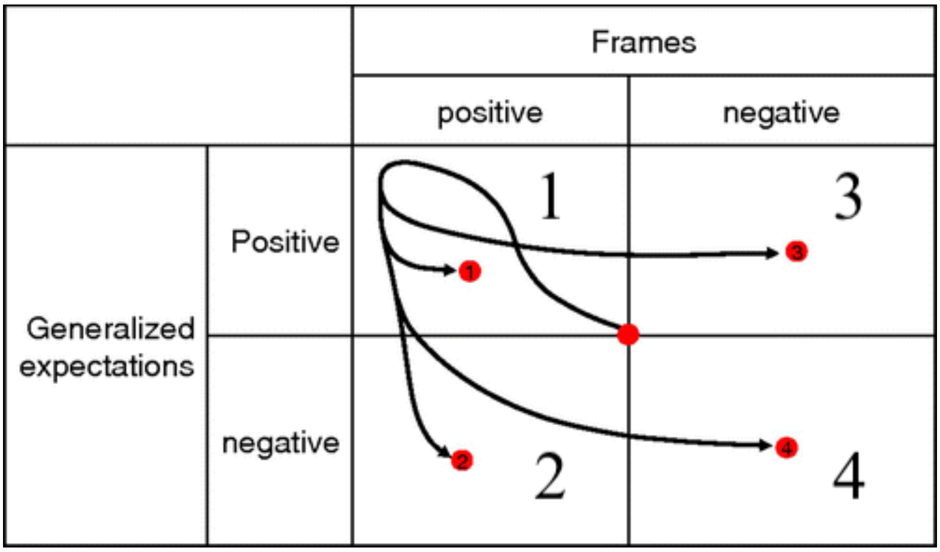



*Figure 3: Stylized patterns of expectations (Ruef and Markad 2010)*

**Table 1**

Different types of disappointments and potential effects on innovation (Ruef and Markard 2010)

| | | **Frames** | |
|---|---|---|---|
| | | **Positive** | **Negative** |
| | | **Disillusionment**<br>- Legitimacy intact<br>- Guidance intact | **Disenchantment**<br>- Legitimacy lost or contested<br>- Guidance intact |
| | **Positive** | **Innovation sustained**<br>- Innovation activities continue<br>- Former direction of development sustained | **Innovation delayed/modified**<br>- Decrease of societal/public support<br>- Potential shift to alternative technologies |
| **Generalized** | | | |
| | | **Disappointment**<br>- Legitimacy intact<br>- Guidance weakened or lost | **Total disappointment**<br>- Legitimacy lost<br>- Guidance lost |
| | **Negative** | **Innovation delayed/modified**<br>- Innovation activities reduced<br>- Potential shift to other applications of the technology | **Innovation abandoned**<br>- Innovation activities cut down significantly or abandoned<br>- Shift to other technologies |

In this analytical framework, it is clear that the worst outcome for technological development is a type 4 disappointment, where the innovation can potentially be abandoned. During a hype period, there is an increase in positive general and frame expectations. If these are adjusted, but continue to be positive, there is reason to believe that there will not be much disappointment in the continued development of the technology—what Ruef and Markard identify as a type 1 disappointment. If, however, the frame expectations stay positive, but the general expectations turn negative, the technology experiences a type 2 disappointment, where the positive frame expectations keep the legitimacy of the technology intact, but the guidance of the technology is weakened. Following Alkemade and Suurs (2012), who studied expectation patterns, this thesis expects that a convergence of expectations which is replaced by a divergence of expectations again, would be an indication of a type 2 disappointment. Such a disappointment will keep incentives to develop the technology, as its legitimacy is intact, but in new directions and applications.

Finally, Ruef and Markard point to a type 3 disappointment, in which the general expectations remain positive—for example, the technology has begun to yield economic benefits or penetrated the market in some way—but the broader social frame expectations have taken a negative turn. A decline in social acceptance, perhaps due to the uncovering of new risks or costs in the development, may shift support for a technological solution over to alternative technologies, or at the very least delay or modify the development of the technology in question.

Dividing expectations into different levels and values to study a hype pattern is also congruent to van Lente et al. (2013). They differentiated between expectations at a micro, project-specific level; a meso, general level; and a macro, frame level. This underpins Ruef and

Markard's (2010) typology of dividing expectations into levels, and will be used in this thesis's analytical framework. Furthermore, van Lente et al. (2013) refer to the positive or negative characteristics of an expectation as the *value* of the expectation, and by combining this with the content of the expectations, they are able to identify factors which keep innovation going after disappointment sets in and the hype is over. In their case, concrete applications of the technology—at either level, but not so vague as to confuse the potential uses of the technology—aids in getting it through what the Gartner Hype Cycle calls the "trough of disillusionment". Generic applications, on the other hand, when expectations are "detached too far from interested commercial or societal environment" (van Lente, Spitters, and Peine 2013, 1625), have a harder time of getting the technology through the trough.

They conclude with noting that a degree of disagreement between the levels may be conducive to a technology's recovery after disappointment, as this makes it easier to reorient and redefine expectations. In the terms of Ruef and Markard (2010) above, when groups and levels are aligned in their expectations, it is more likely that a disappointment due to failed development in the technology leads to a change from positive to negative both in the general and the frame expectations—a type 4 disappoint, or "total disappointment", potentially leading to the abandonment of the technology.

## 2.4 Types of actors

Finally, what actor groups voice expectations need to be taken into account. Studying actors' expectations is much used in expectation studies (e.g. Brown and Michael 2003; Borup et al. 2006; Bakker and Budde 2012; Jun 2012a; Kriechbaum, Prol, and Posch 2018), and is important both in studying how different actors' expectations influences others', and the dynamics involved when managing expectations to one's advantage. The most important reasons to include actors in this thesis is that it allows for studying the current state of expectations to

Bitcoin across different actors in greater detail, and to investigate convergence of expectations. Different actors may have differing interests, and voice expectations as such; entrepreneurs may wish to express many positive expectations in order to draw resources and attention to the technology's development, incumbents may try to counter this by expressing negative expectations, users may try to influence the direction of development by voicing their hopes for future capabilities, and policy makers will try to manage expectations at a larger, societal level in alignment with their political motives.

In this thesis, both by drawing on Alkemade and Suurs (2012) and Jun (2012b), and through an iterative process in coding the data set, six key actor groups are identified:

**Entrepreneurs:** Here defined as small (niche) actors who challenge the existing (regime) actors in a field—in Bitcoin's case, financial institutions. Although they may know most about the possible technical performance capabilities of the technology, and as such can give the clearest view of the maturity of the field, entrepreneurs are expected to give positive, perhaps overblown, expectations. This is for reasons mentioned earlier: attracting resources and new entrants to their technology. Entrepreneurs are innovative agents, or "enactors" in the words of Bakker and Budde (Bakker and Budde 2012), and have an incentive to hype a technology once other enactors do—while the reward can be high, eventual costs are born by the whole community. They are also thought to play a key role in the spreading of information and the defining of the technology.

**Incumbents:** Existing (regime) actors, such as banks and other financial institutions, who are challenged by the new technology. In contrast to the entrepreneurs, incumbents are expected to voice negative expectations, at least on the areas where they are threatened. Another way of managing expectations that are not aligned with one's interests, is to redefine positive expectations to be in line with them. For incumbents, this can take the form of expectations concerning adopting parts of the technology that do not challenge their core workings.

**Knowledge institution:** Expectation studies, such as van Lente et al. (2013), and bibliometric studies, such as Jun (2012a), point to the centrality of scientific papers in determining the performance capabilities of a technology. As scientific journals are not included in the data used in this thesis, scientists and other academics are in this category. Along with consultants, think thanks, and other professionals, knowledge institutions are expected to have more of an explanatory role, describing how and what the technology is or can be. Knowledge institutions are along with the entrepreneurs probably the most knowledgeable of the technology, however, and know what capabilities the technology can or can not possess. While entrepreneurs are thought to voice positive expectations to attract resources, knowledge institutions are expected to not moralize their expectations, be more neutral. Where entrepreneurs will hype technological performance, knowledge institutions will look at the technical capabilities and make their expectations based on that.

**Policy makers:** Government officials or representatives thereof, with expectations assumed to be put in a larger, societal context. When a technology gets enough attention, policy makers may make expectations in an effort to influence its direction. Kriechbaum et al. (2018) point to how public policy can influence expectations by setting goals, and act as powerful selectors of technological alternatives (Bakker, van Lente, and Meeus 2011). However, as Bitcoin is as yet a relatively unregulated technology, this is not expected to be a large expectation voicing group.

**Media:** Identified partly through the idea of media being information disseminators in a socio-technical system (Rogers 2003; Geels 2004), and partly through an iterative analysis of the articles in question, the media—represented by journalists, opinion pieces, and impersonal news articles—is a main actor when analyzing media content;

expectations that appear in the media, but are not voiced by any of the other actor groups, are classified as being voiced by the media.

**Users:** The users of the technology also make up part of the socio-technical system, and through feedback and expectations can influence the development of the technology. As consumers, their influence comes from voicing hopes and requirements to future versions of the technology. In this thesis the main types of users are thought to be those who use Bitcoin as a currency, as an investment object, or use computer power to “mine” for new bitcoins.

# 3 Methodology

This thesis makes use of both qualitative and quantitative methods in answering its research questions. This chapter introduces the methods and sources used, and clarifies the analytical framework that will be used in analyzing the empirical findings in later chapters. The sources used, Atekst and Google Trends, will be discussed, but first a few words on the delimitations of the study.

## 3.1 Spatial and temporal delimitations

In order to study a certain phenomenon, it is necessary to delimit the data analyzed. For a study of attention given to Bitcoin technology, both time and place were taken into consideration for the data gathering. As for where the data were gathered from, this thesis looks at data from Norway. In studying attention and expectations voiced in the media, Atekst was used to search Norwegian newspapers for expectation events, both to reduce the scope of the study, as well as for ease of data collection. In studying how this relates to interest in the technology in the user groups, it was natural to also delimit this data to Norway. To question this, however, the interest in Bitcoin in Norway was compared to the interest in Bitcoin worldwide. Figure 4 shows that there was very comparable interest in Norway to the interest worldwide, based on amount of Google searches. The data is from Google Trends, and shows normalized interest in a search word, where 100 is peak interest, 50 is half of that, and so it. It should be noted that the content of local and international expectations is likely to differ, due to the different contexts they're voiced in, and specified that this thesis only studies expectations voiced in the Norwegian context. Yet the comparable interest leads to the conclusion that Norway is not an anomalous case in its interest, and is used in order to study the technology at large.

The searches only go as far back as October 2016. This delimitation is based on the price of one bitcoin, which is the third data line in Figure 4. Owing to that the cryptocurrency is global in its reach, and the only factor that influences its price is demand for it, the historic price of bitcoin was used to figure out how far back to look. Using the historic data at CoinMarketCap (CoinMarketCap 2018c), I found that excluding a small hype around bitcoin in 2013, the price for a bitcoin stayed consistently below USD 1000 until January 2017. As it was not until during 2017 that the price rose sharply, it was decided that when the price rose above USD 1000 would be the cutoff date. To include any events that may have led to this rise, a further three months back were also included, bringing the start of the study to October 2016. For practical reasons, and considering that data for the future is not yet available, the cutoff date for the end of the study was set as the end of May 2017.

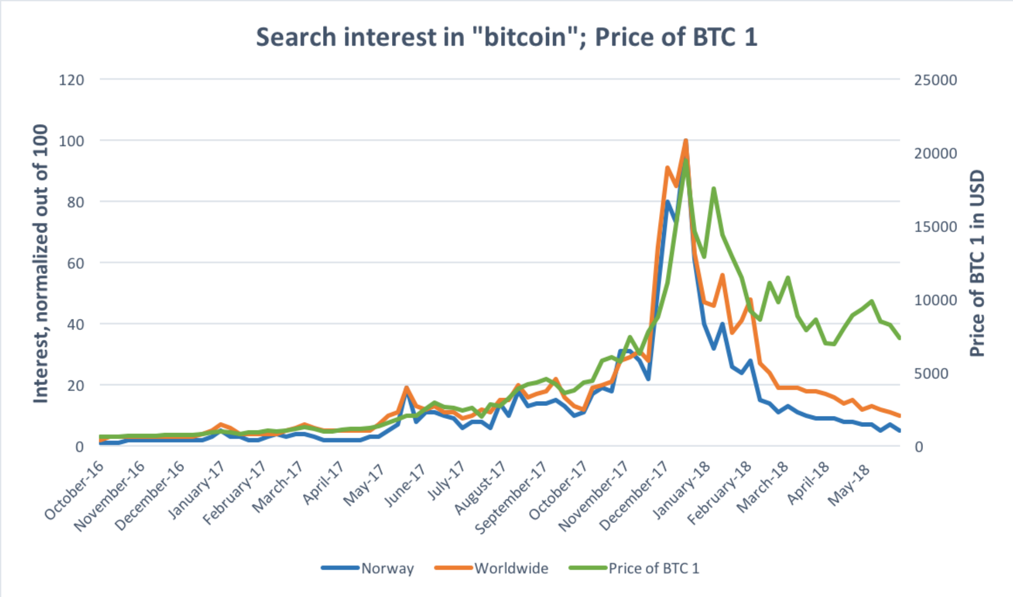



*Figure 4: Interest in "bitcoin", Worldwide and Norway, and historic Bitcoin price*

## 3.2 Data selection

The main data sources used in this thesis rely on bibliometrics, namely Google Trends and searches in mass media. Using bibliometrics, or "counts of publications, patents or citations" to "measure and interpret technological advances" (Watts and Porter 1997, 27) is a common practice in innovation forecasting, including in studying hype patterns (e.g. Järvenpää and Mäkinen 2008; Ruef and Markard 2010; van Lente, Spitters, and Peine 2013; Jun, Yeom, and Son 2014). When searching media attention in Atekst, for example, a quantitative view on how much attention—or rather, visibility—a technology receives is given. At the same time, again referring to Watts and Porter (1997), counts do not distinguish quality. To understand the quality of the expectations, as intended in this thesis, a sample of the media attention has to be read for context. This content analysis allows for a greater understanding of the happening of events, which also allows for an event-analysis of the expectation cycle. The process of analysis is explained in the next section, while this section concerns the selection of data for analysis.

Google Trends is a service provided by Google that allows researchers to search for certain keywords and see how popular they have been in a certain time frame and for a certain location. As Google Trends do not give absolute numbers, but normalize the interest rate, environmental factors such as population and multiple searches by single users, perhaps done to increase the likelihood of specific products to appear when other people search for something similar, are nullified. In the time period in question, the period which has received the biggest amount of interest from users of the search engine receive a score of 100; a period where the interest was about half as much receives a score of 50, and so on. If there have not been enough searches to gather any data about a time period, it receives a score of 0. This allows for studying when there is interest in a search term, without the results being skewed by absolute search amounts (Jun, Yeom, and Son 2014, 87). It opens for studying the relative interest between different regions, to easier see if trends in searches are the same—for example if the trend between countries is similar, even if the absolute number of searches in a country with a bigger population may be larger.

For studying the expectations of actors, media attention was also used. As Rogers (2003, 205) points to on the topic of communication channels for diffusion of knowledge surrounding information, mass media reach a large audience quickly, and are good at creating knowledge and spreading information. Furthermore, on their discussion on bibliometrics, Watts and Porter (1997, 27) point to items in databases of newspapers as an indicator of the application of a technology, although they also note that the maturation of a technology is best evaluated by the type and detail of issues linked to the technology (p. 30). This in turn ties into the content analysis pointed to as necessary to gain a better picture of expectations. In addition to this, there are several precedents of using media attention as a proxy for visibility (e.g. Ruef and Markard 2010; van Lente, Spitters, and Peine 2013), as well as studies on the effectiveness of sub-dividing different media sources to study different aspects of technology attention (e.g. differentiating between technical and mass media (Järvenpää and Mäkinen 2008a, 2008b)).

The specific choices of media channels fell on *Aftenposten*, *Aftenposten Nett*, *VG*, and *VG Nett*. These sources were chosen on the basis of the results in several surveys about media use in the Norwegian population. First, Medienorge publishes the circulation figures of the largest newspapers in Norway, and *Aftenposten* and *VG* are the two largest, and hence the two with probably the largest reach (Medienorge 2018). A survey done by Respons analyse for *Nordiske Mediedager 2017* (Respons analyse 2017, 19) underscores this, as *Aftenposten* and *VG* are named as the two most read newspapers. Second, the decision to include the online versions of the newspapers, *Aftenposten - login* (as it appears on Atekst) and *VG Nett*, come from a survey done by Respons analyse for *Nordiske Mediedager 2018* (Respons analyse 2018, 22), where 43% of respondents chose online newspapers as their main source of news, compared to 12% who chose physical newspapers.

In both Google Trends and Atekst, only the search word "bitcoin" was used, and the time frame was, as previously explained, set to be October 1, 2016, to May 31, 2017. It was considered including a search for "blockchain", but as the overwhelming amount of interest was on "bitcoin", it was left out. Figure 5 shows the difference between search interest in "bitcoin" and "blockchain".

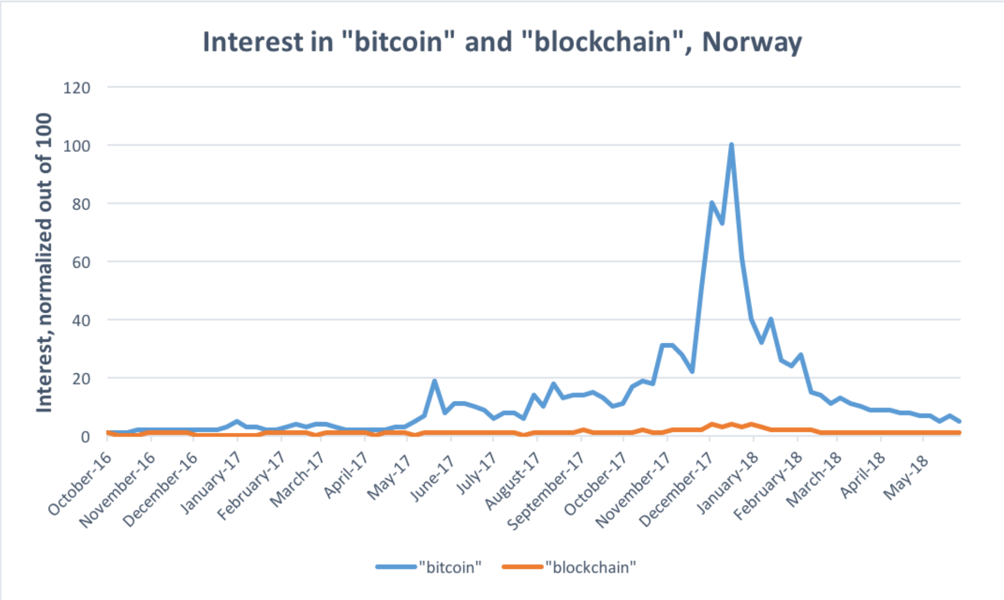



*Figure 5: Interest in "bitcoin" and "blockchain", Norway*

The same goes for the data from Atekst: a search for "bitcoin" returned 158 articles, while a search for "bitcoin OR blockchain"—to include articles on blockchain that did not already show in the first search—returned 165 articles. This small difference furthered the assumption that a search for "bitcoin" would suffice. A preliminary screening of the 158 articles was done, to remove any observations that did not relate to technological capabilities or situations (e.g. columns on etymology), or that were duplicates which appeared both in the physical and online version of the newspaper. In the latter cases, the online version was kept, as it was assumed to have reached a larger audience (cf. distribution of readers who use online newspapers as their primary source of information compared to those using paper versions). This screening left 110 articles, which were then read carefully for the content analysis. This process uncovered nine more articles that were left out of the analysis, leaving the total number of articles to be included in the analysis at 101. A summary of these numbers are in Table 2. For each article, not only voiced expectations are recorded and coded, but also statements relating to bitcoin without voicing a specific expectation. These are included in the analysis as such stories are thought to influence other actor groups' expectations; their context provides information pertaining to events that can have influenced events, such as criminal cases where bitcoin has been used, or the rising price of bitcoin.

**Table 2**

Number of articles before and after screening

| Articles before screening | Articles after first screening | Articles analyzed |
|---|---|---|
| 158 | 110 | 101 |

## 3.3 Process of analysis

Aiming to understand the current state and possible future trajectories of Bitcoin technology in Norway, this thesis analyses changing expectations for different actors. These actors have already been identified in the last chapter, and will be identified in the process of content analyzing the voiced expectations found through Atekst. As also mentioned, however, there are other characteristics of expectations that are necessary to identify in order to answer the research question: for hype cycles of different actors, the value as well as the total amount of expectations is needed; for identifying converging expectations, the specificity both in time frame and level of the expectations is needed; for identifying different types of disappointment, the value as well as the level of the expectations for all actors is needed; and for analyzing key events that can explain the actors' changes in expectation, a context around the voiced expectations is needed. A change in any of the mentioned characteristics constitute changing expectations, and are thus necessary to find in order to answer the research question.

As such, in the following the operationalization used in the content analysis of media articles collected is explained.

### 3.3.1 Operationalization of expectations

Expectations are understood in this thesis as "real-time representations of future technological situations and capabilities" (Borup et al. 2006, 286). Once identified in the media articles, each expectation's characteristics will be coded. The importance of value, level, time frame, and actor of the voiced expectation, is identified by Alkemade and Suurs (2012, 451). Actors are identified not as who they are, but as which actor role they inhabit at the time of voicing the expectation.

The *level* of the expectation—that is, whether it pertains to project-specific, generalized, or frame characteristics of the technology—follows van Lente et al. (2013, 1619), and, as previously mentioned, is aligned with the terminology Ruef and Markard (2010) uses to delimit different types of expectations. Table 3 is the framework used by van Lente et al.:

**Table 3**

Framework to determine the level of expectations (van Lente et al. 2013)

| **Label** | **Description** |
|---|---|
| Project-specific expectations | Future characteristics of a technology specific to a product project or firm. Micro level. |
| Generalized expectations | Expectations referring to generalized features of a technology, expressed in impersonal statements. Expectations address the level of the technological field. |
| Frames | Rather overarching expectations which place the technology in the context of generic societal problems or promises (societal debates). |

Project-specific expectations describe characteristics of the technology at a micro level, specific to an ongoing or future project or product. Generalized expectations refer to "generalized features of a technology", and "address the level of the technological field" (van Lente, Spitters, and Peine 2013, 1619)—not specific applications of the technology, but general, possible applications made possible by its nature (more on this in the next chapter). Frame expectations are overarching, and place the technology "in the context of generic societal problems or promises (societal debates)"—the promises of how a new technology can solve larger, social problems outside the specific domains of current capabilities.

The *value* of the expectation is what has earlier been referred to as the "moralization" of the expectation: whether it's positive or negative. This is also operationalized based on the framework used by van Lente et al. (2013, 1619), which can be seen in Table 4:

**Table 4**
Framework to determine value of expectations (van Lente et al. 2013)

| Label | Description |
|---|---|
| Very positive expectations | Deterministic expectations. Occurrence of superlatives or emphasize a breakthrough character without mentioning forthcoming problems. Time to commercialization is often short. |
| Positive expectations | Expectations on a future for a technology (e.g. in terms of application or number of users) without mentioning forthcoming problems. Superlatives or breakthrough character is absent. |
| Expectations with both a positive and a negative element | Expectations seeing a positive future but mention problems that have to be solved in order for the technology to succeed. |
| Negative expectations | Expectations seeing problems around a technology which decrease the success of this technology. |
| Very negative expectations | Deterministic expectations. Technology is not expected to develop into applications nor commercialization. Negative superlatives or words as disappointment. |

The framework used in this thesis, however, differs from theirs in two ways: first, what they label as "Expectations with both a positive and a negative element" is rebranded to "Neutral". This is to include those expectations that are not necessarily both positive *and* negative, but those that describe more general possible capabilities of the technology without an attempt to pose them as positive or negative. Second, the framework used here only divides value into three tiers, rather than five, combining what van Lente et al. call “Very positive” and “Positive”, and “Very negative” and “Negative”. This is done to cluster the results, as the data set used here is relatively small compared to the one used by van Lente et al.

In addition to value and level, the time frame of the expectation is noted—with “near future” defined as anything within the next 10 years—as well as the actor who voices the expectation. For examining the rise of convergent expectations, once again Alkemade and Suurs (2012, 451) are drawn upon: signs of converging expectations are increases in project-specific and short-term expectations, as these two characteristics indicate the maturity in the technological development.

In summary, the following framework will be used to code the expectations found during the content analysis of each article retrieved from Atekst:

1. Level: Do the expectations pertain to specific capabilities (micro); to general features of the technology (meso); or to overarching features which place the technology in a larger societal context (macro)?
2. Value: Do the articles express positive, neutral, or negative expectations?
3. Time frame: Do the expectations relate to the near or the far future (“near future” is here defined as within the next 10 years)?
4. Actor: Is the expectation voiced by entrepreneurs (developers of the technology), policy makers, users (e.g. miners, merchants, or activists), incumbents (e.g. banks), knowledge institutions (e.g. academics, think tanks, or consulting firms), or the media (e.g. journalists or opinion pieces)?

Also the time the expectation is voiced (published) is recorded, to determine how and if the value of expectations change over time for different actors, and the context in which it was voiced, to determine which events may have been key in changing expectations.

## 3.4 Event history analysis

With regard to Gartner's Hype Cycle, the content analysis outlined is necessary to understand which events can be regarded as parts of the different phases—what served as an innovation trigger? What happened at the peak of the hype, and turned the tide?

Processes of change and development over time are the subject of *process studies*, which have a central focus on progressions of activities or events to describe change based on a narrative (Van de Ven 2007, 155, 194–96). In this thesis, the change and development of expectations to Bitcoin over time serves as the unit of analysis, and as such it uses *event history analysis* to examine if and when critical events occurred that affected the hype cycle. These events will be examined abductively—working with just the data and see what they show—to be able to sort them into categories that can be worked with narratively (Van de Ven 2007, 220). It is necessary here to define both what is meant by "event" and by "category".

According to Van de Ven (2007, 217), events are abstract, second-tier concepts that are built up from "incidents", which are first-tier, operational empirical observations, made up of "bracketed string of words… about a discrete incident…" (p. 218). Getting to events from incidents one can use an abductive approach, where one first examines the data and secondly see which events can be built from the incidents. In this case, voiced expectations could be classified as incidents, and events based on a larger number of incidents (i.e. voiced expectations) would emerge from a collection of incidents. Following Alkemade and Suurs (2012, 451), however, each voiced expectation is in itself an event. In this thesis, expectations will mainly be viewed as incidents, and its contents will reveal which category—or rather, *what* the expectation concerns—it falls into. Changes within each category will be able to tell us whether changing expectations relate only to specific uses of the technology—e.g. Bitcoin as a payment currency, or as a record for storing university diplomas—or to a more generalized view of what it can do. Narratively, this may provide insight into how changing expectations affect the hype around the technology, as well as possible paths for future development of it.

Deciding causality from events is one of the main weaknesses of a qualitative event analysis, as there is a myriad of different interpretations to any set of data, both regarding the events' meaning as well as their coding. The way to increase the reliability of the coding exercise in this thesis is to be clear on the process of analysis, but this is also where the quantitative parts of the thesis reenter. In addition to being used to identify hype patterns in expectations and attention, using the total numbers of expectations and articles allows for seeing where changes in attention or expectations occur, and thus where to look for key events.

## 3.5 Methodological limitations

The main arguments against the validity of the results analyzed later in this thesis, are a small data set and limited time frame. A quantitative and qualitative analysis of a larger number of media articles, both in terms of time period and sources, would have been preferable to a data set of 101 analyzed articles, but unfortunately time and resources did not allow for a larger analysis to take place.

Although the content analysis of articles was necessary to understand whether attention given the technology actually included expectations, and to understand how the expectations changed, it does raise questions about reliability and validity. As Van de Ven (2007, 219) points out, this can be counteracted by having two or more researchers each do the analysis, and then synthesize their results, or by running the analysis by key informants. Here also, time and resources presented themselves as problems. The analysis has been attempted clarified in previous sections of the thesis, and a list of the 101 articles analyzed can be found in the appendix, but the analysis was done by one person alone. This influences the data used for analysis in this thesis, and a larger future study following the same methods would be expected to find more reliable results and would be conducive to the further development of the field of expectations studies.

Due to the coupling of Bitcoin technology and the price of bitcoin as a currency or investment object, the choice of investigated technology is also open for questioning. Although Bitcoin was decided upon rather than e.g. blockchain, due to the clear majority of interest in these two technologies went to Bitcoin, much of the interest found concerning Bitcoin was related to its price. The study of price dynamics and psychology can be interesting, but is outside this thesis's area. As the economist Torbjørn Bull Jenssen said in one of the articles analyzed: the market is very sensitive, and psychology can affect price fluctuations even if there have not been many news stories (Martin Hagh Høgseth 2018).

# 4 Technology

In order to understand why there has been a huge increase in interest surrounding Bitcoin, it helps to understand its features, here by looking at the underlying technology: blockchain technology (BCT). This chapter will examine the workings of BCT—by studying how Bitcoin works—including its history, some of its greatest challenges, and what has by some been called the *true* innovation in BCT: consensus mechanisms. It will then summarize some of the main points of hype surrounding the technology—that is, what do its advocates promise it can do?

## 4.1 Inside the blockchain

A blockchain a decentralized ledger technology (DLT). This means that every action on a blockchain is viewed as a transaction—in the conventional, fiscal sense—and recorded in a ledger that is stored and updated across innumerable hard drives. More traditional databases are, in contrast, composed of servers where all the users' information is stored. The company which runs and owns the servers usually also owns the information that is stored there. While this may be to the detriment of libertarians, privacy advocates, blockchain enthusiasts, and others, the hierarchical structure ensures that there is no need for any disagreement of which information is correct—the one recorded in the database by those users with the necessary privileges is the one. On the other hand, many blockchains, especially the largest ones we tackle here, are open and transparent. In other words, any user can read and write any data to the blockchain. Ensuring that all nodes on the network can agree on the correct information is one of the challenges that have long stymied distributed computer systems, and one which—with blockchains—new mechanisms using cryptographic proofs have arisen to answer.

Blockchains first entered the scene in 2008, when a paper detailing a distributed, peer-to-peer payment system was released (Nakamoto 2008). The author or group of authors—the identity of who was behind the paper is still a mystery—called itself Satoshi Nakamoto, and the short paper, titled *Bitcoin: A Peer-to-Peer Electronic Cash System*, sought to all but eradicate financial transaction costs which arises through the need for financial institutions to mediate all electronic transactions. The system was to become Bitcoin[1], and while there had been several attempts at developing similar digital currencies before—Nakamoto even refers to them in the paper—the author(s) of the paper proposed a new solution to the *double-spending problem*.

Electronic transactions differ from physical transactions in several ways, but perhaps the most important is this: electronic currencies are bits on a computer, easy to copy; physical currencies are cash, hard to forge. If you hand a bill to a friend, your friend can trust that you have not used the same, physical money to pay someone else. When that money is sent electronically, however, your friend has no choice but to trust that the banks mediating the transaction ensure that the money you send is both real and previously unused. This, in addition to keeping and updating the ledgers of who owns what, necessitates the mediation of financial institutions, and drives up transaction costs.

[1] Uppercase "B" denotes the protocol/software; lowercase "b" denotes the currency and units thereof.

To understand how a blockchain is able to automatically ensure the security and reliability that institutions currently stand for—and as such understand why BCT is promised to totally subvert said institutions—we need to dive into the technical workings of the Bitcoin protocol, and unpack the meaning of a "peer-to-peer distributed timestamp server to generate computational proof of the chronological order of transactions" (Nakamoto 2008, 1).

## 4.2 Technical aspects

For the sake of simplicity, this section only be concerned about the workings of the Bitcoin protocol. Other blockchains—such as Ethereum, Ripple, Bitcoin Cash, etc.—follow essentially the same rules, although their purposes in part differ from that of Bitcoin.

Every blockchain has a "currency", although the currency is not necessarily used as a currency in the normal, financial sense. As such, the cryptocurrencies are sometimes called "tokens", and they are used for executing transactions on the blockchain. On Bitcoin the token is called *bitcoin* (BTC), and is used for financial transactions; on Ethereum the token is called *ether* (ETH), and is used for executing programs—smart contracts; on Ripple the token is called *ripple* (XRP), and is used as a mediator when converting different currencies. Tokens are used as a way of imposing a cost to using the blockchain, as a reward for those working to uphold the blockchain (verifiers, i.e. miners, for Bitcoin get rewarded in bitcoin), and as a way to raise resources for new blockchains (initial coin offerings (ICOs) allow actors to invest in the chain and get rewarded not with stakes in a company, but with tokens on the chain). Tokens are made up of a set of transactions. In other words, to answer the question of what a bitcoin *is*: a bitcoin is composed of however many transactions needed to make it up—either one transaction worth BTC 1, two transactions worth BTC 0.25 and BTC 0.75, etc. If you have three incoming transactions to your account with BTC 0.5, BTC 1.24, and BTC 0.09 you have a total of BTC 1.83. While I here focus on financial transactions using bitcoin, whenever there is talk of "cryptocurrency", there is not necessarily talk of finance.

Much like systems already in place for sending money between two parties, bitcoin concerns itself with sending value between people. It differs from orthodox financial institutions, however, through the way it handles the transactions. To be able to receive bitcoin you need an address—much like a bank account. This address is a represented by a public key[2], and can be accessed by anyone with the right private key—much like a password to your account[3]. Your private key is along with your public key used to verify that you are the owner of the "account", and so as with your normal bank account it's necessary to keep it a secret. Unlike your normal bank account, however, the private key is not stored anywhere on the server. That is, if you lose or forget your private key, there is no way to access the funds you have in the corresponding account (Antonopoulos 2015, 61). Losing the key is one of the main reasons for "lost" bitcoin (Roberts and Rapp 2017).

To be able to send bitcoin, the system has to verify three things: that you have bitcoin on the address you wish to send from, that the bitcoin you have are real, and that the bitcoin you have are not already spent somewhere else (see the double-spending problem). The first two are solved by ensuring that you have incoming transactions to your account—received bitcoin—that in total add up to at least the amount of bitcoin you wish to send. As each bitcoin, either the one you're using or the one you're receiving, is composed of transactions, it's possible to follow the history of a coin back to the time it was created, thus verifying its integrity. When an incoming transaction is used to make up an

[2] An example of a public key is *04fc4e1f4ffde3106449c46365af1cb4c1b14eb485a2ed00261e15840cc3ed3dfe99fbe9036 9a7d631f6e4d9319a549ae81a8aaae2e9b04ed8ce5c47107a055ff7*.

[3] Unlike a conventional password, the private key is a 256-bit number. An example of a representation of a private key is *2ea34a312e7ad46f5d8873796d975b3fcdc98d481a05d9a6c9587ca50b9dcfc6*.

outgoing transaction, this is registered and the used transaction cannot be used again. How this is done is what solves the third problem of double-spending, and makes Bitcoin different from earlier decentralized computing systems and able to facilitate transactions without the need to mediate them.

### 4.2.1 Consensus algorithms

As briefly mentioned, blockchains differ from conventional databases in their transparency and openness. Blockchains are ledgers: they are long lists containing transactional information between actors. In public, open blockchains—which all the largest are examples of—anyone can view the ledger, all the way back to the Genesis Block (the first transaction made), and anyone can write new transactions to it. The challenge then becomes how you can trust the information in the ledger, and thus that transactions made in the past and the future will be valid. In a blockchain, each unit connected to it are nodes in a network. When enough nodes are updating the network at the same time—e.g. when one performs a transaction, this is added to the ledger and so updates it—different nodes invariably end up with different versions of the ledger. In one, Alice performs a transaction first; in another, Bob does. Agreeing on the order of transactions is important, as each bitcoin exists only *as a set of transactions*. Bob can only use a bitcoin Alice sent him if her transaction exists before his on the chain. This is what Nakamoto referred to as "chronological order of transactions". In addition, in a distributed system there is a need to overcome the Byzantine Generals' Problem—some nodes may maliciously attack the network, and the rest of the nodes need to be able to distinguish between information that is correct and information that is tampered with (Mingxiao et al. 2017, 2567). Answers to these challenges come in the form of *consensus algorithms*.

There are several different consensus algorithms, but as they quickly become too technical to be of use to this paper's purpose, I will again focus on one: proof-of-work (PoW). Proof-of-work is the original consensus mechanism put forward by Nakamoto, and is the mechanism used in the largest chains, including Bitcoin (although some, due to challenges posed by using PoW, are looking to change to for example "proof-of-stake" or "Practical Byzantine Fault Tolerance"). To understand PoW, however, we first need to go deeper and understand what makes up a blockchain.

### 4.2.2 The block

Blockchains are distributed ledgers, but it is too demanding to verify all transactions constantly, so transactions are collected together and put into blocks. Each transaction is encrypted using the publicly available SHA-256 algorithm, which turns the information in the transaction into a key—a *hash*. As is normal with modern encryption, getting the hash from the information is simple—just pass it through the encryption algorithm—but getting the transactional information from the hash is next to impossible. Each generated hash is unique, and has the attribute that if just one bit of information that went into the algorithm is changed, the hash changes completely.

After transactions are encrypted once, they are further encrypted along with other transactions—and encrypted again and so on—creating a *Merkle tree* (Antonopoulos 2015, 164). The root of the tree is a hash that is only possible to generate if all the information contained in it—possibly several thousand encrypted transactions encrypted with each other—is exactly as it is. Along with the root hash at the "top" of the block is included a timestamp, the hash of the previous block, and a nonce (Antonopoulos 2015, 160). The timestamp ensures that each block is sorted in chronological order; the hash of the previous block chains the blocks together—hence its name. (See Figure 6 for an illustration of a block of data on the Bitcoin network.) The nonce is initially unknown, and so poses a challenge: whoever finds a valid nonce will be rewarded in bitcoin.

A valid nonce is a 256-bit piece of information that, when combined with the rest of the information in the block and then encrypted, produces a special kind of hash. (Note that there is not just *one* valid nonce per block—several different may produce a hash that is accepted by the system, but it's the first valid nonce found that usually solves the challenge and awards bitcoin.) By adjusting the bar for what kind of hash is accepted, one adjusts the difficulty of solving the challenge. One can set the bar low: if the hash produced by the information at the top of the block—including the nonce—has to start with the number zero, many different nonces will produce a satisfactory hash. Usually, however, this would lead to a solution to the challenge much quicker than the system would like, and so the difficulty is adjusted up. If the produced hash has to start with five, ten, or fifty zeros, the amount of acceptable nonces go way down.

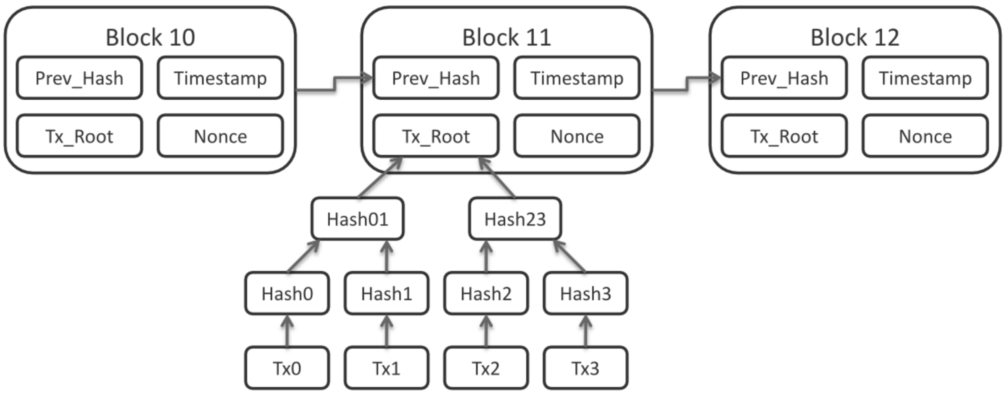



*Figure 6: The data in a block on the Bitcoin protocol (Matthäus Wander, Wikimedia Commons, CC-BY-SA-3.0)*

### 4.2.3 Mining

It lies in the nature of the challenge that there is no shortcut to finding a valid nonce. In practice, all one can do is guess: add the number $n$ to the information, check if it produces an acceptable hash; add the number $n$+1, check it, etc. This may sound like tedious work, but the reward can be great: when a computer submits a nonce that produces an acceptable hash to the network, the rest of the network checks it validity (it's easier to check a nonce than to find it; just add it yourself and see if you produce the same hash). If the nonce is accepted by the network, tokens are released to the finder and the network moves on to verifying the next block of transactions. In Bitcoin this means that each "winner" is rewarded with bitcoin, which we have seen can be quite valuable indeed. As these bitcoins are registered as a transaction seemingly out of thin air, this is the only way new bitcoins are "minted", and those who enter the contest to win bitcoin are known as "miners". Miners play a valuable role in the network, as it is their computations that uphold the integrity and validity of the blockchain (Antonopoulos 2015, 27).

Each node in the network has the ability to download the blockchain and mine for bitcoin. It's possible to use bitcoin without downloading the whole chain; you can send transactional information to the chain and let someone else check that a) you have the money you're spending, and b) you haven't already used it elsewhere—or if you're using your computational power to mine as part of a larger group (a pool), the pool sends you the parts you need for your mining activity. To mine solo, on the other hand, you need access to the entire blockchain as each blocks references the previous block, all the way back to the Genesis Block produced by Nakamoto at 18:15:05, January 3, 2009 ("Bitcoin Block # 0" n.d.).

Each block's hash includes the hash of the previous block, linking all the blocks together in a chain. Due to the encryption algorithm, even changing one bit of transactional information in a block changes the hash all the way up the Merkle tree, and so changes the block's hash, and this is what ensures the integrity of the blockchain. If a malicious actor tries to tamper with the blockchain—say Eve wishes to double-spend a bitcoin she receives from Alice, or wishes to add a fake transaction that gives herself BTC 100—this changes the transactional information in at least one block. This change propagates all the way to the top of the block, changing that block's hash. But the new hash is not the one that is included in the next block, and so the change is easy to spot. For Eve to get away with her tampering, she needs to find a new nonce for the block she has tampered with, as well as all the succeeding blocks. In addition, she needs to do this before the newest block is verified by the miners; the blockchain is programmed so that when a new block is added to the chain, everybody's ledger gets replaced with the version that contains the new block, and this version does not have Eve's tampering in it. This aspect of a blockchain ensures that all information written to it is immutable; once on the blockchain, it is not possible to change it.

Due to the difficulty in finding a valid nonce, the contest is essentially a lottery. Like any other lottery, you can increase your chances of winning by buying more tickets—in a lottery decided by PoW, the tickets are the amount of computational power used (Antonopoulos 2015, 188–89). If you have faster hardware, you have a larger hash rate per second, which increases your chances of being the first to guess at a valid nonce (van Valkenburgh 2016, 19). This has led to several innovations in the field of computational power mining. Miners moved from normal central processing units (CPU), which were slow and slowed down the performance of the computer due to its high energy usage, to graphical processing units (GPU), which are more powerful and use less energy. This is what all miners are after in their hardware: a larger hash rate for a lower power cost. This lead to the development of application-specific integrated circuits (ASIC machines), which are hardware specialized for mining bitcoin. The difficulty of the challenge, however, gets adjusted based on the global processing power of the network, and for Bitcoin it gets adjusted every 2016 blocks to a level where the global mining community spend on average ten minutes to verify a block. The larger the global processing power, the harder the challenge has to be to ensure the average of ten minutes per block, and the harder it will be for Eve to tamper with the blockchain.

Sometimes the chain *forks*, and two blocks—block A and block B—with different transactional information contained in them get verified and added to the chain at the same time. When this happens, some miners work on verifying a new block (block A+1) which includes the hash of block A, while others on a block which contains the hash of block B (block B+1). Eventually, one of the paths "pulls ahead", and all the nodes on the network switch to working on that path. The path with more blocks necessarily has had more computational work poured into verifying blocks, which gives proof-of-work its name. (Other consensus mechanisms resolve conflicts differently—proof-of-stake, one of the main contenders to proof-of-work, gives more power to those actors with a larger stake—more tokens— in the chain.) If your transaction is contained in a block that is replaced when the network agrees on the longer chain, it will disappear. Because of this, it's generally agreed that a transaction is not final (safe) until a certain amount of time has passed, usually about an hour (or approximately six iterations of block verification).

In addition to making sure that everyone in the network agrees on what is correct ledger information, following the longest chain increases security in the network. For Eve to achieve her tampering with the ledger, she needs to, on average, have more than half the computational power of the network. This would allow her to win the lottery and add new blocks in just enough cases to make her malicious version of the ledger become the reigning version—a 51%-attack. Such attacks are understandably hard to pull off, but the increase in global processing power, which is supposed to secure the blockchain, might be exactly what makes it possible (Antonopoulos 2015, 210).

### 4.2.4 Challenges posed by power-of-work

As more and more processing power is devoted to mining for bitcoin, the difficulty of winning the lottery increases. To increase their chances of winning, miners acquire more processing power, which in turn again raises the difficulty of the challenge, and so on. A circle like this leads to some the main challenges for the PoW consensus mechanism.

First, to be able to have any reasonably chance of winning the bitcoin lottery, you need a lot of computational power. This has led to the creation of so-called mining farms—warehouses filled with servers solely dedicating to hashing. While this is what makes it possible to trust the integrity and validity of the blockchain without a mediator (the main point of the blockchain in the first place), such a concentration of hashing power increases the chances that an actor may be able to perform a 51%-attack. Mostly, however, mining farms participate in mining pools, and this is where the biggest problem lies: the five or six largest mining pools together has more than 50% of the global hashing power (Mingxiao et al. 2017, 2571). In addition, while there have been established mining farms in Norway which experience their own problems (Aarekol and Løken 2018), processing power is concentrated in a few countries (Patel 2017). This opens the blockchain to the possibility of being controlled—or at least affected—by local policies not necessarily aligned with the intention of creating an open and transparent ledger.

One of the largest countries is China, where mining power has concentrated partly due to cheap, coal-reliant electricity. For that is the second main challenge of PoW: its enormous need for power, which is often not green, is not sustainable. According to Digiconomist as of this writing, the Bitcoin blockchain currently uses more energy that Chile, and only slightly less than Austria ("Bitcoin Energy Consumption Index" 2018). One transaction using bitcoin uses the same amount of energy that could power just over 32 American households for a day, and the power usage may just continue to increase.

Finally, Bitcoin is not a fast system. It's true that when you receive your coins, and the transaction has been verified far enough into the chain to be reliable, the coins are yours to own; you don't have to wait for your financial institutions to settle eventual backlogs to agree on the fact that you now own the coins. Getting rid of the mediators, though, increases latency on micro-transactions. It might be fine to wait an hour for larger payments to go through, but if you need to have hold of the money fast, it becomes a challenge[4]. While technically possible, scaling a blockchain using PoW is unfeasible—the latency for transactions get added to a block either gets too high, making a transaction simply becomes too expensive (where you need to add a small fee to your transaction that goes straight to the miner as a reward for choosing to include *your* transaction in a block (Antonopoulos 2015, 27)), or the power usage of the blockchain becomes unsustainable.

## 4.3 The problem with immutability

Blockchains are often heralded for their immutability, which even I have described them as, thus far. If one is to use BCT/DLT and legislate it, however, it's necessary to know that just because data is on a blockchain, it is *not* necessarily immutable. As Walch points out (2017, 738), both a hard fork in the Bitcoin blockchain in 2013 and the hard fork in the Ethereum blockchain with the hacking of the DAO "…demonstrate at a minimum that it is problematic to describe blockchain technology as a whole as immutable … [P]eople can always agree to override the technology" (2017, 739). Although other discourse on BCT states that "[i]mmutability is a characteristic of blockchain technology" (Pilkington 2015), Walch argues that immutability is an *emergent* property of decentralized ledger technology, and there is no consensus on how to achieve it (Walch 2017, 742). Being aware that immutability is not *necessarily* a property of blockchains, and that immutability may

[4] Solutions to the problem of scalability—either by increasing the amount of transactions in a block, creating an extra layer in the blockchain reserved for micro-payments, or reducing the time for verifying a block—constitute some of the largest discussions concerning the future development of Bitcoin and blockchains in general.

indeed be impossible to achieve, is important if the technology—and especially the term "immutability"—is to be included in regulatory decisions.

## 4.4 Some technological promises

Still, blockchains are hard to change—either through the need for the community to reach a consensus to make a hard fork, or for a malicious attacker to mount enough computing power to make a 51%-attack. While much work and experimenting still has to be done to find out how to regulate the technology, find out whether a public or permissioned blockchain is best for a specific need, and if cryptocurrencies can ever be a real threat to fiat currencies, there is no lack of hopes surrounding blockchain technology. In this section I will expand slightly on exactly what proponents of the technology are hoping it could achieve.

### 4.4.1 Finance

First and foremost, blockchains and cryptocurrencies vowed to disrupt the world of finance. Springing from a libertarian streak in a time when trust in existing financial institutions were low (Golumbia 2015, 125; Botsman 2017, 207), however, Bitcoin is seen by some to have failed in becoming a viable financial transaction service. In addition to the asset bubble of late 2017, concentration of Chinese mining pools (as discussed earlier) and a falling number of retailers accepting bitcoin (Greenfield 2017, 145), one of Bitcoin's early adopters and core developers, Mike Hearn, sold all his coins in 2016 with the reason that the community, and hence Bitcoin, had failed (Hearn 2016). There are many reasons for his decision, including scalability problems due to a limited block size, perverse incentives from core developers and too powerful miners to upgrade the blockchain to a level where it is sustainable, but the main take-away is that Bitcoin as a subversive force on the world's financial institutions has failed. At least, it is not obvious that Bitcoin will become what the initial cyberlibertarians hoped for (Golumbia 2015).

### 4.4.2 Smart contracts

Ethereum is currently the second largest blockchain in existence as measured in market capitalization (CoinMarketCap 2018a). Ethereum looks to be a universal platform that other services and applications can build upon—a blockchain-based operative system, aiming at using the technology to create a world-spanning decentralized computer. Similar to other blockchains, Ethereum has its own token, ether, which is used to perform transactions. On Ethereum, however, transactions are not used in the same financial sense as in Bitcoin, but are used to implement and activate *smart contracts.* (Its founder, Vitalik Buterin, even avoids terms used so far in this paper, such as "ledger", "money", or "transactions" in order to highlight that blockchain does not necessarily relate to financial proceedings (Buterin 2015).) These are essentially lines of code—programs—which are automatically carried out when certain criteria are met. As the programs are recorded to the blockchain, they are deemed immutable—hence a "contract". As they will automatically execute, they are "smart". This innovation has led to the creation of several programs that attempt to completely automate activities that previously have been done by humans—such as running an organization—by automating all routines, they create a decentralized autonomous organization (DAO).

The first great experiment in DAOs was the organization called the DAO. Created as a service to allocate venture capital to companies deemed deserving through a vote held by the community, the DAO did not last long. Shortly after launch—and after criticism by computer scientists regarding software and economic flaws (Metz 2016)—a security hole was exploited to siphon off approximately $60 million in ether (Castillo 2016). In an autonomous organization, code is law, and as the theft happened in accordance with the code, it was considered legal by the system. The community was divided on how to handle the malicious activity, but Ethereum's lead developers—the DAO was built on the Ethereum chain—decided to "hard fork" the chain. That is, retroactively change the ledger so that the siphoning of assets never happened—at least on the new chain. The community split between those agreeing to hard fork, and those who argued that the whole premise of the DAO was that it was not supposed to be "ownable", and that as the ether was stolen legally it was to remain lost (Botsman 2017, 228–30). Ethereum is to this day split into "Ethereum" and its side-chain "Ethereum Classic" as a result of this.

### 4.4.3 Information infrastructure

The Internet started out as an open network which consisted of open-source, transparent protocols that enable computers to exchange information and agree on how they should exchange it. These protocols still exist today—email is based on POP, IMAP, and SMTP; the Internet is still connected through TCP/IP; websites still use HTTP, etc.—but the initial open nature of the Internet has changed. Companies established during the late 1990s and early 2000s have grown at an impressive rate to become some of the world's most valuable companies (Shen 2018; Johnson 2018). A combination of an increase in Internet usage and network effects—whereby the more people use a service, the better the service becomes, increasing the influx of new users, which makes the service even better, and so on (Investopedia 2010)—has helped these companies become dominant on the world stage; both US-based FANG (Facebook, Amazon, Netflix, Google) or China-based BAT (Baidu, Alibaba, Tencent) (Ferguson 2017, ch. 59). Meanwhile, proponents of BCT hope that a return to the old ideals of the Internet, with open-source software and free-to-use protocols, will be made possible through the use of blockchain as an information infrastructure (Ølnes 2016; Ølnes and Jansen 2017; Johnson 2018), thereby allowing us to transfer data and use services between what the dominant companies in effect are creating: silos.

## 4.5 Summary

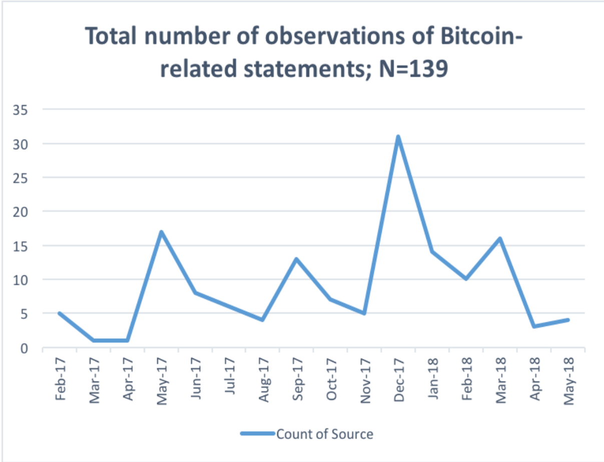
In short, what we are dealing with is a novel technology that promises anything from decentralizing all financial transactions to automating organizations without there being a man in the middle controlling it. Bitcoin was the first of these technologies, and is perhaps the most famous—it is the largest in market capitalization, and interest in it versus interest in blockchain in general is, as shown in Chapter 3, much larger. Still, while there are a lot of hopes for what Bitcoin and other blockchains will be able to do—or have been shown to be able to do already—the purpose of this thesis is to study how specifically voiced expectations have changed and, potentially, converged. To examine this, it's not enough to read what proponents of the technology have of expectations, as these are necessarily positive and promise great things; it's necessary to look into what other actor groups, such as knowledge institutions, users, policy makers, and not least the information distributors—media—expect of the technology. These groups, after all, make up a much larger portion of the population than the entrepreneurs, who make up just one group in a society where several actors' expectations are thought to influence the direction of the development of Bitcoin.

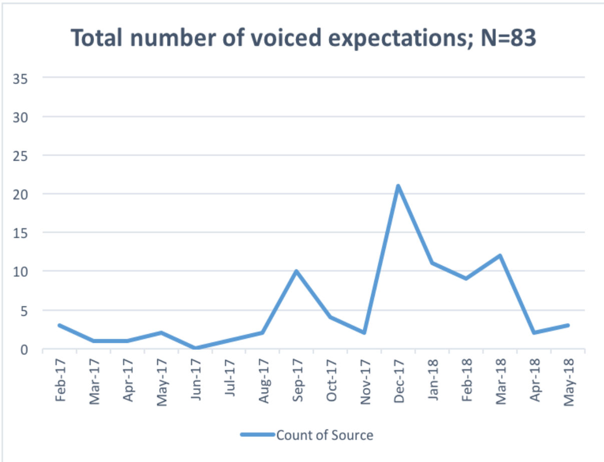
# 5 Results

This chapter describes the findings of the data collection, as well as the results of the content analysis of media articles. The time frame, as mentioned, used was October 1, 2016, to May 31, 2018, and the search word used was “bitcoin”. It was concluded that this key search word encompassed most of the attention given, as there were only a few articles that were included by also using the search term “blockchain”. It was also the much more popular search term, as shown in Figure 5.

## 5.1 Quantitative results

The search interest in Norway for Bitcoin has already been shown in Figure 4, which also shows how it corresponds to the rise and fall of the price of bitcoin. This was to delimit the time frame articles were collected from the four chosen news sources, and thus which articles the expectations analyzed were from. After the screening process, 101 articles were left for analysis, as shown in Table 2. In these articles there were identified 139 Bitcoin-related statements, but only 83 of these, from 47 articles, where voiced expectations. Figures 7 and 8 show the temporal distributions of the total number of Bitcoin-related statements and the total number of voiced expectations.




*Figures 7 and 8 on the temporal distribution of observations in the data set*

First to note is that there were no observations of any Bitcoin-related statements or expectations before February 2017 after the screening process, which effectively put the start date of the study at this date. Second, in both figures there's a clear peak of observations in December 2017 which aligns both with the price peak and the peak in Google searches (cf. Figure 4). In Figure 8, however, the second-largest peak in Figure 7, in May 2017, is gone. This was the time the virus WannaCry happened, and the virus demanded bitcoin for unlocking the infected computers (Sarmadawy 2017). The number of articles and observations concerning Bitcoin were thus large at this point in time, but almost none of the articles contained any expectations, which is why the peak disappears when filtered for expectations.

For expectations, there are therefore two distinctly identifiable peaks: September 2017 and December 2017. While it looks like another peak in March 2018, this is due to expectations coming from one feature length article; it can be viewed as a small up-tick in a general declining trend which lasts at least until April 2018. In the discussion of the results, the peaks in September and December will be zeroed in on to examine what may be contributing causes to changes in expectations—why did they increase in amount, and why did they subsequently fall?

### 5.1.1 Breakdown of expectation characteristics

This section provides the distributions of the expectation characteristics as identified by the content analysis of the articles. Preceding that, however, there are two notes to the characteristics analyzed. First, regarding the level of the expectations. Of the 139 Bitcoin-related statements observed in the data set, 26 were project-specific. None of these, however, were voiced expectations; they almost all related to specific uses of bitcoin in criminal cases (such as WannaCry), and so the micro level of expectations will not be part of the further analysis, simply because there are no observations of them.

Second, the time frame characteristic of the expectations showed to be irrelevant. There were five expectations that contained a time frame. Although all five were short term, they do not provide enough information to indicate any level of maturity or convergence of expectations between actors, and this characteristic is thus also excluded from the rest of the analysis. In the following the quantitative distributions of the frame and general level expectations, the value of expectations, and the actors voicing the expectations will be presented. Since a study of changes in expectations necessarily is a study of expectations over time, the data is presented by their temporal distributions.

First, the level of the expectations. Without the project-specific level in voiced expectations, only frame and general expectations were observed. There was a total of 35 frame expectations, and 48 general expectations. The main peak as identified in Figure 8 appears to consist mainly of general level expectations, which peak in December 2017, while the frame expectations are more stable in amount from September 2017 to March 2018. Table 5 summarizes this data, which is shown in Figure 9 at the end of this sub-section.

Second, the value of the expectations, of which 37 were positive, 14 were neutral, and 32 were negative. The expectation peak in September 2017 consists almost entirely of negative expectations, while the December peak is more balanced, if slightly in favor of positive expectations. Beginning in January 2018, while positive expectations are falling, negative expectations are rising, both in total numbers and as a percentage of the total number of expectations made. Table 6 summarized this data, which is shown in Figure 10 at the end of this subsection.

If we sort the value of expectations by level, we get the following numbers: frame expectations were mostly positive, with 17 positive expectations, 11 negative, and 7 neutral. Although the negative frame expectations outnumbered the positive frame expectations in September 2017, the opposite was true for all of the other months except March 2018. In short, voiced frame expectations were mainly positive, all through the time period studied. General expectations were more equal in value: 20 were positive, 21 were negative. Seven were neutral. Unlike the frame expectations, the majority of the positive expectations were voiced up through December 2017, while a majority of the negative general expectations were voiced in 2018. In other words, when looking at all actors as one, there was stability in frame expectations, which remained mainly positive, and a shift in the general expectations from mostly positive to mostly negative.

**Table 5**
Distribution of expectations sorted by level

| | Feb-17 | Mar-17 | Apr-17 | May-17 | Jun-17 | Aug-17 | Sep-17 | Oct-17 | Nov-17 | Dec-17 | Jan-18 | Feb-18 | Mar-18 | Apr-18 | May-18 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frame | 2 | | | | | | 7 | 3 | 2 | 4 | 4 | 4 | 7 | | 2 | 35 |
| General | 1 | 1 | 1 | 2 | | 2 | 3 | 1 | | 17 | 7 | 5 | 5 | 2 | 1 | 48 |
| Grand Total | **3** | **1** | **1** | **2** | | **2** | **10** | **4** | **2** | **21** | **11** | **9** | **12** | **2** | **3** | **83** |

**Table 6**
Distribution of expectations sorted by value

| | Feb-17 | Mar-17 | Apr-17 | May-17 | Jun-17 | Aug-17 | Sep-17 | Oct-17 | Nov-17 | Dec-17 | Jan-18 | Feb-18 | Mar-18 | Apr-18 | May-18 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Negative | | | | | | | 8 | | 1 | 8 | 3 | 4 | 5 | 1 | 2 | 32 |
| Neutral | 1 | | | 1 | | | | 2 | | 3 | 2 | 1 | 4 | | | 14 |
| Positive | 2 | 1 | 1 | 1 | | 2 | 2 | 2 | 1 | 10 | 6 | 4 | 3 | 1 | 1 | 37 |
| Grand Total | **3** | **1** | **1** | **2** | | **2** | **10** | **4** | **2** | **21** | **11** | **9** | **12** | **2** | **3** | **83** |

**Table 7**
Distribution of expectations sorted by actor

| | Feb-17 | Mar-17 | Apr-17 | May-17 | Jun-17 | Aug-17 | Sep-17 | Oct-17 | Nov-17 | Dec-17 | Jan-18 | Feb-18 | Mar-18 | Apr-18 | May-18 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Entrepreneur | 2 | | | | | | | | | | | | | | 1 | 3 |
| Incumbent | | | | | | | 2 | | | 5 | 1 | | 1 | 1 | 1 | 11 |
| Knowledge institution | | | | 1 | | | 4 | 3 | | 8 | 1 | 6 | 8 | 1 | | 32 |
| Policy maker | | | | | | | 2 | | | 2 | 1 | 2 | | | | 7 |
| User | | | | 1 | | | | | | | 2 | 1 | 3 | | | 7 |
| Media | 1 | 1 | 1 | | | 2 | 2 | 1 | 2 | 6 | 6 | | | | 1 | 23 |
| Grand Total | **3** | **1** | **1** | **2** | | **2** | **10** | **4** | **2** | **21** | **11** | **9** | **12** | **2** | **3** | **83** |

Third, the distribution of actors voicing the expectations. The two most vocal groups were by far the media and the knowledge institutions, followed by incumbents. The rise in expectations from the knowledge institutions follow the rise in expectations in general; as there was an increase in attention given to the technology, more and more news articles may have felt the need to involve knowledge institutions to explain the technology.

Knowledge institutions were mainly negative or neutral, voicing fourteen and ten expectations with each value, respectively; the remaining eight expectations were positive, which was more valued expectations than initially expected. The most positive expectations were voiced by the media—fourteen of their expectations were positive, with six negative and three neutral. An increase in the use of knowledge actors in the media is agreeable to Rogers's view of mass media as disseminators of knowledge (Rogers 2003, 205), but notice what happens after the peak: first, the amount of expectations drops to almost zero, before the level rises to what it was in December 2017 before tapering all off again for the remainder of the time period. If actors in the knowledge institution group were brought in to spread knowledge about the technology through mass media, this might be an expected pattern of voiced expectations in this group.

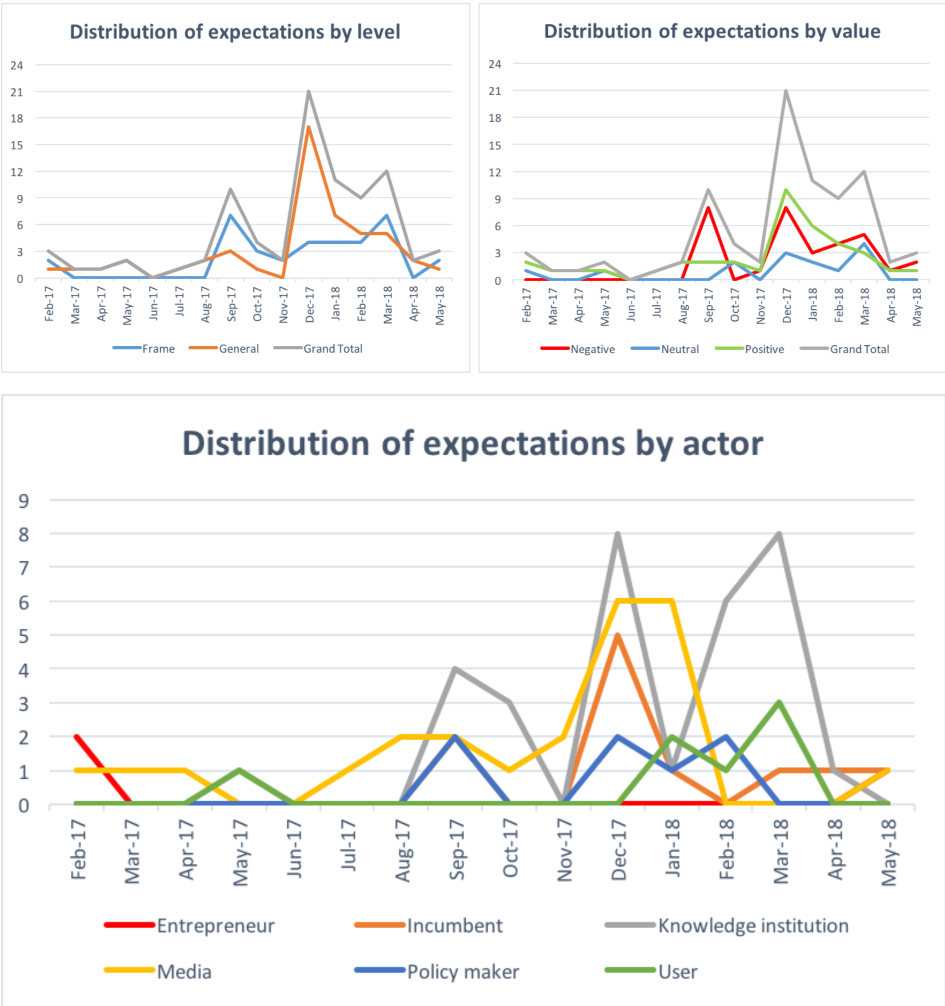
Although previous studies have shown that media attention influences media consumers' expectations (Lamla and Lein 2008), if that was the case here it did not show clearly in users' expectations—this group voiced seven expectations. It should be noted, though, that most were positive, perhaps due to positive news coverage. Still, regarding users' expectations, the data from Google Trends should be taken into account; they might not have been vocal, but they did search for the technology.

Contrary to what was expected of entrepreneurs strategically using expectations to create legitimization and draw resources to development (Geels and Smit 2000; Alkemade and Suurs 2012; Kriechbaum, Prol, and Posch 2018), entrepreneurs were the least vocal actor group, having only three voiced expectations. These were only voiced in the first and the last month included in the study, and although the first two were positive on the frame level, indicating perhaps an intention to draw attention to the technology, they do not continue doing this as time goes on. As reviewed in Chapter 4, there are potentially a lot of expectations as to what capabilities cryptocurrencies and blockchains in general—and bitcoin specifically—will one day have, but the lack of statements from entrepreneurs coupled with a lack of time-specific and project-specific expectations from actors across the board indicate no clear emergence of these capabilities. That is, at least, besides the use of Bitcoin as a currency or investment object. If that is the endpoint of the expectations to and development of Bitcoin, there might indeed be substance in those statements which call for developing other blockchains, rather than Bitcoin (Dahl 2018a).

Also perhaps surprisingly, incumbents had as many positive as negative expectations: five each. As the attention reached its peak in December 2017, banks and financial institutions were looking into how cryptocurrencies could revolutionize money transfer. After the peak, however, they were again negative, warning against fraudsters, white washing, and financial bubbles. Also, that the shift in negative expectations went from being on a frame, societal level before the peak, to a more general "toned down" level after the peak, can indicate that as knowledge around the technology diffused, other characteristics of the technology—other than that it would either never succeed or would somehow radically alter society to the worse—became more important for the incumbents.

Last are the policy makers, who also had just seven voiced expectations. The three positive expectations were voiced by representatives of other nation states interested in, or already in the process of, regulating and using cryptocurrencies themselves (Dahl 2018b), and one was Minister of Finance, Siv Jensen, expressing hopes of using the technology to improve cooperation (NTB 2017). The four negative expectations all regarded banning ICOs or warning of a financial bubble.

This data is summarized in Table 7, and is shown in Figure 11 below. Due to the relatively low share of the total expectations each actor had, a line showing the grand total per month is not included here. The reader is instead referred to Figure 8 to see the total.




*Figures 9, 10, and 11: Distribution of expectation sorted by level, value, and actors, respectively*

## 5.2 Qualitative results

In this section the results from the qualitative analysis is presented. That is, not only what characteristics the expectations had, but what they were and in what context they were voiced. This is so as to identify any key events, as well as examining how the actors' expectations change in content as well as characteristics.

The quantitative data has provided two pronounced peaks (cf. Figure 8), which each resemble the Hype Cycle's "peak of inflated expectations". Based on this one can identify four main turning points in the volume of expectations to the technology, all in 2017: August (1), after which expectations start to rise to the first peak in September (2); and November (3), after which expectations start to rise to the second peak in December (4). August and November are starting points in the rising expectations, and can be labeled according to the Hype Cycle as "innovation triggers" (or at least one can expect to find events that act as innovation triggers in these time periods). September and December are peaks, after which some form of disappointment sets in and results in the decline in expectations.

In the following, the changes in August and September will be presented as "Peak 1", and November and December as "Peak 2", and the voiced expectations for each of the peaks will be examined as first-tier, empirical observations (incidents), which together can make up second-tier, more abstract concepts (events) (Van de Ven 2007, 217–18). In order to examine the changes in expectations in a larger context than just within expectations, the total amount of Bitcoin-related statements will also be considered (see Figure 7), to see whether there are any incidents not comprising voiced expectations that nonetheless can have influenced the expectation patterns found.

### 5.2.1 Peak 1

In August 2017 there were two recorded voiced expectations, both of which were positive and voiced by the media. One expectation was related to an increase in bitcoin accepted as a payment system, and the other an expectation that transaction time in the network would be improved; the former made in the context of illegal use of computers to mine for bitcoin (negative context, but positive expectation), the latter in the context of the rising price of bitcoin. The latest of the expectations was voiced mid-August, and was voiced three weeks before the next expectation, which came in the start of September.

In September, as can be seen from Table 6, eight of the ten voiced expectations were negative. The first expectation is an expectation by the media that policy makers will increasingly do more to regulate cryptocurrencies, which later in the month negatively influences the price of bitcoin as China prohibits the use of ICOs to raise money for new cryptocurrencies. The peak in expectations happens approximately at the same time, in mid-September. This is when an incumbent—JP Morgan's CEO Jamie Dimon (Breivik 2017)—expects someone to be killed, and the media warns of a financial bubble, backed by knowledge institutions. The latter does also voice positive expectations to regulating cryptocurrencies, expressing hopes that it can include in the financial market actors who have previously been excluded, but this is the last voiced expectation of the first peak. At the end of the month policy makers expect South Korea to prohibit ICOs as well, and the media reports—without voicing expectations—of new cases of bitcoin used in fraud and selling of narcotics.

While September 2017 seems to constitute a preliminary peak in attention, it consists overwhelmingly of negative expectations. Although this was followed by a moderate lack of voiced expectations, the price of bitcoin continued to increase.

### 5.2.2 Peak 2

In November 2017 there were two voiced expectations, both by the media. The first, which came in mid-November, called for the use of bitcoin or other blockchains as a method of combatting tax fraud. The second, from the very end of the month, was negative, expecting that bitcoin would continue to be used by criminal organizations.

The peak in December begins at the start of the month, and a trigger for increased attention and expectations seems to be when the price of one bitcoin passed USD 15,000 (approximately NOK 100,000 at the time; a round-number benchmark for the price of bitcoin). This was when the media started reporting on the Winklevoss twins and how they had become billionaires on the "wacky" price rise (*VG* 2017), and shared opinion pieces voicing expectations to the technology, including challenges to overcome and issues on ICOs being started by illegitimate actors (Nagell 2017).

At the same time, most of the expectations voiced at the beginning of the peak were negative and made by knowledge institutions who warned of a price bubble and called for regulations so as to avoid a purely criminal use of the technology. All five of the incumbents' expectations, on the other hand, were positive; they expected the technology to revolutionize money transfer, but at the same time be a part of the revolution.

Data from CoinMarketCap show that the peak in bitcoin price came on December 17, 2017, at just under USD 20,000. This is just before Minister of Finance, Siv Jensen, warns of bitcoin being a bubble, while at the same time expressing hopes that the underlying technology—presumably blockchain—can be used to better cooperation. Perhaps the most internationally weighted event of this time, at least as presented in the data set, was an article concerning how interest from investors in East Asia had driven the price up (Wasberg 2017). Still, the price had already started falling by that time, and although no one knew that it would not pick up again, interest had also fallen; there was one "Everything you need to know" article, before the last two statements at the end of the month, which both again concerned criminal activities.

The first expectations in January were positive to Bitcoin, although there was a shift with an increase in neutral expectations—similar to Ruef and Markard's (2010) expectation that a peak would be followed by negative attention. There was also a shift to more expectations concerning blockchain, rather than Bitcoin, as the true innovation, and while there was still coverage of the price of bitcoin, it now concerned the falling price. With the knowledge of Bitcoin now diffused through the mass media, interest for the technology was perhaps saturated, and the repeated warnings of the price being a bubble—even policy makers warning against investing in it—can have contributed to turning the expectation patterns.

# 6 Discussion

In this chapter the results presented in the previous chapter will be discussed with regard to the research questions and its four sub-questions, as well as with regard to the previous literature and studies referred to in the second chapter.

## 6.1 Research questions revisited

At the outset of this thesis, four sub-research questions where posed as a way of understanding both the dynamics of the expectation patterns in different groups as they have been expressed, and of understanding how these expectations can influence the future development of the technological innovation system. They will here shortly be revisited and answered, based on the results from the quantitative and qualitative analysis.

**SQ1:** *How do the expectations to Bitcoin from different key actor groups hold up to the classic hype cycle pattern?*

The first research question concerned whether the attention given to Bitcoin technology over time would resemble the hype cycle pattern. The data show that some expectation patterns do, and some do not. Although all the actors combined to exhibit a pattern of expectations that resembles the Hype Cycle—a hype is, as mentioned, combining positive expectations with a high level of visibility—this is harder to identify when sorted by the different actors (see Figure 11). The majority of the expectations voiced were by knowledge institutions and the media, and surprisingly there were no signs of expectation patterns for the entrepreneurs. This does not lend credence to previous expectations of entrepreneurs using expectations to attract attention and resources (Geels and Smit 2000; Alkemade and Suurs 2012), but this may of course just be a result of a limited data set. The pattern of the media, on the other hand, does exhibit a hype pattern, although based on the number of articles that concerned rising prices and interest in the technology, there was likely a tendency towards media resonance (Järvenpää and Mäkinen 2008a). Examples of stories at this time included stories concerning how "bitcoin" was one of the top search terms on Google in 2017. Knowledge institutions for their part also resemble the Hype Cycle, but this seems to be tightly correlated to the media's expectations; as the media writes about the technology, professionals and academics are called in to explain the technology, and as the media moves on to other stories, this actor group disappears from view.

According to the Hype Cycle, the decline in volume of attention shown from all the actors is an indication of interest in the technology being in the trough of disillusionment. It is, however, difficult to spot a trough before interest in the technology eventually rises—if it never rises, it is less an indication of a trough than of a flat plain of disinterest. Additionally, looking just at Google Trend and historic price data, the interest shown may have tapered off not as a result of users' disappointment in the technology, but as a result of the knowledge of the technology having become widely spread and there thus being no need to search for the technology to understand it. (This is similar to the hypothesis regarding the drop in voiced expectations from knowledge institutions around the same time.)

The price drop of bitcoin can be an indication that, although it peaked concurrently with interest in the technology, the peak was a result of a large number of new entrants to the system—people who bought the currency and drove the price up. These entrants later either got disinterested, and sold their coins, thus causing an excess of free coins and a lowering of the price, or simply comprised the majority of people who were potential users of the technology. When the pool of potential entrant users to the system was depleted, there was not enough pressure on the currency to drive the price up. In addition, as the price of bitcoin is entirely based on supply and demand, there are groups who "pump and dump" the currency—buying it to drive the price up, causing existing and new users to buy the coin to join in the price rise, and then selling off coins at a profit, causing the price to fall again—which may have contributed to the price hike in late 2017 (Martineau 2018).

Identifying hype patterns may be more fruitful with a larger data set, especially if including bibliometric data from e.g. scientific databases (as per Watts and Porter (1997)). Looking at all the actors' expectations, however, this data set does resemble the start of the Hype Cycle. The question is whether that is enough to forecast anything about the future of the technology. As hypes can only be identified after they have happened, and a trough only after it has passed, examining actors' changing expectations tells us how we have come to the current state of affairs, but not what will happen. This ties in to previous criticism of the Hype Cycle as a concept that is good to use for getting an overview over existing technology alternatives, but that it does not necessarily give valuable information as to which alternatives survive a hype; some technologies just die, and others go under the radar of a hype cycle altogether (Mullany 2016).

**SQ2:** *Do changes in actor groups' expectations show any indication of a convergence of expectations?*

The data showed no indication of converging expectations. This is based on the indicators used by Alkemade and Suurs (2012), where project-specific expectations and short time frames are used to identify where expectations align between actors. If any, the only convergence of expectations was that different actor groups warned against the sharp price rise being a speculative bubble. Again, this shows in a lack of protected spaces for the technology (Konrad 2006; Geels and Raven 2006), and although it does indicate immaturity in technological development, it's important to remember that shared expectations is not a uniformly positive event; it makes reorientation after a disappointment more difficult (van Lente, Spitters, and Peine 2013, 1626). Pointing back to the current lack of interest in the technology, it is difficult to say whether a reorientation will occur and result in new hype patterns, but an increase in expectations relating to the generally applicable blockchain technology, rather than the specific application of bitcoin (Skogvang 2018), may be a sign that it will happen.

**SQ3:** *What do changing expectations and attention at different levels say about possible disappointment in the technology, and how does this relate to possible future development of the technology?*

When examining each actor group's expectations in isolation, the value of their expectations are quite stable: users and the media are mostly optimistic, incumbents are reasonably neutral, and knowledge institutions are mostly negative. This holds up across the time period studied. As such, to be able to study types of disappointment one needs to look at all the expectations as one. That is when we find that frame expectations are quite stable, while general expectations experience a hype. The same goes for the value of the expectations—positive expectations are clearly clustered around December 2017, while negative expectations are more spread out (see Figures 9 and 10).

Sorting for changes in frame and general expectations, and showing to Table 8, there are indications for classifying the changes in expectations across all actors as a Type 2 disappointment—called "Disappointment" (Ruef and Markard 2010, 334). The legitimacy of the technology at a societal level is intact, but there is a need for reorienting the technology in terms of application.

This is also the strength of combining the quantitative and qualitative methods used. Looking to the content of the expectations, it shows support for Ruef and Markard's typology: as disappointment set in and attention for Bitcoin fell, there were an increase in attention for Bitcoin's underlying technology, blockchain (e.g. Skogvang 2018). Blockchain appears to have kept its legitimacy, while Bitcoin has lost it due to a speculative bubble. Furthermore, as blockchains are more general-purpose than Bitcoin, it allows for experimenting with other applications. Although rejected by Parliament, policy makers in Norway have suggested to start experimenting with using blockchains in the public sector (Dokument 8:35 S (2017-2018)). That this is as yet not public policy, policy makers in Norway have not emerged as an influential selector of technological alternatives in this area (Kriechbaum, Prol, and Posch 2018).

Looking again to van Lente et al. (2013), the lack of emergent collective expectations may as such be viewed positively; a reorientation from Bitcoin to other blockchains may be easier to undertake as long as the actors involved are not involved in specific applications and expectations to Bitcoin.

Finally, as for the attention given to Bitcoin in the time period studied, the large amount of if that concerned crime or the rising price of bitcoin, and the lack of project- and time-specific expectations to future capabilities of the technology, indicate that perhaps Bitcoin was never hyped as a technology, but rather as an investment object which caused a price bubble, and a Dark Web currency which connects it in the minds of many to criminal activities.

**SQ4:** *Are there any identifiable key events that explain the actors' change in expectations?*

The qualitative analysis of the voiced expectations did not uncover any special events that triggered the first, smaller peak in September 2017, except that, as almost all the expectations at that point were negative, not all coverage is good coverage. But it did point to a large increase of expectations after the price of bitcoin rose above USD 15,000 at the start of December. In a sense, this confirms Fenn and Raskino's view that the innovation trigger may be a "rush of media interest that socializes and legitimizes the concept" (Fenn and Raskino 2008, 69)—the price could have risen a lot without anyone commenting on it, but since the media did, interest rose along with the price.

As for the major decline in expectations following the peak, this in turn appears to be due to a drop in positive expectations following the sharp drop in price. The technology was, as it were, the subject of a speculative bubble, which it was shown that investors in Asia partly were responsible for (Wasberg 2017). The global aspect of the technology means that there can have been other key events that affected the price, and consequently lead to the trigger in expectations and attention here in Norway, that were not identified due to not being reported in the Norwegian press. This is, in other words, an example of a technology that one has to look at international trends and events to be able to understand local enthusiasm and expectations for.

## 6.2 Implications

The current state of Bitcoin technology in Norway appears to be one of disappointment following a speculative bubble and a lack of application-specific expectations surrounding the technology. That the underlying technology, blockchain, seems to have made it through the disappointment (regarding the still positive frame expectations), suggests that there is still hope for BCT applications to be used, although not in the context of Bitcoin. Showing again to Bakker and Budde (2012), it seems that entrepreneurs have an opening, as enactors of expectations, to formulate new expectations that selectors such as policy makers and users can choose from. Such a reorientation should be possible, due to the lack of indicators for converging expectations. Of course, a study of the technology that is gaining tailwind—blockchain—might show a different picture.

Policy makers have the opportunity to be ahead of the curve, and look past the recent hype of Bitcoin to blockchain and its possible applications, setting goals and as such acting as a powerful selector. The lack of voiced expectations from policy makers in this study shows that they have not taken a prominent role thus far in the technology. Although that may have been positive in this case—Kriechbaum et al. (2018) show to research that policy makers selecting technologies too early can lead to a lock-in, which results in them losing credibility if the need to change the trajectory later on arises. Still, policy makers need to be aware of novel technological trends in order to not miss out if a successful application comes along. This thesis has shown that the classifications and typologies for studying expectations, hypes, and disappointments as suggested by Ruef and Markard (2010), Alkemade and Suurs (2012), and van Lente et al. (2013), are conducive to analyze actors' changing expectations and its effects on hype and disappointment. These are thus perspectives that would be advantageous for actors selecting amongst competing technologies on the basis of expectations to be aware of.

The addition of a qualitative content analysis has also shown to be useful, as it allows for identifying the characteristics, contents, and contexts of expectations. This, in turn, not only makes it possible to use the above-mentioned terminologies and typologies in analyzing the changes, but also to study the existence of key events which affect expectations. The way international events affected the price of bitcoin, and hence the interest in it, shows the importance of selectors to be aware of global trends. The content analysis also showed the value of being aware of media resonance when looking at expectations—if an actor gets caught up in the tide of overwhelming expectations, she may not realize that the hype may, at least partly, be fueled by the fact of its own existence.

# 7 Conclusion

When engaging in innovative activities, one necessarily works with a vision of the future. The way to convey this vision is through sharing expectations, or "real-time representations of future technological situations and capabilities" (Borup et al. 2006, 286). Theories on expectations' roles in influencing technological trajectories agree that to put force behind an expectation, they need to paint a moral value of the future (Berkhout 2006). Considering the level the expectation concerns (Ruef and Markard 2010; van Lente, Spitters, and Peine 2013) furthers the understanding of its impact, and allows us to identify converging expectations (Konrad 2006). Different actors will argue for futures that are most agreeable with their interests or preferred outcomes, and if successful in convincing other actors that their interpretation of what technological capabilities are possible and desirable, they can get other actors to align with them. Collective expectations are powerful in creating protective spaces, as different actors pulling together puts more force behind a technological development. On the other hand, in the case of a disappointment in the technology—especially after expectations are overblown with regard to positivity and amount in relation to actual technological capabilities, resulting in a hype—shared expectations can hinder a reorientation of the technology, increasing the chance that it never evolves and eventually dies.

Bitcoin is the largest of the cryptocurrencies, a technology that has received increasing attention the past years. In 2017 it experienced a price surge that was largely due to a speculative bubble, and attention for the technology in Norway and worldwide rose and fell along with its price. This thesis aimed to employ methods previously used in expectations studies to understand the current state of the technology and how changing expectations within different actor groups got us to this state, as well as what are possible future directions for the technology.

Using quantitative data from Atekst and Google Trends, and coding them in accordance with methods used by Ruef and Markard (2010), Alkemade and Suurs (2012), and van Lente et al. (2013), the study did find hype patterns, although some key actors were notably absent from voicing expectations to the technology—entrepreneurs and policy makers chief amongst them. Limitations of this study, primarily a small data set in terms of observations, sources, and time frame, can have contributed to this; a broader study may have uncovered voiced expectations that were not picked up here, especially regarding the lack of expectations from entrepreneurs and the lack of converging expectations. The former may be due to the data sources; entrepreneurs have, at least for this technology and time period, chosen to be vocal in other channels than the nation's two largest newspapers, if they were vocal at all. The latter may emerge in the case of a larger number of observations. Furthermore, a more comprehensive study could counteract questions of validity and reliability, in part by having several different people do the work of coding and analyzing the expectations (Van de Ven 2007, 219). It would also allow for studying specific actors' changing expectations—this study had too few observations to study most of the actors separately.

The thesis combined this quantitative data with a qualitative analysis of the expectations, a method that has lacked in many previous studies. This uncovered that the hype was mainly attributable to the rising price of bitcoin—which, as a global currency was not decisively affected by events in Norway—and the effect of media resonance. In contrast to the expectation of a technology being hyped through too many positive expectations, most of the observations of Bitcoin were here found in a negative context, e.g. being used in crime. As a take-away for all actor groups in public debates, this is an example of the importance of not getting carried away by media expectations when choosing to invest in innovations, and of the importance of being aware of international events when following a technology influenced by global trends.

As for Bitcoin itself, this thesis found indications that although general expectations to it have turned negative, societal frame expectations are still positive. Following Ruef and Markard (2010), this is an example of a Type 2 disappointment—a "Disappointment". To continue developing the technology, a reorientation to other applications of the technology is necessary. Seeing as how this aligns with an increase in attention the content analysis found for the general-purpose blockchain technology, the empirical data fits the typology. Whether the technology develops and succeeds or not is, of course, impossible to say with certainty until it happens; identifying a technology that has made it through the trough is only possible *ex post*.

The implications of this study are constrained by the limitations of this study, as mentioned. Also, as this is a global trend studied at a local level, comparisons between countries can be favorable to examining how expectation dynamics evolve at an international level. This may also reveal key events that had a great impact on the expectations, but which did not show at the national level. Another way to study key events is by combining the methods used here with interviews of key actors identified by an expectation study, getting their view on what was deemed important in changing expectations. This study found a correlation between the amount of expectations voiced by the knowledge institutions and media attention, but further work into the dynamics between knowledge diffusion and its effect on hype cycles is necessary to conclude anything about their relation.

Finally, although this thesis was limited in the amount of expectations it found and studied, the wider field of expectation studies is a useful tool for any practitioner working with innovation, especially when considering how other actors behave. In studying, reacting to, and voicing expectations, and thus bidding on one's preferred technological future, it's essential to remember that other actors are doing exactly the same.

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# Appendix: List of news articles analyzed

| Article title | Source | Date |
|---|---|---|
| • Momsfritak | VG | 10.02.2017 |
| • Hun lokker nordmenn til å satse store penger på omstridt nettvaluta | Aftenposten – Login | 10.02.2017 |
| • NY BITCOIN-REKORD | VG | 25.02.2017 |
| • Alt kan deles – unntatt overskuddet | VG Nett | 06.03.2017 |
| • Prisrekord etter Bitcoin-oppgang | VG | 29.04.2017 |
| • Bitcoin med ny record | VG | 11.05.2017 |
| • Norske fotballklubber og bedrifter rammet av internasjonalt dataangrep | Aftenposten – Login | 12.05.2017 |
| • Dette er løspengeviruset WannaCry | VG Nett | 13.05.2017 |
| • Dataangrepet: - Jeg frykter at mandag kan bli en svært krevende dag for mange IT-avdelinger | Aftenposten – Login | 13.05.2017 |
| • 22-åring bremset hackerangrepet | VG Nett | 13.05.2017 |
| • NSM: Norske bedrifter betaler hackere løsepenger | VG Nett | 13.05.2017 |
| • 170.000 datamaskiner rammet | VG | 14.05.2017 |
| • Norsk idrett og bedrifter rammet av internasjonalt dataangrep | Aftenposten | 14.05.2017 |
| • Europol: Dataangrepet rammet 200.000 ofre i over 150 land | Aftenposten - Login | 14.05.2017 |
| • NSM: Tror dataangrepet er under kontroll i Norge | VG Nett | 15.05.2017 |
| • USAs etterretning varslet ikke om sikkerhetshullet som åpnet for kjempeangrepet | Aftenposten - Login | 15.05.2017 |
| • Tror dataangrepet er avverget | VG | 16.05.2017 |
| • Hackere krever løsepenger for Pirates | VG Nett | 16.05.2017 |
| • Nettpirater krever løsepenger for den nye Pirates of the Caribbean | Aftenposten - Login | 16.05.2017 |
| • Datakriminalitet er til å grine av | VG Nett | 16.05.2017 |
| • I Nord-Korea er hackerne håndplukket o gen del av eliten | Aftenposten - Login | 16.05.2017 |
| • Dataangriperne kan avsløre seg selv hvis de tar ut løsepengene | VG Nett | 30.05.2017 |
| • Bitcoin-pris i fritt fall | VG | 14.06.2017 |
| • Krever tre å rog ni måneder for narkotikasalg på det mørke nettet | Aftenposten - Login | 14.06.2017 |
| • To selskaper i Norge rammet i internasjonalt dataangrep | VG Nett | 27.06.2017 |
| • Nytt løsepengevirus i Europa: Slik rammer det | VG Nett | 27.06.2017 |
| • Fem spørsmål og svar om de store hackerangrepene som rammer Europa | Aftenposten - Login | 28.06.2017 |
| • Dømt for narkotikasalg på det mørke nettet | Aftenposten - Login | 29.06.2017 |
| • 1200 datamaskiner i Helse Sør-Øst benytter seg av utdatert operativsystem | VG Nett | 30.06.2017 |
| • Game of Thrones-manus lag tut etter HBO-hacking | VG Nett | 08.08.2017 |

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| • Ukrainsk polit fant ulovlig Bitcoin-farm ved statlig institutt | Aftenposten - Login | 11.08.2017 |
| • HBO takker hackerne som stjal og publiserte flere Game of Thrones-manuskript | Aftenposten - Login | 12.08.2017 |
| • Bitcoin går rett til værs | VG | 15.08.2017 |
| • FORBUD GA BITCOIN-FALL | VG | 06.09.2017 |
| • Hackere mistenkes for å ha stjålet bitcoins | Aftenposten | 13.09.2017 |
| • VIL SPARKE ANSATTE SOM HANDLER BITCOIN | VG | 14.09.2017 |
| • KRAFTIG BITCOINFALL | VG | 16.09.2017 |
| • Ryktene om Bitcoins død er sterkt overdrevet | Aftenposten - Login | 17.09.2017 |
| • Svindelmistenkt kreves utlevert | Aftenposten | 20.09.2017 |
| • Tre men tiltalt for salg av narkotika – mottok bitcoin som betaling | Aftenposten - Login | 23.09.2017 |
| • TILTALT FOR SALG AV NARKOTIKA – FIKK BITCOIN SOM BETALING | VG | 24.09.2017 |
| • GÅR TIL KRYPTOKRIG | VG | 30.09.2017 |
| • Utleverer russer mistenkt for svindel | Aftenposten | 05.10.2017 |
| • VG har avslørt verdens største overgrepsforum. Det ble drevet av politiet | VG Nett | 07.10.2017 |
| • ELLEVILT! | VG | 14.10.2017 |
| • Slik opererer Kims cyberhær | VG Nett | 20.10.2017 |
| • - Kriminelle går tilbake til kontanter | VG | 21.10.2017 |
| • BITCOIN RASTE | VG | 14.11.2017 |
| • Kort sagt, torsdag 16. November | Aftenposten | 15.11.2017 |
| • Langet dop for millioner på Internett | Aftenposten | 17.11.2017 |
| • Mafiaen klar for Brexit | VG | 28.11.2017 |
| • DIREKTE | VG | 30.11.2017 |
| • Tvillingenes Bitcoin-kupp | VG | 05.12.2017 |
| • 100 00 | VG | 07.12.2017 |
| • SHOPPINGKJEMPE I TRØBBEL | VG | 07.12.2017 |
| • Bitcoin passerer 15.000 dollar | Aftenposten - Login | 07.12.2017 |
| • 15 000 | VG | 08.12.2017 |
| • Bitcoin trenger politick | Aftenposten - Login | 08.12.2017 |
| • KRAFTIGE BITCOINSVINGNINGER | VG | 09.12.2017 |
| • Bank-leder om fremtiden: Behovet for banker som mellomledd kan forsvinne | VG Nett | 10.12.2017 |
| • Bitcoin debuterte på børs | Aftenposten - Login | 11.12.2017 |
| • "Valgomat" var nordmenns toppsøk på Google i år | Aftenposten - Login | 13.12.2017 |
| • Slik kjøper du bitcoin | VG Nett | 13.12.2017 |
| • "Valgomat" var nordmenns toppsøk | VG | 14.12.2017 |
| • SVINDELMISTENKT RUSSER BLIR UTLEVERT | VG | 14.12.2017 |
| • Utleverer mistenkt russer til USA | Aftenposten | 14.12.2017 |
| • Prøvekjøring av Opel Grandland X Premium: Bilen som passer for folk som egentlig ikke bryr seg om biler | Aftenposten - Login | 14.12.2017 |
| • VIL BETALE LØNN I BITCOIN | VG | 16.12.2017 |
| • James hevder han kastet en harddisk full av bitcoin i 2013. Så leste han en historie fra Norge, og skjønte hva han hadde gjort | VG | 18.12.2017 |
| • - Investorer fra Asia bak bitcoin-boom | VG | 19.12.2017 |

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| • Finansministeren: Risikofylt å investere i bitcoin | VG Nett | 21.12.2017 |
| • HELT VANLIGE MENNESKER HAR BLITT MULTIMILLIONÆRER PÅ BITCOINS. HER ER ALT DU TRENGER Å VITE OM DEN VIRTUELLE VALUTAEN | VG | 22.12.2017 |
| • Rapport: Faren for dataangrep fra kryptokriminelle øker i 2018 | Aftenposten - Login | 26.12.2017 |
| • Bankkunder lurt i bitcoin-svindel | VG | 28.12.2017 |
| • Bitcoin ern å verdt mer enn alt av norske kroner | Aftenposten - Login | 02.01.2018 |
| • Slaget om lommeboken | Aftenposten - Login | 05.01.2018 |
| • RIPPLE-VERDIEN HALVERT | VG | 11.01.2018 |
| • KRYPTOSTUP | VG | 17.01.2018 |
| • Kryptovaluta kan revolusjonere nødhjelp og bistand | Aftenposten - Login | 18.01.2018 |
| • Kjøpte dataangrep fra russisk adresse: Ville svindle DNBs nettbankkunder | Aftenposten - Login | 26.01.2018 |
| • - Teknologien bak bitcoin kan bli milliardindustri i Norge | Aftenposten - Login | 29.01.2018 |
| • DIREKTE | VG | 30.01.2018 |
| • Undersøkelse: Nærmere 200.000 nordmenn eier bitcoin | Aftenposten - Login | 01.02.2018 |
| • NORDMENN KAN HA 7 MILLIARDER I KRYPTOVALUTA | VG | 03.02.2018 |
| • Stille før stormen i bankene | Aftenposten - Login | 05.02.2018 |
| • KRAFTIG KRYPTOREKYL | VG | 08.02.2018 |
| • Kraftig kursoppgang | Aftenposten | 20.02.2018 |
| • Venezuela lanserer egen "olje-bitcoin" for å redde økonomien | Aftenposten - Login | 21.02.2018 |
| • Eksperter advarer mot bitcoin | VG | 27.02.2018 |
| • Bitcoin-kupp er tidenes største tyveri på Island | Aftenposten - Login | 03.03.2018 |
| • Alle "Franks" datamaskiner graver etter digital gull | Aftenposten - Login | 08.03.2018 |
| • NED, NED, NED! | VG | 10.03.2018 |
| • - ULØNNSOMT Å UTVINNE BITCOIN | VG | 17.03.2018 |
| • BITCOIN MED NYTT FALL ETTER TWITTER-FORBUD | VG | 28.03.2018 |
| • TAPER PÅ BITCOINUTVINNING | VG | 11.04.2018 |
| • BARCLAYS: BITCOIN ER SOM INFLUENSA | VG | 14.04.2018 |
| • Dagens banksystem er som en gammel Nokia | Aftenposten - Login | 17.04.2018 |
| • Bitcoin-selskap tapte søksmål mot Nordea | Aftenposten | 05.05.2018 |
| • NORDEA VANT RETTSSAK MOT NORSK BITCOINVEKSLER | VG | 05.05.2018 |
| • KILDER: USA ETTERFORSKER BITCOIN | VG | 25.05.2018 |
| • De gode slår tilbake | VG Nett | 26.05.2018 |