

Towards bridging the concept of exponential organizations and the theory of disruptive innovation

Eksamensrapport

Kandidatuddannelsen i Interaktive Digitale Medier

Aalborg Universitet 2017

Udarbejdet af:

Helle Vesti

Studienr: 20113232

Sidetal:58 /Anslag: 123.207

Afleverings dato: 24/5/2017

Vejleder: Claus Andreas Foss Rosenstand

Resume (Danish)

Denne speciale-rapport er udarbejdet af kandidatstuderende Helle Vest, v. Interaktive Digitale Medier, Aalborg Universitet.

Verden har i det 21. århundrede manifesteret sig til noget abstrakt; noget mennesker ikke kan gribe, føle eller se i den tredimensionale verden, hvori de eksisterer. Teknologi accelererer i deres udvikling og rammer alle sektorer af det samfund vi lever i. Disruption (forstået som i "noget forstyrrende") er et højaktuelt emne i denne tid, hvilket ses i form af mange udgivelser om emner afledt heraf. Denne opgave tager afsæt i den originale teori af Clayton Christensen.

Clayton M. Christensen (f. 1952), er professor i forvaltningsadministration fra Harvard, som udgjorde begrebet disruptive teknologier, der blev introduceret i sin 1995 artikel *Disruptive Technologies: Catching the Wave* medforfattet af Joseph Bower. Denne artikel var udgangspunktet for en teori kaldet "Disruptiv Innovation", som blev beskrevet i Christensens bog *"The innovators solution"* (2003). Han beskriver termen disruptive teknologier yderligere i sin bog *The Innovator's Dilemma* (1997). I sin efterfølger med Michael E. Raynor, *The Innovators Solution*, erstattede Christensen udtrykket disruptiv teknologi med disruptiv innovation, fordi han erkendte, at ganske få teknologier er ibrugende disruptive eller vedligeholdende i karakter. Det er snarere forretningsmodellen, at teknologien gør det muligt at skabe den disruptive/forstyrrende virkning. Christensen forfattede en række andre artikler og bøger fra 2003-2015 om disruptiv innovation, nogle af dem indenfor sundhedssektoren og uddannelsessektoren. Rapporten tager udgangspunkt i en observation af en problemstilling i bogen "Eksponentielle organisationer". Denne handler om at udrede hvorvidt der er tale om et misapplikations-problem eller om der kan argumenteres for en teoretisk kobling til teorien. Via et litteraturstudie samt en analyse forsøger jeg at besvare følgende problemstilling:

Hvordan kan en litteraturstudie bruges til at bygge bro over teorien om forstyrrende innovation med begrebet eksponentielle organisationer?

Jeg finder i rapporten frem til, hvordan de samme processer, værdisæt og kulturelle kræfter som har bragt organisationen stor succes, kan vel være selv samme årsag til deres destruktion og hvordan dette paradox håndteres af forskellige forfattere. I rapporten peger jeg på at digitalisering accelererer disruptive processer og at der kan peges på dette som værende en sammenhæng mellem eksponentielle organisationer og teorien om disruptiv innovation.

Table of content

0. <u>Preface</u>	1
1. <u>Introduction</u>	2
1.1 The 21st century.....	2
1.2 On adaptation.....	3
1.3 Exponential organizations.....	4
2. <u>Problemanalysis</u>	6
2.1 The literature gap.....	6
3. <u>Research design</u>	9
3.1 The overall design.....	9
3.2 Litterature review – the method.....	10
3.3 Framing theory.....	11
4. <u>Litterature review</u>	12

A. Disruptive innovation.....	12
A.1 The earlier works of Clayton Christensen.....	13
A.2 Adaptation and technology innovation.....	14
A.3 Central contributions to Christensen’s work.....	15
A.4 Coining the term disruptive technologies.....	15
A.5 The innovator dilemma.....	17
A.6 The failure framework.....	19
A.7 Where the innovators dilemma end and the innovators solution begins.....	19
A.8 New-Market disruption and Low-End disruption.....	20
A.9 Change in perspective – the misapplication problem.....	22
A.10 Building the theory of disruptive innovation.....	23
A.11 Supply-side and Demand-side of disruption.....	25
A.12 The old and the new disruption.....	27
A.13 Summing up review part A.....	28
B. Exponential growth.....	31
B1. Predictions of a technological revolution.....	31
B.2 Exponential organizations and Singularity University.....	34
B.3 Linear vs. Exponential	34
B.4 The architecture of an exponential organization.....	35
B.5 The Massive Transformative Purpose.....	36
B.6 SCALE & IDEA	36
B.7 The implications of the model.....	38
B.8 Switching from scarcity to abundance.....	39
B.9 Summing up part B.....	40
C. Discussion – relation between authors.....	42
C.1 Connections in exponential organizations to the theory of disruptive innovation.....	42
C.2 Building a concept vs. building a theory.....	43
C.3 Predictive power and validity testing	44
C.4 Linear vs. exponential – the disruptive factor.....	45

C.5 Connecting Digital Disruption.....	46
5. Analysis	48
5.1 The results compared.....	48
5.2 Testing the hypothesis.....	50
5.3 Reflection.....	51
6. Discussion.....	52
6.1 The factor of time.....	52
6.2 The connection.....	53
7. Conclusion.....	54
8. Source-list.....	55
9. Appendix.....	
A. Quotations from online video material.....	
B. The S-Curve in technology- and management research.....	

O. Pre-face

This study concerns *disruption within the digital field which is a subject highly entwined in the concept of exponential organizations*. I find this to be a natural priority of focus as the digital field corresponds with my study in Interactive Digital Media (AAU, §20 s. 21-23, 2017).

I enter this report by building a problem formulation based on my observations in reading the book "Exponential Organizations". Here I supply the reader with sub-research questions that will help getting through the examination of a possible relation between the concept of exponential organizations and the theory of disruptive innovation.

Hereafter, I present my research-design containing the methodological and scientifically approaches I have chosen to utilize in order to respond to the problem formulation. The following chapter contains a literature review aimed at answering the three sub-research questions presented in the first chapters.

The review is followed by a deductive analysis where I use the matrix-frame to collect and visualize what data point to correlations as well as opposites between the two areas of interest. Here I move further towards testing the hypothesis, while also testing the methodological approach in combining inductive and deductive research methods.

The analysis-findings are then discussed and concluded upon. The two following chapters contain the source-list and the appendix.

1. Introduction

1.1 The 21st century

In the case of the 21st century, the passage of time in which technology develops exceeds far beyond what the biological human mind can comprehend. In the middle of this, digitalization has become a way of breaking down the physical form of the world into atoms, molecules and bits of information and then rebuilt in the form of computer-language. (Kurzweil, s. 35, 2005; Ismail, p. 18, 2014)

The world manifests itself into something abstract, something humans cannot grab, feel or see in the three-dimensional world in which they exist. The enabling of information caused by the internet-technology extends the human mind in the same way as a hammer extends the human hand; the hammer adds reach and power to the motion of hitting in a nail (McLuhan, s. 220, 1994). Like such, the information extends the human mind in intellectual and communicative ways. But down under its substance is no more than algorithms and information stated in different forms and measurements. Every individual using technology is most likely aware of this, but regardless of opinion towards its ethical and practical implications most of the world's population has now accepted digitalization and adapted to a life intertwined with digital technology. So a digital-culture has arisen, and quickly that is. Because of the way we calculate problems in math, chemistry and physics, the aids of technology and digitalization & connection by the internet, the time it takes to evolve for both humans and entire societies are accelerating (Kurzweil, p. 50-56, 2005; Diamandis, p. 51-56, 2012; Ismail. p. 18, 2014). Recent statistics shows that by 2030 the world will house 1 trillion connected devices using bandwidth, which means access for 1 trillion individuals to contribute to the collective super intelligence that the internet holds and continuously accumulates (USI, t: 7:20-7:30, 2015). Knowing that this amount of people will be connected to the internet and how many are already using it clearly underlines the vast embrace of the possibilities in things such as Cloud technology, global communicational reach via social media, on-demand services and many more (Ismail, p. 46-50, 2014).

1.2 On adaptation

In an era of exponential growth in technology and digitalization a broad range of media and literature are focusing on the importance of willingness and ability to adapt in order to surpass and survive grand challenges in the evolution of modern society (see references listed in figure 4; Ismail, p. 20, ll. 10-12, 2014). One of the top trending topics is within organizational management and business strategy.

Now, a very powerful example on how adaptation is connected to survival can be found in the history of Homo Sapiens and how their ability to adapt sustained their existence to this very day. Around 200,000 years ago Homo sapiens evolved in East Africa. Homo sapiens - unlike other species at the current time, showed the ability to adapt to their surroundings both physically and cognitively which ultimately lead to them becoming the only surviving species of the Genus Homo;

“Consequently, ever since the Cognitive revolution Homo sapiens has been able to *revise its behavior rapidly in accordance with changing needs* (...) Homo sapiens soon far outstripped all other human and animal species its ability to cooperate.” (Harari, s. 36, ll. 21-26, 2014)

In the above quotation the two terms adaptation and survival are linked in a biological context. To move towards an organizational context I provide another quote presenting a varied definition:

“**Yes**, change is the basic law of nature. But the changes wrought by the passage of time affect individuals and institutions in different ways. According to Darwin’s Origin of Species, *it is not the most intellectual of the species that survives; it is not the strongest that survives; but the species that survives is the one that is able best to adapt and adjust to the changing environment in which it finds itself*. Applying this theoretical concept to us as individuals, we can state that the civilization that is able to survive is the one that is able to adapt to the changing physical, social, political, moral, and spiritual environment in which it finds itself.” (Megginson, s. 91, 1963)

Even though the above quote has gone through some falsely made connections¹ it does not become less valid when quoted correctly. Both quotations points to the theoretical link between adaptation (cause) and survival (effect); the first one is a prime example of how the link can be made in biological context, the second exemplifies a connection made between the biological phenomenon and the variables of *time* and *change*, while adding a dimension of institutions to the subjects prone to be affected by change.

¹ In 1963 Leon C. Megginson delivered a speech that contained a passage presenting his own interpretation of *Charles Darwin’s ideas*. Megginson did not claim that he was quoting the words of Darwin. Nevertheless, over time, in a multistep process this passage has been simplified, shortened, altered, and reassigned directly to Darwin (QI, 2014)

The link of causality between adaptation and survival is a central subject in the report you are about to read. In the following chapter I introduce a concept that embraces these three dimensions.

1.3 Exponential organizations

One recently developed concept is particularly being mediated through a wide variety of media channels, books and movies and is being addressed in many public speaks on business management and new growth organizations. The concept is termed *exponential organizations* and has been developed at Singularity University which was co-founded in 2008 by Ray Kurzweil (cofounder and chancellor) and Peter Diamandis (cofounder and executive chairman) (Ismail, p. 7-8, 2014).

In the publication of exponential organizations the term “ExOs” (shortage for exponential organizations) is referred to as a *new organizing principle for the information age* (Ismail, p. 264, ll.1-3, 2014). Also, it is being referred to as “the latest embodiment of human acceleration in human culture and enterprise”. They refer to the situation of incumbent companies as :“(..)Once-great industry-dominant corporations unable to adapt to rapid technological change”. (Ismail, p. 20, ll.4-5 + ll. 10-12)

The main area of interest to this project is looking into this trend and how it is contributing to a shift in the paradigm of organizational management and building business strategies. Exponential organizations is a concept that lays out a framework for start-up-, mid-market, or established companies, to become adaptable and thrive with success in any given industry by utilizing a new kind of organizational structure derived from an exponential business mindset. (Ismail, p. 18 + 147-175, 2014)

“For leadership of any kind, but especially for CEOs, it is becoming increasingly apparent that their duties – especially those that are externally facing – are shifting from operating in a predictable world, where the scaling of efficiencies is the dominant strategy, to a world in which *adaptability and disruption* represents higher-order competitive advantages. This will present tremendous opportunities – and at the same time considerable pressure – for change, especially when it comes to legacy businesses.” (Ismail, p. 271, ll. 25-34, 2014)

As the above quote states, adaptability is one of the central keywords to achieve competitive advantages and surviving in the face of new opportunities and challenges, which the acceleration pace of technological development is pointing towards (Ismail, p. 18-22, 2014). A

term presented along with adaptation is disruption. Now, what Ismail is referring to is the phenomenon of *market disruption* which stems from Clayton M. Christensen (born 1952) and his *theory on disruptive innovation*, which currently has gone through 22 years of development. The term *disruption*, in the context of economic studies, has been misused and misapplied in many ways (Gans, s. 7, 2016; C.C Reader, s. 157-158, 2015). It has also been used as a scare-factor for struggling companies in fear of getting disrupted by competitors as well as being hailed for its usefulness in becoming the disrupter and not the disrupted (Hein & Honoré, 2016; Ismail, p. 7, 2014). Likewise, it has caused a shift in the way businesses understands competition in different markets and has become a widely adopted and popular theory (C.C Reader, p. 157-159, 2015).

On a more problem-oriented note, I want to point to the fact that in exiting literature on building exponential business strategies by utilizing digital and technological possibilities of the 21st century, disruption (as in the theory of disruptive innovation), is being treated as the “new norm” in organizational paradigms (Ismail, 124-126, 2014). A quick search on Google-trends on the term disruptive Innovation reveals, that this term has increasingly been typed in as the search text on Google from the year 2004 and forward (figure 1). In comparison, search-hits on exponential organizations start getting many hits around the years 2013-2014. The graph also shows a small peak around the publication of Kurzweil’s Law of accelerating returns in 2004 and this book “Singularity is near” the following year (2005). Exponential organizations search hits is at its highest in June 2016 :

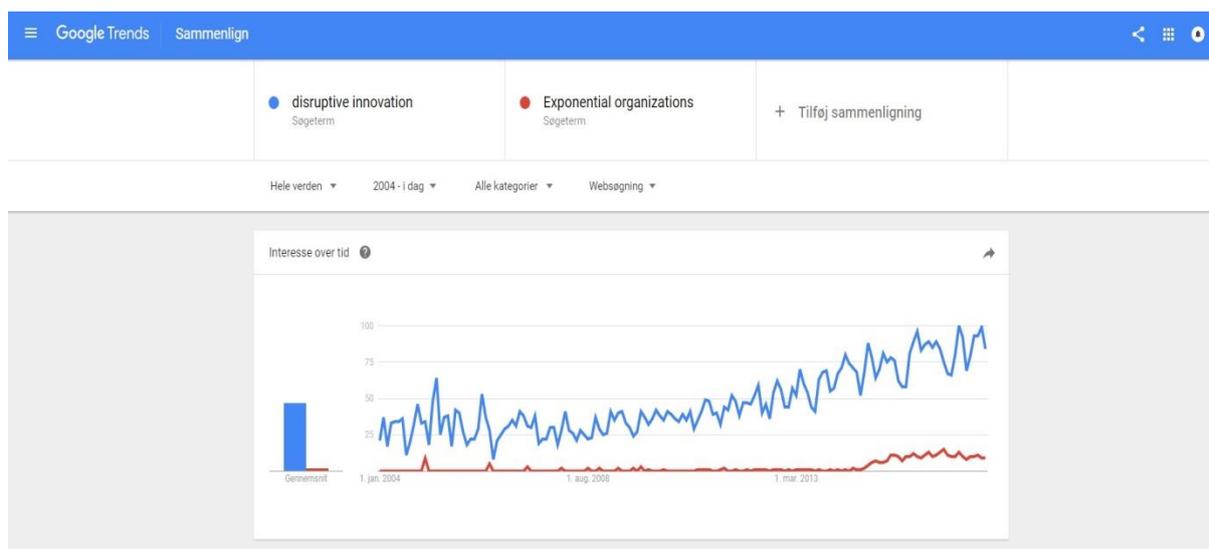


Figure 1: Google-trends showing the search hits on Disruptive innovation vs. exponential organizations (<https://trends.google.com/trends/explore?date=all&q=disruptive%20innovation,Exponential%20organizations>)

In the next chapter I look into the gaps and shortcomings observed in the publication of exponential organizations. I then suggest a problem-formulation I wish to work towards answering, and a fitting scientific approach to handle the process.

2. Problem analysis

2.1 The literature gap

Looking at the concept of exponential organizations a clear gap can be identified between the theory on disruptive innovation and the concept. Even though the theory of disruptive innovation seems to be a clear prerequisite for the development of new concept of exponential organizations, the relation to the theory is not explained.

Linear vs. Exponential

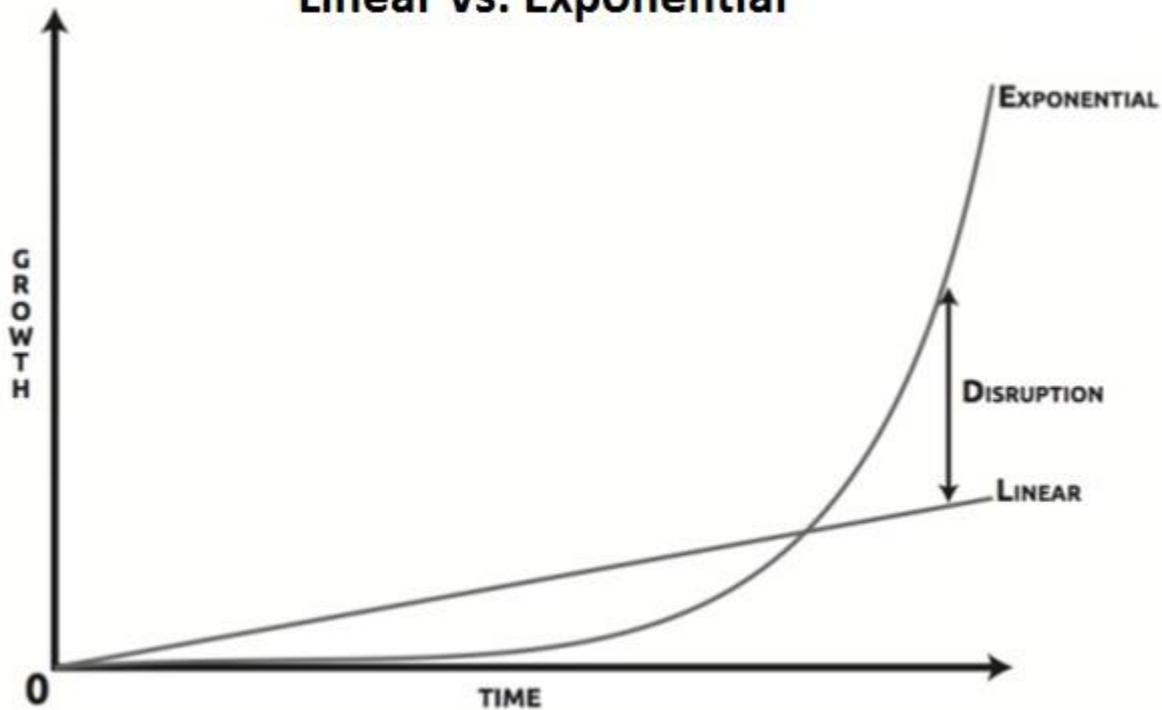


Figure 2: Model projecting the different curves of linear and exponential growth (Ismail, p. 20, 2014)

A prime example is found in the publication on exponential organizations in the introductory passages, where a graph is presented. This graph (see. Fig. 2) is showing how the rate of technology is moving exponentially and is thoroughly explained as to be based on Gordon Moore's law) (Ismail, p. 18-22, 2014). Now what is missing in the entire episode (and forward on), is an actual explanation as to why disruption is applied in the graph; where it comes from, what it means, and why it is placed in the same context as a graph depicting *linear vs. exponential* growth. The graph is showing disruption as a causal mechanism or effect happening in between the process of switching from linear to exponential growth. Also, what does the variable measurement "growth" entail? Is it technological growth or organizational growth? Again, the book fail to explain clearly what is put forth to the reader.

Now, presuming the reader knows the line-outs of the theory of Clayton Christensen, one may be tempted to make an assumption as to why it is being presented in the graph (fig. 2). In the case of the informed reader, one may be intrigued to ask why they make this connection, and why no reference is made to the term *disruption*. On the other hand, provided that the reader *does not* know of the theory of disruptive innovation, it may be hard to understand the message

here with no explanation of the term or, as to why it is placed in between the two curves. I personally am looking at the graph through the optics of an informed reader. Reading further into the publication on exponential organizations it can be observed that, while not counting the references to Clayton Christensen, there are no point at which the authors of exponential organizations argues or establishes any proof, that the theory by Christensen is in any way correlated to the work of Singularity University. What this means, is that there is no actual evidence or argument made pointing towards a connection between the theory of disruptive innovation and the concept of exponential organizations. Having observed this fact, one may argue that the theory and the concept can be viewed as mutually exclusive to one another.

Having observed a gap in the literature on exponential organizations in utilizing the term disruption, I wish to perform an inductive research process that examines the presumed relationship between the theory of disruptive innovation and the concept of exponential organizations.

In addition to obtain a deeper understanding as to how the theory by Clayton Christensen (from the perspective of the authors of exponential organization) is presented as being related to the concept, I find it important not to leave any grainy or unanswered questions in regards to the presumed existence of a connection between the two areas. Therefore I work towards deductively testing if a correlation can be established between *the two areas of interest* (the concept and the theory) by incorporating the following hypothesis:

Hypothesis: *The concept of exponential organizations is theoretical correlated to the theory of disruptive innovation.*

Read more about the choice of a deductive vs. an inductive research method and overall design in chapter 3.

I hope to gain a deeper understanding as to how theory on the subject of disruption can be connected to the concept of exponential organizations. The contribution will be a discussion on how my research findings may answer to the problem formulation and hypothesis. Furthermore I will discuss as to why the theory of disruptive innovation currently is being utilized in a wide variety of subjects concerning new growth businesses *within the digital field*.

By working closely with two areas I seek to find out *if they are-* and *to what extent*, they are intertwined or related to one another. I wrap up this chapter by presenting the problem formulation and the related sub-research questions below:

Problem formulation:

How can a literature study be used to bridge the theory of disruptive innovation with the concept of exponential organizations?

Sub-research questions:

- 1. What is disruptive Innovation?*
- 2. What are exponential organizations?*
- 3. What connects the two areas of interest?*
- 4. Is there a theoretical correlation between exponential organizations as a new organizational concept and the theory on disruptive innovation?*

3. Research design

3.1 The overall design

In this report I take a systematic and chronologically walk through the broadly applied theory of disruptive innovation and compare its essential points with the concept of exponential organizations. I have chosen to work inductive with the literature review - but deductive with the analysis of the review.

Through desk-research (Crouch & Housden, 2003, s. 19), I conduct an examination on: 1.) Trending guides on how to adapt-to-survive within organizational literature and 2.) Gain knowledge as to why the term *disruption* has been popularized as “the new norm” in such literature.

The literature review is aimed at framing the literary field on the two subjects (sub-research question 1 & 2). As seen in figure 3, the large central circles entails literature directly connected with the two areas of interest (disruptive innovation and exponential organizations) while the small circles represent the literature indirectly connected to the two areas of interest.

In the first step of the research design marked “review”, I collect, read, and compare different perspectives of the authors of different subjects that are related to the main subjects. This is an inductive research process. At the next step marked “analysis”, the large circles have become more dense (framed with a thicker outlining), this visualizes that the inductive research have resulted in the addition of new knowledge to the areas of interest - in this second step, the focus is on comparing the two areas and finding correlations - hence the red colored zone which indicates the deductive analysis. In the third step, marked “contribution”, the results of the analysis will be discussed. The ring surrounding the two circles indicates that this discussion also articulates the context of the researched areas of interest. In this step the hypothesis is addressed and the problem formulation is concluded upon. What I intend to find out, is whether or not my findings can bridge out the gap that has been observed in the literature.

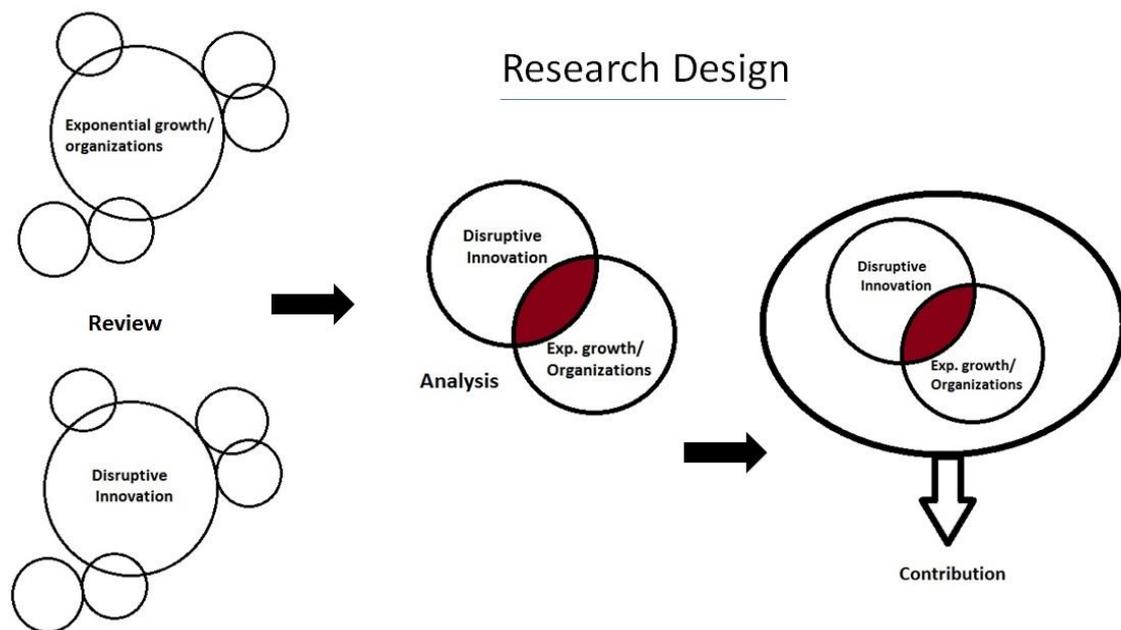


Figure 3: The three stages of literature study in this report.

3.2 Literature review - the method

The following section deals with the search of the relevant literature and background material to cover the problem area. The section structure and explain literary, visual and auditory media contributions, in order to create a basic framework for understanding the problem area. It is

strived to include a wide range of literature, so that the problem area is illuminated on both micro and macro level (Ridley, p. 3, 2012). The patterns which become apparent in the literature review can also be visualized in order to establish a certain gestalt insight; such insights can provide an overview of the problem area and also help defining it (Ridley, p. 102, 2012)

The literature review is constructed as a 3-step process that is initiated by an extensive literature search. This search takes place through databases such as. AUB.dk (Aalborg University Library), Njl.dk/Safari Books and Google Scholar. The understanding of the problem area assumes in particular problem-based examples from the real world and in the light of this, I choose to supplement the literature search of the problem area with current debates and streaming of lectures on the media platform YouTube with writers/researchers who founded knowledge within the central literature. By default a physical library search on the field is also conducted. After the first two steps, the collected literature is read, processed and categorized. The final step involves the actual writing process, where content and prospects are explained. All steps are iterative in order to obtain a basic understanding of the problem area and context. Every time a new branch of the area scanned, change the knowledge, and thus the material being produced. (Ridley, p. 102, 2012)

3.3 Framing theory

The model below (fig. 4) visualizes priorities within the literature on disruptive innovation and exponential organizations. References inside the diamond shaped frame as well as references inside the circular frame shows how the references connect to the subject of disruptive innovation and exponential organizations. The references placed *outside* of the diamond- and circular shapes are literature that indirectly connects to the literature placed *inside* the diamond- and circular shapes. Examples of such references are articles, data or publications that, in some way, contribute to the development of the theory/concept or can be placed in relation to the study of these two areas. Some of these references constitute as an important part of-, or builds the foundation of the literature which is placed inside of the shapes. The lower part of the diamond contains the concept of exponential organizations and represents the interconnection as the task at hand in this report – which is to move towards the construction of arguments for- and/or against, a correlation between the concept and theory.

Framing theory

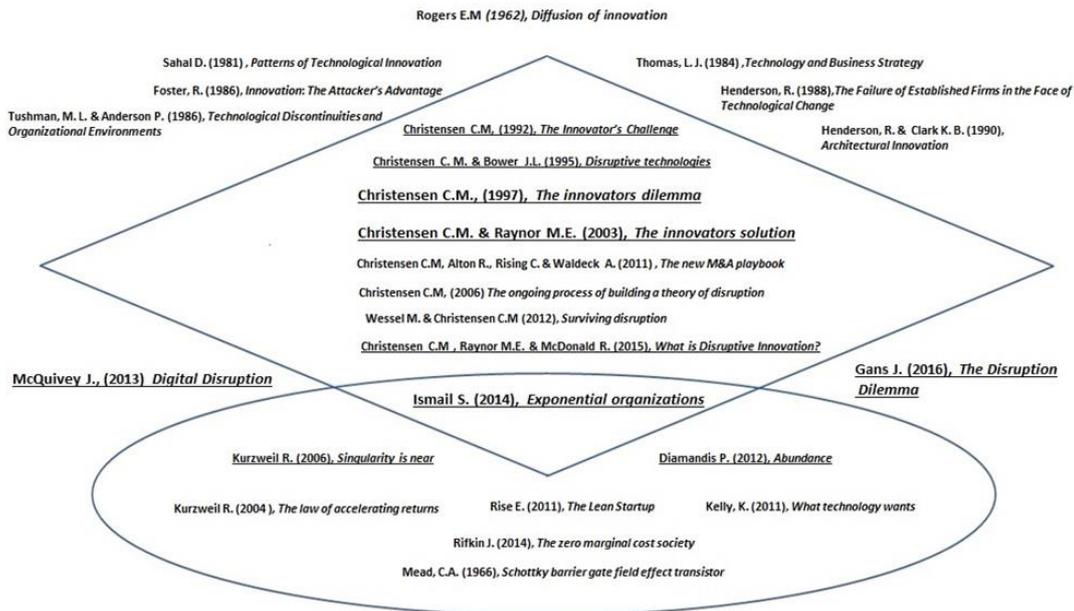


Figure 4: The model visualizes priorities of literature in the review (underlined references are emphasized in the review) while also showing some of the central contributions to the field of the disruption theory as well as the literary field of exponential growth in new organizations.

4. Literature review

A.) *Disruptive innovation*

The term “disruptive technologies” was coined by Clayton M. Christensen and introduced in his 1995 article *Disruptive Technologies: Catching the Wave* (Christensen & Bower, 1995) which is co-authored by Joseph Bower. The article is aimed at management executives who make the funding or purchasing decisions in companies as well as the research community (academic readers). He describes the term further in his book *The Innovator's Dilemma* (1997) where he explored the cases of the disk drive industry. In his sequel with Michael E. Raynor, *The Innovator's Solution* (2003), Christensen replaced the term *disruptive technology* with *disruptive innovation* because he recognized, that few technologies are intrinsically disruptive or sustaining in character; rather, it is the business model that the technology enables that creates the disruptive impact. However, Christensen's evolution from a technological focus to a business-modeling focus is central to understanding the evolution of business at the market or

industry-level. From studying innovation and S-curves² Christensen corrects the focus on business paradigms and economics (Christensen & Raynor, 2003). It is from this publication that the original understanding of disruptive innovation has originated.

A.1 The earlier works of Clayton Christensen

In 1992 Clayton Christensen writes his doctoral thesis “Exploring the limits of the technology S-Curve”. Christensen’s thesis from 1992 is parted into section a and b. Section a of the thesis went on to examine component technologies and whether the use of S-curves to predict the impact that new technology and radical technological innovations would have on established companies in various market industries.

In the second part he goes to concerns himself with architectural technologies. Here Christensen shows that it is in *architectural*, rather than component innovation, that entrant firms exhibit an attacker’s advantage. Here he proposes a different S-curve framework for processes of architectural technology change that comprehends *both* its technological and market aspects.

In the two papers Christensen explores the strengths and shortcomings of S-curve theory when managers use it within individual firms to plan technology development applying theory in communication science (Rogers 1962; Becker and Speltz, 1983) and innovation-studies of market- and business management contexts (Sahal, 1981; Foster, 1986; Henderson, 1988).

He performed studies in companies in the disk-drive industry. Christensen’s thesis shows that, unlike previous studies of technological development, in which the S-curves was used as a framework for describing how new technologies replacing older technologies (see Fig. 5), the S-curves flattening (fig. 5, point marked with “C”) are *firm-specific*, rather than a universal industry phenomenon. The following quote backs this up:

“(.) However, in which a technology’s performance results from exploiting some combination of broadly understood physical laws and firm-specific, experience-based know-how, the shape of perceived technology S-curves may be *unique to individual firms* rather than driven by absolute laws and physical relationships. Descriptions and predictions based upon industry-level maturity curves, therefore, need not and possibly *should not be taken as prescriptions of firm-level strategy.*” (Christensen, p. 347, 1992)

He proves in his thesis that the theory of using S- to predict the life cycles of technologies is not universal but firm-specific. He adds variables demonstrating that the industry of electrical engineering is success/failure flared different when companies begin to choose which technologies they will give up and start to invest in. The investments and outcomes to value-trajectories for companies investing in the same technology fluctuate and therefore cannot be said to apply to all companies.

² Go to appendix B. for explanation of the S-Curve.

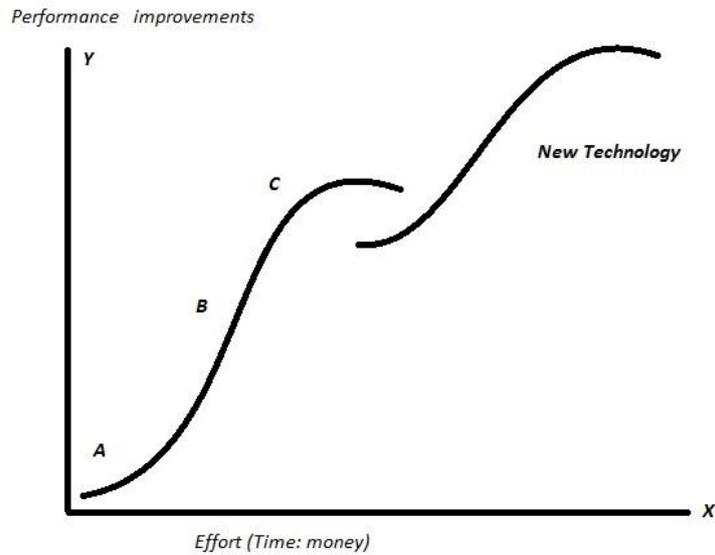


Figure 5: Example of S-curve graph inspired by diffusion of innovation/technology trajectory studies (Becker & Speltz, s. 31-33. 1983; Maxwideman, 2017). Christensen, involving his background knowledge of S-curves, uses this to explain how an established company puts out a minimal value per iteration in the beginning of the curve. Once the company achieves a certain point of their development where they can improve the product radically per. innovation, the curve goes upward and the value per. innovation grows exponentially. This happens after many repetitions of improvements (iterations in the attempt to improve a product) (Christensen, p. 39-42, 2016).

[An explanation of the S-Curve in managerial context can be found in the appendix B]

A.2 Adaption and technology innovation

Christensen utilized the theory of Diffusion of Innovations in his thesis from 1992 (Rogers, 1962). The theory concerns itself with levels and speed of adaptation in society to new innovations, demonstrating this in the form of S-curves. Being part of the fundament to Christensen's early work the theory of diffusion of innovation connects *adaptation* into the theory of disruptive innovation (Christensen, 1992a). The technological perspective can be traced further back. Joshua Gans points out, that a connection can be made between the theory on disruption and the term of *creative destruction*:

"It was in his 1942 book *Capitalism, Socialism and Democracy* that Schumpeter introduced the concept whose lineage to disruption can be most clearly seen: "creative destruction"(..) But for Schumpeter, it was a description of what he believed to be an endemic feature of capitalism: that the system made room for creativity by destroying what had come before." (Gans, p. 16, ll. 24-26; 29-31, 2016)

Joseph Alois Schumpeter ended up as a Professor in Harvard's economics department³ and was occupied with *innovation, technological change and entrepreneurship*. Schumpeter coined the word *Unternehmergeist*, which is German for "entrepreneur-spirit", and asserted that the doing of things that are already being done in a new way, stemmed directly from the efforts of entrepreneurs (Schumpeter, p. 149-159, 1947).

Clayton Christensen did not intentionally anchor his theory of disruption in the concept of creative destruction, but acknowledges the connection in the preface of the 2016 edition of the innovators dilemma:

"Michael Raynor (...) has noted that disruptive technology is probably the cause behind the "creative destruction" that economist Joseph Schumpeter observed to be the primary engine of economic progress more than half a century ago. I think Michael is right." (Christensen, p.10, ll.10-13, 2016)

To what extent these two are connected is described in full detail in chapter 2 of Gans' book. For reasons of limited writing space this is not articulated further in this report. If the subject is of particular interest I refer the reader to the work of Joshua Gans *The disruption dilemma* (2016) where the matter is explained in further detail.

A.3 Central contributions in Christensen's work

If you are reading this paper while knowing the essence of the theory of disruptive innovation, some authors and their contributions seem more eye-catching than others.

An example is R. Foster who cites the tendency of leading firms to reinforce and refine maturing technological approaches and their failure to spot new, successor technologies in a timely way as a primary reason why leading firms lose their positions of industry dominance (Christensen a, p. 335, ll. 1-7, 1992). The second is Henderson (1988) who argues that radically new technologies are frequently developed and brought into an industry by entering firms, rather than by the incumbent leaders (Christensen a, p. 335, ll. 2-4, 1992).

A.4 Coining the term Disruptive Technologies

Christensen's thesis from 1992 forms the background for the article from 1995 "*Disruptive technologies - catching the wave*". In this article Christensen uses the term *Disruptive Technologies* – notice that the theory is not yet formed under the current name of *disruptive innovation*, but the term is mentioned in a side-note in the article (C.C Reader, p. 4, 2015).

³ Professors of economy with connection to Harvard University: J. A. Schumpeter (1932), R. Henderson (1983), C. M. Christensen (1979).

The quotation below is from the article published in 1995. Here, Christensen and Bower put forward a central question:

“Why is it that companies like these invest aggressively-and successfully-in the technologies necessary to retain their current customers but then fail to make certain other technological investments that customers of the future will demand?” (Clayton & Bower, s. 43, ll. 22-26, 1995)

Christensen and Bower basically ask why successful companies choose to invest according to their current customer demand, but choose not to invest in technologies that could potentially cover future customer demand. The authors conduct a research on selected corporate cases presented as examples of how some companies can be successful at doing one kind of innovation, but fail when it comes to doing disruptive innovation. In the article Christensen and Bower distinguish between what they call *sustaining and disruptive innovation*.

Sustaining innovation means that the companies is doing a great job at maintaining a good relation to their customers and meet the needs and demands of the highest costumer tiers, but fails when it comes to keep up with technological development and invest accordingly. They account for new market trends and the role of technology in the development of many small companies that, with great success, outperforming the big firms by doing the opposite and investing in technologies that bring new markets and customers.

Angling in the article is mainly technological and directs its focus as demand trajectories. Bower and Christensen included reflections on economic priorities of organizations in incorporating new technology in their production. Based on their findings, they describe a new type of market trend and present it in the article's conclusion.

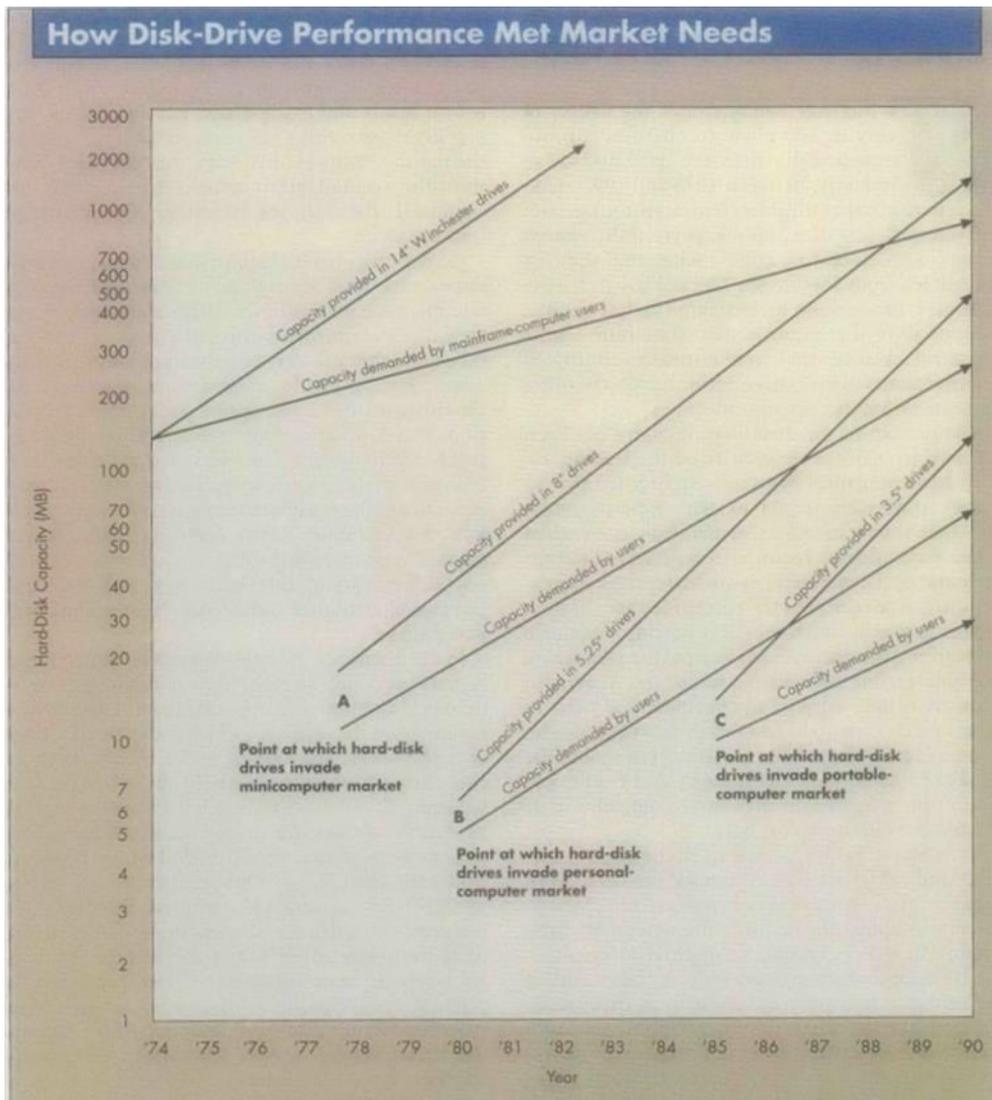


Figure 6: How disk-drive performance met market needs (C.C. Reader, p. 9, 2015)

A.5 The Innovator's Dilemma

Clayton Christensen demonstrates in *The innovators dilemma* (1997) how successful companies can fail in the face of disruption.

“Companies stumble for many reasons, of course, among them bureaucracy, arrogance, tired executive blood, poor planning, short-term investment horizons, inadequate skills and resources, and just plain bad luck. But this book is not about companies with such weaknesses: it is about well-managed companies that have their competitive antennae up, listen astutely to their customers, invest aggressively in new technologies, and yet still lose market dominance.” (Christensen, p. 13, ll. 5-12, 2016)

As Christensen puts it in the quotation above, the innovators dilemma or paradox, is not referring to companies with either of the listed reasons for stumbling and failing as a company. The dilemma consists of managers doing the right things (heuristically according to the book, serving their costumers the right way and investing in attractive opportunities and technological innovations) but still stumbles and fails - even risk going bankrupt as new competitors from low-market or new-market grows and takes over their domain on a given market.

The dilemma consists of two main parts- how *sustaining* technologies works and how *disruptive* technologies works.

Sustaining technologies foster improved product performance; some can be discontinuous or radical in nature while others can be of an incremental nature. What sustaining technologies have in common is that they improve the performance of established products also in accordance to what mainstream costumers in major markets value. The disruptive technologies however, normally result in worse product performance and therefore they generally underperform in regards to established products in mainstream markets, but they have other features that a few fringe and generally new costumers value. Products based in disruptive technologies are generally cheaper, simpler, smaller, and can also be more convenient to use by costumers. (Christensen, p. 19, 2016)

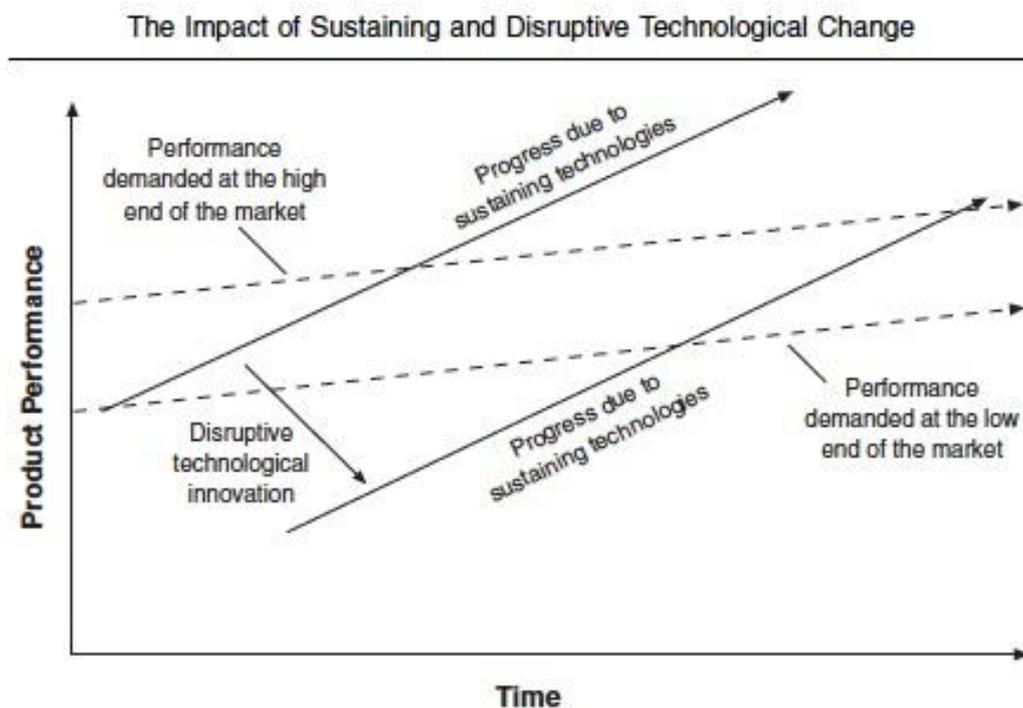


Figure 7: In The Innovator's Dilemma a graph is introduced visualizing the impact of Sustaining and Disruptive technological change (Christensen, s. 20, 2016)

A.6 The failure framework

The book defines the problem of disruptive technologies and describes how they can be managed attending to establishing the external and internal validity of its propositions. Christensen builds through chapter 1 and 2 in the innovators dilemma “the failure framework” in the context of the disk drive industry. The reason as to why Christensen paints a picture of a single industry such as the disk-drive industry is “If a framework or model cannot reliably explain what happened within a single industry, it cannot be applied to other situations with confidence.”(Christensen, p.21, ll. 24-26, 2016)

Christensen utilizes the term of *value networks* to create a new perspective on the drivers of failure. A value network is the context within which a firm establishes a cost structure, operating processes and works with suppliers and channel partners in order to respond profitably to the common needs of class of costumers. Within a value network, each firm’s competitive strategy, and particularly its cost structure and its choices of markets and costumers to serve, determines its perceptions of the economic value of an innovation. (Christensen, p. 44, 2003; Christensen, p. 29-33, 2016)

A.7 Where the innovators dilemma ends and the innovators solution begins

Six years after *The Innovators Dilemma* was published, Clayton Christensen and coauthor Michael Raynor⁴ published *The Innovators Solution* in 2003. I will shortly return to the essence of this publication, but for now I want to explain what Christensen spent his time on during the six years between the two majorly popular management tomes. In figure 4 (“framing theory”) there is a gap between the two publications; this however, does not mean that Christensen did not publish other articles regarding the subject of disruption; Rather he was focused on building onto the theory that Christensen had presented in *The Innovators dilemma* with the main goal being aimed at producing an array of applicable frameworks to help senior managers create the right conditions at the right time, for a disruption to succeed. One article of particular interest is published in the year 2000 titled “Meeting the challenge of disruptive change” and is coauthored by Michael Overdorf – to this I will shortly return.

There is a link between this article (2000) and the innovators solution (2003) which shows how Christensen was building onto the dilemma presented in 1997. Summed up, the theory in *The*

⁴ Michael E. Raynor is a director with Deloitte Services LP and besides from coauthoring *The Innovators Solution* he is also the author of two other critically acclaimed books: *The strategy paradox* and *The innovators manifesto* (Christensen, p. 303, 2003).

Innovators Dilemma (1997) explains how, under certain circumstances, *the mechanism of profit-maximizing resource-allocation causes well-run companies to get killed* (Christensen & Raynor, p. 17, 2003). In the innovators solution Christensen writes:

“Disruption has a paralyzing effect on industry leaders. With resource-allocation processes designed and perfected to support sustaining innovations, they are constitutionally unable to respond. They are always motivated to go up-market, and almost never motivated to defend the new or low-markets that the disruptors find attractive.” (Christensen & Raynor, p. 35, ll. 37, 2003)

The above mentioned tendency is what Christensen and Raynor calls *asymmetric motivation*, which they present as the core of The Innovator’s Dilemma and the beginning of The Innovator’s Solution (Christensen & Raynor, p. 35, 2003). By using the word *constitutionally* they refer to such factors as the firm internal and embedded processes by which the market leaders must follow. You could call it the company’s *creed* or *values*. Now value in particular is a term of importance in the innovators dilemma because of its impact on management decisions which is a central part and also reason as to why the innovators dilemma exists. In the article from 2000 Christensen and Overdorf lay out a framework for companies to put down autonomous teams to cope with the threat of disruptive change. It constituted of looking at (from the perspective of an established company) *resources, processes and values*, to set up a team designed to act upon the dilemma of disruptive change.

“By selecting the right team and organizational structure for your innovation – and fusing it with the right resources, processes and values – you heighten the chances of innovating successfully.” (C.C Reader, p. 25 (column), ll. 49-54, 2015)

One may view this as an early contribution to the array of different theoretical frameworks that the innovators solution constitutes of, by which a company can turn to finding themselves in the state of the innovators dilemma.

A.8 New-Market disruption and Low-End disruption

Doing disruptive innovation requires either getting foothold in low-end markets or new-markets.

The innovators dilemma presented a diagram picturing disruptive and sustaining innovations (figure 7). This diagram only presented two dimensions where, in reality, there are two different types of disruptions. These can be seen in figure 8 where a third axis has been added. New-market disruption: The vertical and horizontal axes are placed just like the prior diagram - performance of the product is measured on the vertical axis and time measured at the horizontal dimension. The third axis represents new costumers and new contexts for

consumption. The diagram has the same dimensions but different measurements in performance; the dimension extending towards the reader represents a new context for consumption and competition, which are new value networks (as explained in chapter A.6) According to the innovators solution when disrupters are doing New-Market disruption, they are competing against what is called *non-consumption* because new value networks are being established.

Low-end disruption: To be clear in accordance to what the theory states, all disruptive innovations I brought to market in the low-end of a measurement of customer-demand tiers.

But it is still differentiated as the two kinds of disruption have different strategies. If the disrupting company establishes foothold in a mainstream market they can then start moving towards the high-end of the mainstream market by incrementally improving their product innovation. At the point where the two lines intersect (sustaining innovation and disruptive innovation) disruption has occurred. At this point higher customer demand-tiers are beginning to find more value in the disruptive innovation than the sustaining one and the producers of the sustaining innovation is losing customers as well as market dominance. Here the entrant companies compete against sustaining innovations, which means that they are *competing within existing markets*.

New-Market disruption establishes foothold at a low-end, just not in a mainstream market. The new value network is established and consumption can begin. They then move in the same trajectory lines as Low-Market disruption does, but they are competing against non-consumption.

Consumers of products in Low-Market disruption is part of the larger customer segment belonging to incumbent companies, but these being in the lower end of the demand-tiers. This means that they feel over-served by the companies providing products with multiple functions that they do not use

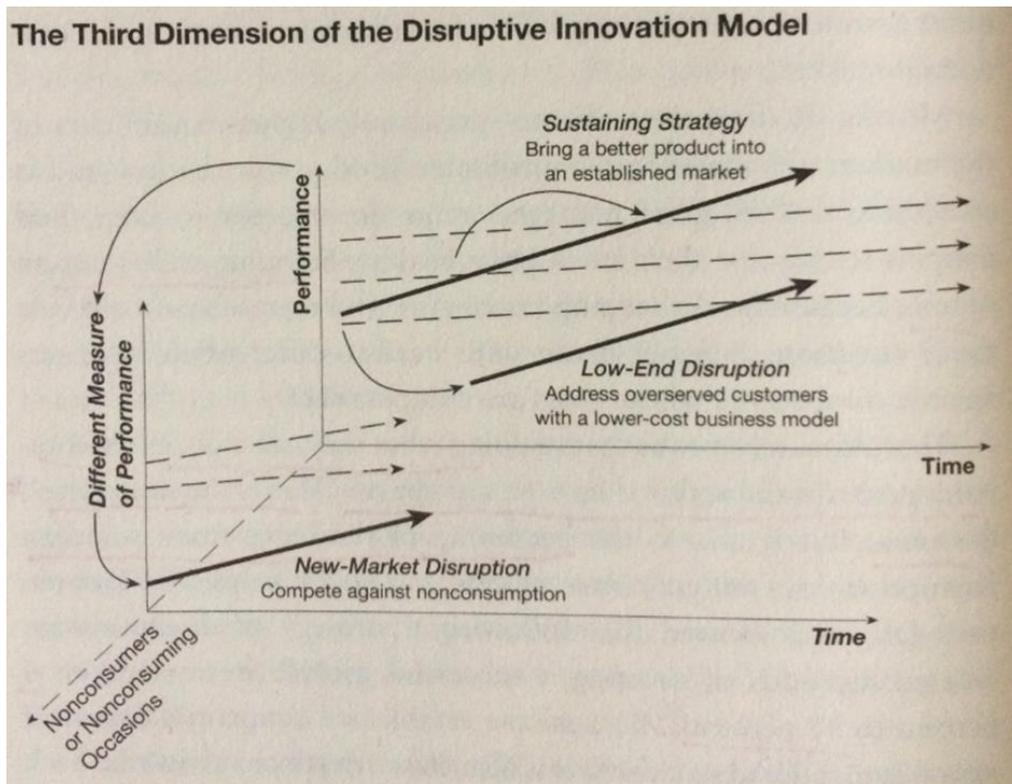


Figure 8: New-Market disruption vs. Low-End disruption (Christensen, p. 44, 2003)

Compared to The Innovator’s Dilemma, The Innovator’s solution is oriented towards understanding the organizational embedded forces such as processes, values and resource-allocation, and the understanding of causalities that can lead to the core management dilemma in The Innovators Dilemma.

A.9 Change in perspective – the misapplication problem

In 2003 the theory of disruptive innovation changed the predominant perspective from *technological to organizational*. In The Innovator’s Solution the authors substitute the term *Disruptive technologies* with *Disruptive innovation* to minimize the chance that readers of the book would twist the concept to fit into what Christensen and Raynor believed was an incorrect way of categorizing the circumstances of the theory. About this problematic observation they state: “(..) we have observed a stunningly common human tendency to take a new concept, new data, or new way of thinking and morph it so that it fits one’s existing mental models.(..) They then conclude that disruptive ideas (as they define the term) are good and merit investments. We regret that this happens, because our findings relate to a very specific definition of disruptiveness, as stated in our text here” (Christensen & Raynor, p. 66, ll.4-13, 2003)

In 2015 Christensen published an article on the very basis of the problem of misunderstandings /misapplications the theory. Together with coauthors Michael Raynor (The Innovator’s

Solution) and Rory McDonald, he revisits the theory which is, at the time of publication, 20 years after the initial introduction to the theory (Christensen and Bower, 1995). The article recaps the initial definition of disruptive innovation as well as lay out what the theory does - and does not. (C.C Reader, p. 157-172, 2015)

From this article I want to point out the newest definition of the theory (2015) as stated by Clayton Christensen himself:

“Disruption” describes a process whereby a smaller company with fewer resources is able to successfully challenge established incumbent businesses. Specifically, as incumbents focus on improving their products and services for their most demanding (and usually their most profitable) costumers, they exceed the needs of some segments and ignore the needs of others. Entrants that prove disruptive begin in successfully targeting those overlooked segments, gaining a foothold by delivering more suitable functionality – frequently at a lower price. Incumbents, chasing higher profitability in more-demanding segments tend not to respond vigorously. Entrants then move upmarket, delivering the performance that incumbents’ mainstream costumers require, while preserving the advantages that drove their early success. When mainstream costumers start adopting the entrants’ offerings in volume, disruption has occurred.” (C.C. Reader, p. 158-159, ll. 24-36+1-3, 2015)

A.10 Building the theory of disruptive innovation

“To succeed predictably, disruptors must be good theorists. As they shape their growth business to be disruptive, they must align every critical process and decision to fit the disruptive circumstances” (Christensen & Raynor, p. 18, 2003)

In the above quotation from *The Innovators solution*, Christensen and Raynor explains that the pre-requisite to being a potential disrupter one must be a good theorist - here they are referring to managers executives within incumbent firms as well as executives in entrant firm.

Christensen and Raynor also express their view on why theory based on understanding causal mechanisms, can be trusted to predict outcomes of either success or failure in the face of disruptive opportunities: “We can only *trust a theory* when its statement of what actions will lead to success describe how this will vary as a company’s circumstance change” (Christensen & Raynor, p. 16, ll. 33-35, 2003)

Joshua Gans agrees on the matter: “While it might be possible to look at an industry and all of the innovations that have occurred in it, classify them, and then associate them with the success or failure of incumbents, disruption theory is only complete if we can describe the mechanism that links them. Mere association is not enough.” (Gans, p. 26, ll. 15-19, 2016) Here Gans points to causality to be a crucial factor in applying/testing disruptive processes.

In 2006 Christensen published a 10-year status on the development of the theory of Disruptive Innovation named “The ongoing process of building theory“ Christensen et al. had, in 2002, invited researchers to empirically test their deductively derived model in order to “...continue to build deeper understanding of the circumstances under which we might expect integration and non-integration to confer competitive advantage or disadvantage” (Christensen et al., 2002, p. 957)

Here he explains the theory in terms of descriptive and normative theory building, and how he and some of his students have provided a model describing how the steps in both terms has applied to the ongoing process of building onto the theory of disruptive innovation.

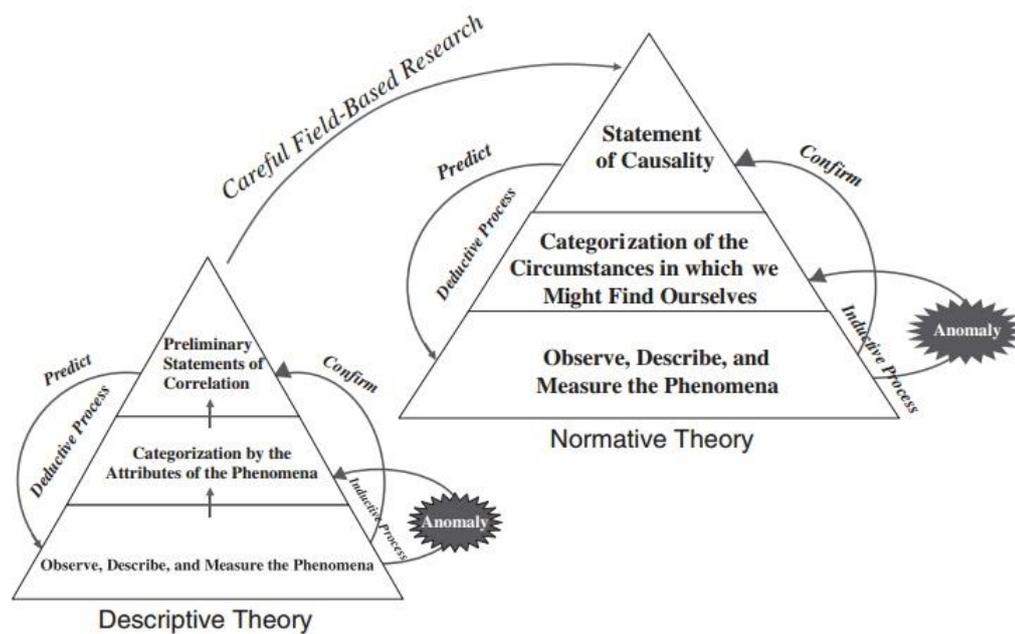


Figure 9: Models showing the two different ways of building theory inductively and testing them deductively - descriptive theory and normative theory (Christensen, p. 42, 2006)

On the basis of an examination of research activity in various management fields, they had suggested that theory-building processes consist of a descriptive and a normative stage. These stages are completed through three steps, observation, and classification and defining relationships. To support this, Christensen writes that “It is more useful to think of the term theory as a body of understanding researchers build cumulatively as they iterate through each of the three steps in the descriptive and normative stages” (Christensen, p. 39, 2006).

This article (2006) is of course an answer to many of the critiques that applications the theory has received from the academic environment. Therefore it is not to be confused with the *misapplication-problem* presented in chapter A.9 by Christensen. I shall return to the matter of this problem in the following chapter, where the work of Joshua Gans (2016) is reviewed.

A.11 Supply-side and demand side of disruption

Joshua Gans, whose work has been mentioned earlier⁵ provides an overview of the work behind the theory of disruptive innovation, (as the origin story of *Creative Destruction*) but he also makes the separation between Rebecca Henderson's work and Christensen's by adding terms that reflect how their respective areas of focus differs from one another. In recap, Henderson was also interested in disruptive change like Christensen; they were also both Harvard students in between 1980-90's. He explains that Henderson's perspective towards the phenomenon of disruption was of architectural concern while Christensen's perspective was aimed at management decisions towards resource-allocations and different customer tiers in mainstream or new-markets of technological innovations. Gans parts the two perspectives into **Supply-side** (Henderson) and **Demand-side** (Christensen) - **disruption**. The following quote sums up the two perspectives:

"In summary, while demand-side disruption involves an established firm missing a certain kind of technology opportunity, supply-side disruption arises when an established firm becomes incapable of taking advantage of a technological opportunity" (Gans, p. 104, ll. 24-27, 2016)

Supply-side refers to the disruption dilemma as a matter of incumbent companies not being able to respond to new innovations because of lacking resources and experiences with the innovation architecture. In contrast, they know very well how to do sustaining innovations by having a vast knowledge on component-parts and how to improve these within existing architectures. But when it comes to new ways in which the components work together, they come up short because a change in architecture requires time and is hard to do when in a large and embedded organization. Gans writes:

"The way to view this is to consider a "design perspective" on how new products are conceived. Consider the design of a product as involving a number of components and also how those components are put together (i.e., their architecture)(..)Henderson and Clark pointed out that a fan is made up of blades, motors, a blade guard, control system, and mechanical housing. Each of these are components, but how they are designed to work together is a fan's architecture." (Gans, p. 23, ll. 1-5+12-15, 2016). Gans then goes on explaining the two main views in product-innovation design terms, which is component innovation and architectural innovation.

Gans continues writing: "For Henderson, many firms become successful precisely because they can out-compete rivals in product improvements (architectural innovation), And the quickest way to do that, perhaps the most efficient in some sense, is to organize for component innovation. But what happens if a new technology comes along that change the architecture of a product – that is, how the components relate to one another? For successful firms organized around component innovation, thinking about how to recognize and deal with a new architecture is a challenge." (Gans, p. 23, ll. 16-23, 2016)

⁵ Gans, J., *The Disruption Dilemma* published in 2016.

Basically Christensen and Henderson both saw that established firms could deal with technological jumps so long as they impacted only specific components. But for jumps involving new architectures, there was indeed a problem. Christensen went on to consider this as sustaining innovations and examined further why this was the core of the innovators dilemma when facing entrant firms presenting new product architectures to market. This happens around Christensen's thesis in 1992 – recall Christensen's early publication mentioned in chapter A.1; here, he derived a new perspective as to why incumbent experience failure by pointing towards *demand-side disruption as the cause*.

To get a better idea about Henderson's logic I refer to the theory on "Design Spaces" which applies to software system architecture. Even though this is a jump in time, it shows how architectural vs. component product understanding still applies to product innovation in the design literature, in this case the theory of design spaces is applied in software development. The theory provides an in depth explanation of the difference between component parts and constituent parts. In system development, holism is connected with complex interactions, and specialization with complex parts. A system's specialization depends on the degree of differentiation that exists between the system parts in the sense of form and action, especially in the constituent parts (basic parts) (Whitworth & Ahmed, chapter 2, 2013).

Now, what Joshua Gans is focusing on is as to why the theory on disruptive innovation often is being misapplied (and misunderstood) by other authors (Gans, p. 13, 2016; C.C Reader, p. 157-172, 2015). Therefore, he travels back to the roots of the theory of disruptive innovation before it was formed into what it is today. Central to Gans' book is the case-study of Netflix vs. Blockbuster; in regards to the story of these two companies Gans proves, that this case can both be labeled as Supply-side and Demand-side disruption, given that Blockbuster faced circumstances that applies to both Henderson's and Christensen's perspectives. Although this is an interesting note, the main reason for bringing up Gans in this review, is to provide a greater understanding of the roots of the theory of disruptive innovation. In my opinion, it cannot go unrecognized, that Joshua Gans has written a book both dissembling, analyzing and re-collecting the theory of disruptive innovation to strengthen its original definition, and in the process of doing so, pointing out perspectives that has not been mediated through popularized literature (mainly because Henderson never wrote popular management tomes and gain a guru-status⁶). This provides an important back-story for the theory and causes readers to better grasp what demand-side disruption entails. He does this with the intent of making less people misapply or "misuse" the term of disruption/disruptive innovation. This matter of misapplications and misunderstandings of the theory of disruptive innovation is another central point in tracing the

⁶ Gans, p. 22, ll.25-27, 2016

footsteps of Clayton Christensen's work. The matter of misapplication and examples of how Christensen himself answers to this has been discussed in prior chapter A.9.

A.12 The old and the new disruption (McQuivey, 2013)

Another book I wish to review in the context of disruption theory is a publication from 2013 by James McQuivey titled *Digital Disruption*. What McQuivey does particularly well, is combining the notion of *disruption* with the word *digital*. The research made in this report has proved that (from Christensen's point of view) other authors have moved into a cross-sectoring area using the theory of disruptive innovation in relation to subjects of very little or no relation at all, one could suspect McQuivey of doing the exact same thing. Even though he might be moving dangerously close to what other authors have been criticized at, I think of him as an important contribution to the research in disruption within the digital field, and here is why:

McQuivey addresses the fact that the world is becoming more and more digitized. He uses different cases to demonstrate how the digitalization is affecting the world economy and businesses. He then claims that there are two types of business models that can lead to disruption; *traditional/old-disruption and new-disruption*. McQuivey initially explains how the two types differ from one another. When describing the traditional or old type of disruption, he refers to Clayton Christensen⁷:

"Clay shows that the traditional disruptive innovations he studies typically take years or even decades to disrupt markets. As his case studies show, physical disruption requires the painstaking manipulation and alignment of physical resources. The resources themselves are often expensive, as is the factory that makes the new product. They can only become profitable by achieving scale, and scale requires massive initial investment to succeed at disruptive prices, and this holds whether you're making a mousetrap, a CD player, or an electric car." (McQuivey, p. 9, ll. 1-9, 2013)

McQuivey emphasizes factors like time and money as crucial to obtaining success and scale your business in terms of what he calls the traditional disruption mindset. He then goes on explaining how digitalization has effected this traditional way of doing innovation:

"Digital disruption will change that. But not just in software or apps. In fact, the power of digital disruption is that it can disrupt any aspect of any product or service, including processes deep within companies focused on physical things, processes that govern partnerships, data collection, pricing, and the management of labor or capital resources. In fact, digital disruption's power multiplies precisely because it can apply to industries that are not even digital. In this way, digital disruption happens *to and*

⁷ McQuivey refers to C. M. Christensen's book *The Innovators Dilemma* (1997)

through digital things, which then accelerate the disruption of physical things.” (McQuivey, p. 9, ll. 10-18, 2013)

First he notes that digital disruption is far more potent than old disruption, regardless of the industry. He then goes on explaining as to why it is far more potent, which is because digital disruption happens both to and through things which accelerate the disruption process of physical things. I will return to McQuivey in part C of this literature review.

A.13 Summing up review part A

In this chapter I will sum up the data and key-points established in the review of Disruptive Innovation. With these I then answer the first sub-research question:

1.) *What is Disruptive Innovation?*

To start out I would like to re-visit the latest definition of the theory, which goes:

“Disruption” describes a *process* whereby a smaller company with fewer resources is able to successfully challenge established *incumbent* businesses. Specifically, as incumbents focus on improving their products and services for their most demanding (and usually their most profitable) costumers, they exceed the needs of some segments and *ignore* the needs of others. *Entrants* that prove disruptive begin in *successfully targeting those overlooked segments*, gaining a *foothold* by delivering more *suitable functionality* – frequently at a lower price. Incumbents, chasing higher profitability in more-demanding segments tend *not to respond vigorously*. Entrants then move *upmarket*, delivering the *performance that incumbents’ mainstream costumers require*, while *preserving* the advantages that drove their early success. When mainstream costumers start *adopting* the entrants’ offerings in volume, disruption has occurred.” (C.C. Reader, p. 158-159, ll. 24-36/ll. 1-3, 2015)

Having established the core of the theoretical statement I will now insert dimensions and variables of importance in regards to the theory in the table below:

The term defined:	<i>Disruption: “dis-“; (negative) “-ruption” (from the word eruption); shaken up or disturbed.</i>
The dilemma / paradox:	[Means of success = Failure] <i>When incumbent companies fail in sustaining success while, in theory*, doing everything right/continue doing what made them successful in the first place.</i>
Key-terms:	1. Disruptive Technologies vs. Sustaining technologies (1995-1997) > Disruptive Innovation vs. Sustaining

	<p>Innovation (2003-2015)</p> <ol style="list-style-type: none"> 2. Low-Entry Disruption vs. New-Market Disruption 3. Asymmetric Motivation (resource-allocation) 4. Demand-side vs. Supply-side of disruption 5. Internal organizational structures 6. Autonomous business units vs. Internal strategic teams 7. Incremental product improvements
Problems:	Misapplications: Using the term loosely, referring to other kinds of market-ruptures, failure of incumbent firms instead of the specific disruptiveness described in the theory.
Architecture:	<ul style="list-style-type: none"> - Triangular model of theory building - From descriptive theory to normative theory - External validity /internal validity - Inductive process of uncovering patterns and causalities vs. deductive test of theory application - Frameworks of failure (data-based, knowing the past) Predicting disruptive potential (unknown future) - Theory describes a <i>process not an event</i>
Methods:	Inductive theory building, quantitative and qualitative data. From one industry to many different
Area of concern (in academia):	Economy, organizational theory, business strategy.
Foundation of theoretical contributions:	Diffusion of innovations/consumer innovation-adaptation process, technological discontinuities, economy statistics, architectural and component innovation, market trajectories.
Target audience:	<p>Primary : Executive managers in incumbent firms</p> <p>Secondary: Entrant companies</p>
View on disrupters	Autonomy, experimentation, innovative products. Non-established frame of rules, open to changes

	Competing in marginal/niche markets or non-consumption. Targeting over served costumers, low-end opportunities.
View on the disrupted	<p>Rules and regulations, attractive investments = high returns, capitalistic orientation, choices based on embedded values, processes and resources, internal structures protects from changes.</p> <p>Competing against consumption, targeting customers in high tiers of demand</p> <p>Look to high-end opportunities.</p>
Prerequisite for disruption to hit a company:	Must be successful
Catalysts of disruption (prerequisites in accordance to the theory)	<p><u>Supply-side</u>: architectural innovation, companies are not able to respond</p> <p><u>Demand-side</u>: asymmetric motivation, unattractive investments vs. attractive investments</p> <p>[Low-end market entry > establish foothold > incremental innovations > move upmarket > establish foothold in mainstream markets = <u>disruption</u>]</p>
Solutions for dealing with disruption	<ul style="list-style-type: none"> - Proactive priorities (management choices) - Autonomous business units - Seeking potential in product innovation/technologies - Focus on Non-consumption and/or over served customer tiers) - Focus on “The job to be done” rather than the user of the product (user-centered product development (personas/stereotypes vs. contexts of usage/scenarios)

*heuristic principles in investments & business strategies – percentages of cost margin returns

B.) Exponential growth

B.1 Predictions of a technological revolution

In 1965, Gordon Moore made a prediction that would set the standard for our modern digital revolution. From careful observation of a growing trend, Moore gained extrapolation that computing would dramatically increase in strength and fall relatively in cost at an exponential rate. The simplified version of this law states that processor speeds, or aggregate computing power to computers, will double every two years. Breaking Moore's law further down, it specifically stated, that the number of transistors on an affordable CPU would double each eighteenth month:

"The complexity for minimum component costs has increased at a rate of roughly a factor of two per year. Certainly over the short term this rate can be expected to continue, if not to increase. Over the longer term, the rate of increase is a bit more uncertain, although there is no reason to believe it will not remain nearly constant for at least 10 years. That means by 1975, the number of components per integrated circuit for minimum cost will be 65,000." (Gordon E. Moore in Electronics Magazine, d. 19. April, 1965)

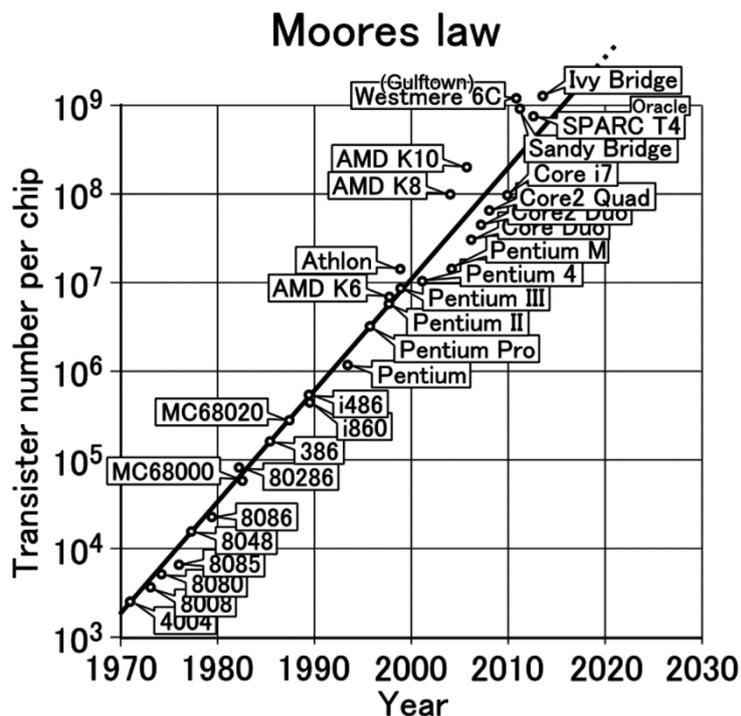


Figure 10: Chart displaying transistor-growth pr. year. Link: <https://phys.org/news/2015-08-silicon-limits-power-electronics-revolution.html>.

The Transistor



Figure 11: Picture A (top left): A floor plan over the transistor structure (Møller, p.18, 1965). Picture B: Transistor produced in 1961, measures 5 cm in length and 0.5 cm in width. Picture C: Evolution in Computer Technology (Right to Left) Two types of transistors (top transistor handles more volt than bottom transistor). Next to these is an early model of a 1979 integrated circuit produced by Zilog. Hereafter, a microchip produced by Intel from 1982. The following microchip is produced by Siemens in 1984 and lastly a microchip produced by Intel in 1989. (Fun fact: Gordon Moore was the co-founder of Intel).

This prediction has been well documented since 1970 and has been the starting point for, inter alia, 30 years of research by Ray Kurzweil (born. 1948) as a result, has derived four core observations:

1. The doubling pattern identified by Moore in integrated circuits applies to any information technology. Kurzweil calls this for "Law of Accelerating Returns" (abbreviated LOAR).
2. The key driver in this phenomenon is information; As soon as an industry, discipline or technology becomes "information-enabled" and powered by information streams; its price/performance begins doubling approximately annually (this is of course area-dependent).
3. As soon as a doubling pattern has started, it will not stop. For example, newer and better computers are constantly evolving from the previous generation of computer technologies.

4. Several key technologies today are information-enabled and following the same trajectory. Those technologies include artificial intelligence (AI), robotics, biotech and bioinformatics, medicine, neuroscience, data science, 3D printing, nanotechnology and aspects of energy. (Kurzweil, p. 184-277, 2005; Ismail, p.19, ll. 1-24, 2014)

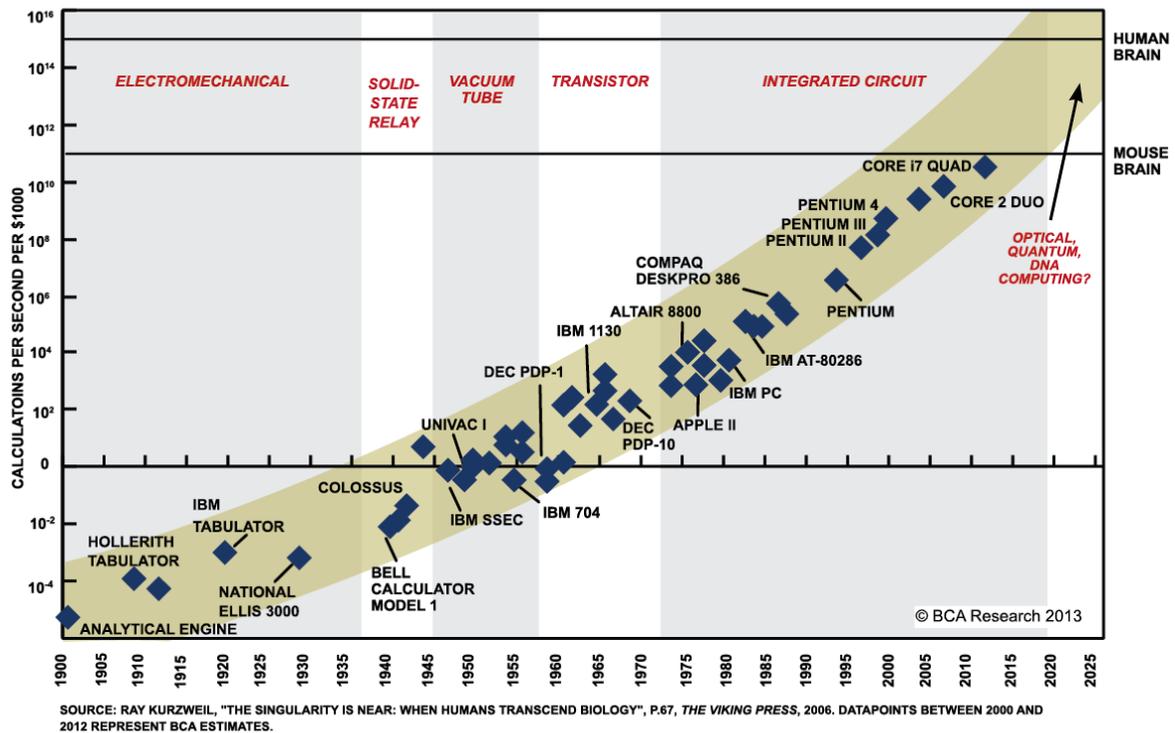


Figure 12: The evolution of technology based on Moore’s law (Kurzweil, P. 67, 2006; Moore, Gordon (April 19, 1965). "Cramming More Components onto Integrated Circuits". *Electronics Magazine*. 38 (8): 114–117.)

Kurzweil's observations points to the importance of information enabling and how this has a societal, technological and, not least, economic impact on today's society. Kurzweil's law has been realized in the form of the 4th industrial revolution (digitization of information) which have meant that information-enabling today (2017) has reached it’s (for now) highest point.

By virtue of the fact that all information is digitized and via the internet, becomes available to all, regardless of time and place, we see a number of factors that constantly enables one another. This means that acceleration in technology continuously releases newer and better technology - according to Ray Kurzweil, we are exponentially moving towards singularity to a point where humans transcend technology and a fusion between the biological and technological realms can/will occur. (Kurzweil, p. 128-184, 2005)

It is important to emphasize that the evolution as described is just beginning (Ismail, p. 31, 2014). In all areas and across sectors, growth arises that points to the coming state of singularity (the price moves towards zero and performance against infinity). An example on

how the term singularity (borrowed from physics) is changing global economy is the rise of new business models constructed around *flat-rate services*. Netflix provides an amount of visual entertainment for a set price per month. The price /value of the service will continue to lower as the performance moves higher up (atm. the amount of free content on Netflix exceeds the limit in which consumers are able to utilize it). We here have an economic example of price moving towards zero as performance moves towards infinite. (Ismail, p. 123, 2014)

B.2 Exponential Organizations and Singularity University

The concept of exponential organizations has been developed at Singularity University. Co-founder and Chancellor of the establishment is futurist Ray Kurzweil who is the author of “The law of accelerating returns” (2004) and “The singularity is near” (2005). Co-founder and executive chairman at Singularity University is Peter Diamandis who is the author of “Abundance: The future is better than you think” (2012). (S.U, 2017)

Salim Ismail (b. 1965) is a Canadian investor, speaker, advisor, entrepreneur and strategist. Together with co-authors M. S. Malone and Y. V. Geest, Ismail wrote *Exponential Organizations* in which a concept generated at Singularity University is presented (Ismail, p. 7-8, 2014). Ismail is also executive director of Singularity University and co-founder of Confabb and Angstro, acquired by Google in 2010. Most recently he founded ExO Works and serves as Chairman of the company. Ismail has a background as an entrepreneur and was the head of Brickhouse, Yahoo's internal incubator for new products. (MIA, t. 0.40- 1.00, 2016; Rowan, 2013; USI, 2015; S.U, 2017)

Before introducing the main framework or “how-to” guide, I would like to make a clear distinction between what the authors often refers to as linear organizations, and also point to its counterpart which is the processes that exponential organizations are built upon.

B.3 Linear vs. exponential

The notion of either being a linear or an exponential thinker depends on where the organizational structure, embedded processes, values and strategy comes from.

The linear way of doing business strategy is also described as the traditional way. When the authors of exponential organizations speak of *linear organizations* they use the example of product creation frameworks to demonstrate the different specs of management strategy.

In project management, many projects can be built on how a project is planned, implemented and evaluated using a variety of methodological approaches (Andersen & Søndergaard, 2013;

Fischer & Oosterbaan, 2011; Elting & Hammer, 2009). There are different project models for organizing different types of projects, including software development (Whitworth & Ahmed, 2013), product development, construction projects, research projects and so on. Common for all models is that they are either based on phase models or may be a derivative thereof (Jensen & Dinitzen, p. 31, 2010). An example of a model based on a strict linear logic is named "Waterfall Model" (Royce, 1970, pp. 328-334). This model describes development processes as independent modules. This type or linear model normally has a non-iterative form. The waterfall model is particularly associated with development processes in software. (Jensen & Dinitzen, p. 33, 2010)

There are also models that reflect a more iterative nature rather than the strictly linear form such as *agile or iterative models*. The exponential organization builds frameworks of product management that are iterative and highly agile. One of the characteristics of this method is that it is able to handle changes in circumstances quickly and efficiently. (Ismail, p. 38-42, 2014)

B.4 The architecture of an exponential organization

"(..)We have learned how to scale technology really well, but scaling the organization organizations and building that is incremental and painfully linear and have always been that way. But literally in the last five years or so we have seen a need breed of organizational structure that can scale in the same seamless way that we can scale technology." (TEL, t. 1.49-1.58, 2014)

The above quote points to an organizational problem in the form of an outdated and linear paradigm within organizations. Ismail and his cowriters both draw on personal experiences (see appendix A.2) and case-studies of approximately 60 companies that within a range of 5 years have shown the potential to scale their organizations in a similar pattern to how technology is scaled in the 21st century (fig. 12). Ismail also points out, that this problem in particular (linear business models) is the very reason as to why he wanted to write the book on exponential organizations. (MIA, t. 0.40-1.00, 2016)

There are some fundamental ways of building an exponential organization, the concept is lining up a how-to guide parted into large- mid-, and start-up companies. Therefore, the book is parted into chapters of different perspectives and interests depending on which organizational position the reader is in.

B.5 The Massive transformative Purpose

All of the researched organizations have one single mission or statement in common and that is *the massive transformative purpose (short = MTP)*. Some examples of what Ismail calls “MTP’s” is given in the book:

- **TED:** “Ideas worth spreading”
- **Google:** “Organize the world’s information”
- **Singularity University:** “Positively impact one billion people”

What separates the massive transformative purposes from what we know as company slogans is that they are *highly aspirational*. They aim to capture the hearts and minds- and imaginations and ambitions- of those both inside and (especially) outside the organization. (Ismail, p. 53-58, 2014) The following chapter is closely connected to the notion of the Massive Transformative Purpose – the concern is to demonstrate the central tools and attributes in the framework that is provided.

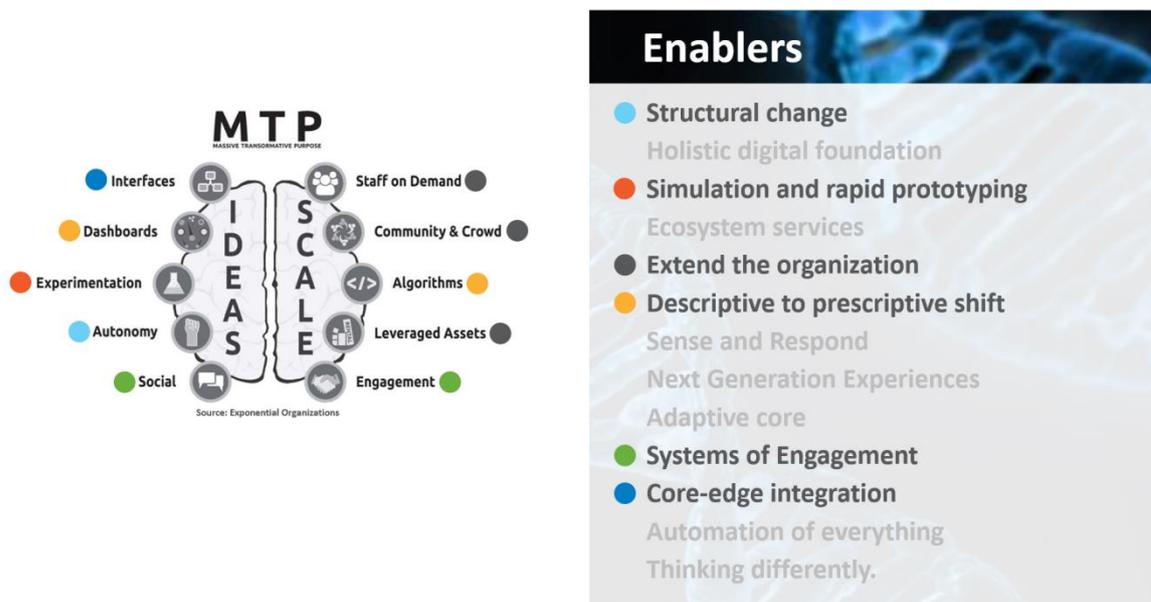


Figure 13: The acronyms SCALE and IDEA explained with color-coded areas of concern (Ismail, p. 53, 2014)

B.6 Scale & Idea (Ismail, p. 58-109, 2014)

The massive transformative is mapped under the 10 externalities under the acronym SCALE and IDEA. Every first-letter of the acronyms represents an attribute. Below is listed the meanings of each attribute.

1. SCALE:

Staff-on-demand: Using staff on demand entails renting workforce based on your companies' current needs. LinkedIn offers this as many educated people are willing to work on a contract for a limited time and then go on to new projects, this is also referred to as freelancing. The main abilities of using staff on demand is that it allows agility, enables learning (with fresh perspectives) and forms stronger bonds among core teams. Its dependencies are clear task specifications and interfaces to manage freelancers.

Community and crowd: For an organization or enterprise, its "community" is made up of core team members, alumni (former team members), partners, vendors, costumers, users and fans. It requires strong leadership to manage communities, because although there are no employees, people still have responsibilities and need to be held accountable for their performances. Exponential organizations can leverage the crowd by harnessing creativity, innovation, validation and even funding. The benefits of utilizing the attribute are that it can increase the loyalty to exponential organizations, drive exponential growth, amplify ideation and allow for agility and rapid implementation. Its dependencies are a strong massive transformative purpose, engagement, low thresholds of participation and authentic and transparent leadership.

Algorithms: This attribute is all about utilizing tools to secure enhance and automatize the company resources. Examples of such algorithms are Machine Learning (built on known properties) and Deep Learning (based on neural net technology). This allows fully scalable products and services, leveraged connected devices and sensors, lower error rates and easy updates. Its dependencies are Machine or Deep Learning techniques and cultural acceptance.

Leveraged assets: This attribute is about renting, sharing or leveraging assets – as opposed to owning things. It builds on a bit of a post-materialistic philosophy. The possibility of renting out assets or tools can be done at a fixed price or done as a demand-service. This allows for scalable products and enables the exponential organizations to lower marginal costs of supply, increase agility and remove the need for having to manage assets. Its dependencies are interfaces and abundance/easy available assets.

Engagement: Engagement is comprised of digital reputation systems, games and incentive prizes and provides the opportunity for virtuous positive feedback loops – which in turn allows for faster growth in consumer-loyalty. Through dynamics, mechanics and components user engagement is created. This concept is also referred to as gamification. The benefits of focusing on engagement are that it amplifies ideation, enables play and learning and converts crowd to community. Its dependencies are a strong massive transformative purpose and clear, fair and consistent rules without conflicts of interest.

2. IDEAS:

Interfaces: Interfaces are filtering and matching processes by which exponential organizations bridge from SCALE externalities to internal IDEAS control frameworks. Interfaces are geared towards filtering and matching. Benefits such as bridge between external growth drivers and internal stabilizing factors comes from using interfaces, this atomization also allows scalability. Its

dependencies are standardized processes to enable atomization, algorithms, and saleable externalities.

Dashboards: Using dashboards allows an entire organization to manage itself: for example, one organization could implement a real-time, adaptable dashboard with all essential company and employee metrics, accessible to everyone in the organization. Its benefits are mainly the ability to track critical growth drivers over time, create control framework to manage fast growth and also, to minimize exposure from errors because of short feedback loops. Its dependencies are that real-time metrics can be tracked, gathered and analyzed and a universal, cultural acceptance by employees.

Experimentation: Experimentation keeps processes aligned with rapidly changing externalities. It's about allowing for failure in order to improve and iterate further in product- or service innovation. Experimentation also maximizes value capture and having the risk-taking mindset can provide an edge and faster learning. Its dependencies are measurement and tracking of experiments as well as cultural acceptance of the "failure leads to experience"-mindset.

Autonomy: The attribute called autonomy is referred to as self-organizing, multi-disciplinary teams operating with decentralized authority. For example the company hires talented, innovative self-starters, who decide which projects they wish to join. They are also encouraged to start new projects (if they fit with the company's MTP). Benefits of this model is increased agility, more accountability at customer face, faster reaction and learning times, and higher morale. Dependencies are having the massive transformative purpose as a gravity well as well as self-starting employees and dashboards.

Social: This attribute refers to *social technologies*. With the workplace becoming increasingly digitized, the social technologies are creating fertile ground for cooperation and efficient feedback loops. It establishes faster conversations, faster decision cycles, faster learning, and it stabilizes team during rapid growth. The dependencies are a massive transformative purpose to follow, Cloud social tools and a cooperative culture.

B.7 The implications of the model

SCALE and IDEAS elements are self-reinforcing and integrative. They can be put together as one wishes so far the MTP is aspirational and the company meets the external and internal needs. The more workforces you have, the harder it is to switch strategies and business models, and the more information-enabled you are, the more strategic flexibility you have as an organization. One implication of this model is that everything is being demonetized and dematerialized, as in turning into an application or such. At this point smaller is better than big, while in the past, in terms of economy scale the bigger companies were better than the small ones. The high order in companies today is flexibility which requires an agile model. This agile approach also entails having interdisciplinary fields and teams that are able to cooperate effectively, and having the tools to support times of rapid growth.

Another implication that is of particular interest is “Disruption is the new norm”. In this chapter a reference is made to Clayton Christensen and his publication “The innovator’s dilemma” (1997): “(..)Christensen points out that disruptive innovation rarely comes from the status quo. That is, established industry players are rarely structured or prepared to counter disruption when eventually it appears.(..) Today, the outsider has all the advantages. With no legacy systems to worry about, as well as the ability to enjoy low overhead and take advantage of the democratization of information and – more important- technology, the newcomer can move quickly and with a minimum of expense. Thus, new actors and entrants are well equipped to attack almost any market, including yours- along with your company’s profit margins.” (Ismail, p. 124, ll. 15-18+21-27, 2014)

This quotation I find to be very important to note down when moving into the analysis of the review-findings. In here Ismail makes a reference to Christensen as well as takes his theory into the current state of the world, pointing out that the organizational paradox, or the innovators dilemma is happening in real-time and the background of technological growth and information-enabling accelerates the disruptive processes/opportunities. He also notes that the entrant (recall small and agile is better than large and incremental) companies has the upper hand by being liberated of boundaries connected to the linear way of building organizations.

B.8 Switching from scarcity to abundance

Selling access to the scarcity within the organizational boundaries, now this access is free because of scaling in price/performance and the on-demand services that are growing in many different markets (examples like Uber and Airbnb) and the friction-free infrastructure of selling and acquiring assets, tools and services (Rifkin, 2014; McQuivey, p. 12-14, 2013; Ismail, p. 51-53, 2014)

“All of our old org-structures is about gathering an asset or workforce and putting a boundary around it and then selling access to that scarcity. Whereas, these new businesses are learning how to scale their business functions and their organizational elements *outside* the core organization and we’ve just never seen that before.” (TEL, t. 2.50-3.08, 2014)

To the concept of Exponential organizations, the focus on the future and the scarcity to abundance shift that Diamandis also elaborates in his book *Abundance (2012)* is a very central key understanding why applying the exponential mindset in organizations is crucial to overcoming future challenges. The biggest challenge is to move the entire organizational structure from closed and internally operating into organizations that are operating externally from the core organizations (Ismail, p. 303, 2014).

B.9 Summing up part B

In this chapter I will sum up the data and key-points established in the review of exponential organizations. With these I then answer the second sub-research question:

1.) *What are exponential organizations?*

The term exponential organizations consists of two words: exponential and organizations. In the chapter on exponential growth we learned that this started with Moore's law back in 1965. Ray Kurzweil then started to build onto Moore's predictions and created the law of accelerating returns which pointed to the tendency of the doubling pattern in technological growth at every 18 months. We also learned that any domain or discipline or information or technology that gets information-enabled, and acquires informational properties – its price/performance start doubling every eighteen to thirty month.

Organizations are institutions of growth, production and innovation. There is a long theoretical history behind organizational theory where a linear pattern applies to regulatory and production processes. The linear organization is built on a hierarchical order, where decisions have to run from managers in the bottom to the top of the pyramid to be approved. This kind of organization is constructed in a way that protects it from external threats, competition and radical changes.

The exponential organization is a company that, because of its architecture is enabled to grow exponentially. To be exponential means being adaptable and agile in changing to external environments, processes and values. To be exponential as an organization includes implementing a minimum of four of the 10 attributes mentioned in the MTP-framework (chapter B.5) in order to reach the *10 x-scaling effect* (TEL, t. 14.00-14.08, 2014).

By utilizing a strongly future-oriented focus backed up by Moore's law and Ray Kurzweil's predictions of the accelerating pace in technological growth (chapter B. the concept points to the importance of scaling your business. By using terms such as "digital" and "disruption" the possibilities of utilizing scale to create growth comes into focus. By pointing towards major scaling opportunities as well as protection in the face of external threats such as disruption ("the large companies"), Ismail lines up a win-win scenario for the reader to obtain through implementation of the concept.

Key-interests:	Future and technological development. From scarcity to abundance. Information-enabling industries – physical and digital products and services.
-----------------------	---

Problems:	Linear thinking in organizational building and scaling
Architecture:	<ul style="list-style-type: none"> - Concept - Applicable practical frameworks with attributes (MTP) SCALE and IDEAS elements are self-reinforcing and integrative
Methods:	Quantitative and qualitative data. Reviews, statistics, interviews.
Area of concern (in academia):	Exponential growth in companies, economy, organizational theory, business strategy, information and digitalization, price/performance.
Foundation of conceptual contribution:	Raymond Kurzweil (2004-2005), Peter Diamandis (2012), Yuri Van Geest (2014), Michael S. Malone (2014), Jeremy Rifkin (2014).
Target audience:	<p>Mainly start-up companies (chapter 6) The new breed of organizations with scaling potential. The smaller the better.</p> <p>Mid- and large organizations (chapters 7 and 8) linear and incremental, the bigger the harder to adapt to information-based organizational paradigm</p>
View on disrupters	<p>Autonomy, experimentation, innovative products. Non-established frame of rules, open to changes</p> <p>Competing in marginal/niche markets using new technologies within a wide range of industrial fields.</p>
View on disruptees	<p>Linear thinkers.</p> <p>Is in a set-back position because of legacy in traditional organizational paradigm</p>
Prerequisite for disruption to hit a company:	Minimum 4 of the 10 attributes of the MTP-framework
Catalysts of disruption (prerequisites in accordance with the concept-writers)	digitalization and information-enabling, accelerating technology
Solutions for dealing with disruption	The MTP + (SCALE and IDEAS)
Addition to the theory by Christensen:	“Disruption is the new norm” – disruptive opportunities and growth trajectories are

	<p>higher than ever.</p> <p>Large- and mid- organizations is having a hard time transitioning to the information-paradigm of business models.</p>
--	---

C. Discussion - relation between authors

While we have the literary back-land for the theory of disruptive innovation established, we have also established what lies behind the concept of exponential organizations.

Let us recap the problem formulation: **How can a literature study be used to bridge the theory of Disruptive innovation with the concept of exponential organizations?**

By having also answered the two sub-research questions: What is Disruptive Innovation & What are Exponential Organizations? We now have an in-depth idea of what the theory and the concept entail. In order to move towards an answer to the problem formulation as stated above, we need to address the third question: *What connects the two areas of interest?*

C.1 Connections in exponential organizations to the theory of disruptive innovation

A quotation from an interview with Salim Ismail reveals that one of the greatest influential books he personally has read is the innovators dilemma (97) by Clayton Christensen (appendix A). What we know from this interview-statement and from the publication *exponential organizations*, Ismail is pointing to Christensen's publication *The Innovator's Dilemma (1997)* as the most influential, furthermore the source listing in the back of the publication holds references of three publications connected to the theory of disruptive innovation: *The Innovator's Dilemma (1997)*, *The Innovator's Solution (2003)* & *The Innovators DNA (2011)* (Ismail, p. 316, 2014).

So far we have discovered 5 connection points in the book on exponential organizations to the theory of disruptive innovation:

- 1.) *Graph in the introduction (p.20)*
- 2.) *The 6 D's (p. 10-11)*
- 3.) *Disruption as the new norm (p. 124-126)*
- 4.) *Exos for large organizations (p. 200-2015)*
- 5.) *Disrupt [X] (p. 216-228)*

C.2 Building a concept vs. building a theory

The authors clearly states that they are not trying to make new theory by writing this publication: “Our objective is to not make a book of theory, but rather to present the reader with a how-to guide to the creation and maintenance of an Exponential Organization. We offer a hands-on, prescriptive look at how to organize an enterprise able to compete in the face of today’s accelerated pace of change” (Ismail, p. 21, ll. 4-8, 2014)

Unlike Christensen that builds theory based on past data and inviting others to deductively try out its validity, the authors of exponential organizations has a disclaimer pointing to the logic that no one knows for sure, what will happen in the future. Put together with the fact that they state that they are not trying to build theory, creates two pieces of well-fitting logic⁸.

Instead the authors points to Ray Kurzweil’s popular work of predictions over the last 40 years and continuously highlighting his role in creating Singularity University where the concept of exponential organizations I made. This can be interpreted as a method of increasing the validity of the fundament upon which the concept is built. Another force built into the concept is the fact that the book keeps repeating the central message of “adapt to survive”, which is a widely adopted and applied philosophy. Looking at the history of- and theories behind human evolution, the relevance of adaptability has been proven many places. This, combined with the usage of the term disruption, could be interpreted as the authors trying to add a level of urgency for the concept to be implemented in all types of organizations.

There is a level of uncertainty related to the whole prescriptive picture of the publication since the concept is based on a *research* of literature tomes in management and organizational theory, *tendencies* of the digital industries today, and as to what organizations is going to have to answer to in the *future* (which is unknown). While having an important disclaimer (as stated above) stating that they are not trying to build theory but rather a guide of survival based on the predictions made by Gordon Moore followed by the studies of Ray Kurzweil, the concept still is lacking clarity as to how the authors understand disruption in the context of the exponential growth and if/how disruption applies to what they call “linear predictions”.

⁸ Enhancing the fact that they are not trying to build a theory, can be interpreted as they do not want their concept to be tested like theories are being tested for validity.

While lacking consideration of the critiques made in regards to the theory of disruptive innovation and its ability to predict disruption, they still apply it freely as a default effect of progression in time (or as “the new norm”). In the article “What is disruptive innovation?” by Christensen one may wonder if the different problems that is put forth in the article applies to literature like exponential organizations. Christensen mentions an example of a misapplication made between disruption theory and the case study of Uber. Now the concept also brings up Uber, but does not directly connect it with disruption as they elaborate their business strategy in the context of Rifkin’s price/performance theory while applying their different acronyms of the MTP (SCALE and IDEAS). Even though it is not connected explicitly, one still have to consider the graph placed in the beginning of the book (figure 2), which points to disruption as a *differentiator* between linear and exponential growth. From this we can argue that the authors of exponential organizations sees disruption as the process that happens in the switch⁹ from business models constructed from a linear way of constructing business models to business models created from an exponential mindset. This way of depicting disruption is crucial to how the concept is understood by readers, especially because it is highlighted in the very introduction of the book.

One may argue that they do not make a connection because disruption is not explicitly mentioned in the section regarding Uber, there will always (based on argument stated before) be an implicitly-made connection to the theory of disruption throughout the book – as in, disruption is the *effect* that organizations transitioning from traditional/linear business models to exponential business models are creating. Christensen does argue that Uber can be, in some sense, be connected to principles and terms used in the theory by looking at it as high-end disruption from Uber’s side. Ultimately it does not apply to the original theory and what it states about every disruption being low-end entry.

C.3 Predictive power and validity-testing

Based on the *external validity* that can be tested on a given theory, mentioned by Christensen in his 2006 article on theory building, one can argue that this is what Ismail have (unconsciously or consciously) performed during his stay at *Brickhouse* which was an autonomous unit of the core organization *Yahoo*. Ismail have had practical experience with the innovators dilemma, as a manager at his (back then) place of work (Ismail, p. 219, 2014).

⁹ Picturing the transitioning process from linear to exponential.

Ismail use the term *organizational immune system* as a way of referencing to the way organizations are built to withstand external threats and changes. Ismail experienced first-hand how hard it was to autonomously operate as a unit of the core-organization. Every time changes were proposed, the organizations regulations prohibited the unit at which he stayed to develop or rebuild structures and strategies aimed at different markets. (MIA, t. 0.40-1.00, 2016; Appendix nr. A.2)

This is a very central topic in Christensen and Henderson's work on the embedded processes, values and architectures in incumbent companies. Again, we don't know for sure if the term "company-immune system" refers to the theory on disruptive innovation, but it has a strong similarity to Christensen's description of incumbent companies in both the innovators dilemma and the innovators solution.

C.4 Linear vs. exponential – the disruptive factor

On the note of company structure and forces against changes, in accordance to the concept of exponential organizations, the dilemma of adapt to change in order to survive makes the linear way of thinking obsolete (Ismail, p. 36-50, 2014). Looking back at the graph in the beginning, this means that the transition from linear to exponential is meant as ways of thinking as a manager inside an organization, and therefor may apply primarily to large and established companies. Start-up companies are recommended to begin and ride along the exponential curve from the very beginning, meaning that they will not face the innovators dilemma (doing what makes you successful = disruption) they will have a fresh start, so to say, in building an adaptable (hence exponential) organization from the bottom. The small companies or "start-ups" then face the challenge of maintaining their business model to continue to scale and ride along the exponential curve of organizational growth. At the same time as linear management is becoming obsolete, experts on linear organizational management and product development are also presented as being obsolete because they are not able to think exponentially about growth. Now, the authors also state that most people find it hard to think or calculate exponentially. An example used in a conference speak by Salim Ismail, he gives an example of the challenge in thinking exponentially; he gives the example of taking 30 steps, and then calculating how far you have moved. This seems easy enough to predict because everyone know how much a step measures in meters and can approximately imagine how far they might have gone in these 30 steps. Now calculating exponential or "doubling steps" 30 steps answers to a trip around the world *24 times*. This particular doubling pattern is cognitively hard to comprehend for the human mind, thus it becomes a greater challenge to predict, and even imagine, exponential

growth in areas such as technology and organizations as presented in the concept. (MIA, t: 1.11-1.52, 2016)

At another conference Diamandis speaks about the two views on disruption that they distinguish between. There are two scenarios that will play out based on your point of view: disruptive stress may occur if you are managing a large company or, disruptive opportunity which is how start-ups may perceive disruption. (WGS, t: 2.28-2.36, 2014; Ismail, p. 36-50, 2014)

This way, the concept of exponential organizations moves the focus from the innovators dilemma to the entrant/ Start-up Company's opportunity. While still handling the disruptive stress factor for the large and mid-sized companies (Ismail, p. 200-237, 2014) they add a different perspective on the theory of disruptive innovation by giving focus to the entrant and mid-size companies (Ismail, p. 147-179, 181-195).

C.5 Connecting Digital disruption

Moving on to comparing the publication on Digital Disruption to the two main areas of interest (exponential organizations and disruptive innovation) I have a few things I want to point out;

This publication is written in 2013 (a year before the book "exponential organizations" was published) and in both publications, the way that digitalization is perceived and how it relates to disruption has some similarities. For example, McQuivey presents the idea of immense scaling capabilities for new growth businesses by referring to a model that uses some of the same terms seen in exponential organizations. For example, the "10x, 100x, 1000x -better" notion is mentioned often in exponential organizations. Also, a description of how the accelerating pace of digital technology enables disruption-processes is seen in both McQuivey and Ismail's publications. Moreover, they both use the term "scale" in appliance to a new breed of businesses - even though the names are different (digital disruptors / exponential organizations) they are pointing to businesses with the same types of attributes and scalability.

The term *on-demand digital assets/tools* are also used by both McQuivey and Ismail when they describe enablers of scalability and growth potency. Ismail also states in an interview: "(..)as we digitize things we hop onto what we refer to as Moore's law, and the pace of change moves very quickly at an accelerating pace." (TEL, t. 5.05-5.13, 2014).

In this quote, Ismail points to digitization as the enabler of accelerating growth exponentially. By taking the word digital/digitize and relating it to Moore's law Digital disruption become

closely related to what the concept is built upon, which is how organizations acquire the potential to scale exponentially.

In the book of exponential organizations this report identified a blurry line between the coherence of disruption (as described by Christensen) and exponential growth in new breed businesses. As McQuivey emphasizes in the quote (p. 9, ll. 1-9), that the disruption theory is not connected to-, or based on how speed of technological growth is going, but that Christensen explains the disruption trajectory as a natural and ongoing process independent of whatever accelerations in time is occurring. Unlike the writers of exponential organizations, McQuivey uses a great part of the book to explain why the two terms “disruption” and “digital” are strongly coherent and also co-enabling factors. He emphasizes on explaining and giving examples of *how digitalization accelerates possibilities of doing disruption*. (McQuivey, p. 3-16, 2013)

Therefore, this book (Digital Disruption) sort of stands in between the theory of disruptive innovation and the concept of exponential organizations and can therefore be viewed as a argument of why the two terms, on many levels, are co-dependent. Based on the analysis one could argue that by *directly* referring to the theory as traditional/old-disruption and *indirectly* referring to the concept as new-disruption McQuivey actually explains precisely the differences and enablers, or better said the *correlation* between Christensen’s theory and the concept of exponential organizations.

5. Analysis

5.1 The results compared

In order to find out what connects the two areas of interest, we also need to find out what separates them. These two measurements will be of use when the fourth research question/the hypothesis will be addressed in the final chapter. The table placed below is a fusion of the two tables created in the sum up chapters of the literature review. Data derived from the part C of this review, *discussion on relation between authors*, contributes to the table below. It is important to mention that all of the content in the three matrixes is discussable and does not provide any finite answers. The results will be discussed in chapter 5.2.

Area of concern:	Disruptive Innovation	Exponential organizations
Main target audience	1.) <i>Incumbent firms</i> 2.) <i>Entrant firms</i>	1.) <i>Start-ups</i> 2.) <i>Larges companies & mid-companies</i>
Disruption formula	Low Price + low performance = Low-market footholds (over served costumers & non- consumption) Incremental improvements = upmarket = disruption	Low price + high performance + digital = High-scale New/low-market footholds Scale + incremental improvements = digital disruption
Management strategy	<i>Proactive :</i> disruption process understanding, different frameworks for different firms	<i>Reactive:</i> Acknowledging exponential effect on the world, model of attributes to be applied to gain exponential potential.
Point of departure and goals (Authors)	<u>Theoretical entrance</u> - Harvard University <i>Academic topics: diffusions of innovations, incumbent failure, architectural and component innovations, innovation S-curve,</i>	<u>Practical entrance</u> - <i>Brickhouse at Yahoo;</i> <i>Academic topics: The Innovator's dilemma, Zero margin cost society, The singularity is near,</i>

	<i>technological discontinuities</i> -Aiming for frameworks of practical use (Management and leaders)	<i>Abundance</i> – Aiming for frameworks of practical use (Executive managers)
Cause of disruption (Manager p.o.v.)	<i>Asymmetric motivation (p.35, 2003; p.18+ 42, 2016)(attractive investments vs. unattractive investments)</i>	<i>Exponential factor/everyone and everything is a potential threat (vast accessibility) + unknown near future (p.271)</i>
Approaches (publication purpose)	<i>Framework defining failure</i>	<i>Framework defining disruptive success + frameworks (large or mid-companies) defining disruptive stress.</i>
Technology type	<i>Physical/Analog</i>	<i>Digital</i>
Cause of disruption	<i>Natural ongoing force (Christensen p.48, 2003)</i>	<i>Natural force – but the factor of Exponential growth in digital technology accelerates disruptive processes and opportunities. Democratization, information enabling/internet connectivity, convergence, globalization.</i>
Perspectives in disruption	<i>Dilemma/Paradox</i>	<i>Disruptive stress or disruptive opportunity (depends on point of view)</i>
Kinds of disruption	<i>New-market/Low-Market entry</i>	<i>Entrant attacks 6 D's , Disrupt[X]</i>

5.2 Testing the hypothesis

The hypothesis states: *The concept of exponential organizations is theoretical correlated to the theory of disruptive innovation.*

By looking at the results in the table, many of the areas differ from one another.

- **Cause of disruption:** Asymmetric motivation vs. the exponential acceleration within fields such as technology and computation power. Christensen points to the manager being unable to make the right decision because it entails (in the view of the linearly build organization) that is equals to taking a risk and putting his/her job on the line. The concept states that the disruption occurs every time an industry or clever innovator becomes information-enabled.
- **Perspectives in disruption:** Where Christensen's theory states that disruption is a dilemma or paradox for incumbent firms, Ismail takes this perspective and turns the it around to the entrant companies. He still holds focus on the incumbents but makes a separation based on point of view (disruptive stress = the innovators dilemma & disruptive opportunity = the entrant/attackers advantage) the same goes for **Approaches**, where Christensen focus on building a framework of failure while Ismail mainly focuses on building a framework on success.

But the main thing to test out is that if the concept *theoretically* is connected to the theory of disruptive innovation; If we then take a look a some of the other results, some of them point to the fact, that the concept is an extension of the theory*, one example is the **Disruption formula:**

- Christensen: Low Price + low performance = Low-market footholds (over served costumers & non-consumption) Incremental improvements = upmarket = disruption

VS.

Ismail: Low price + high performance + digital = 10X-scale potential in incremental improvements + foothold in new- or low-end markets = digital disruption

*One must remember that the concept is not trying to be nor become a theory. Therefore it cannot be argued that there is a theoretical correlation if nothing in the concept applies to the rules of building theory. Still, it can be argued that there is a correlation to the phenomenon of disruption as to how Christensen defines the dilemma.

Another result is the **Kinds of disruption:** Where Christensen solely describes Low- and New-Market entry Ismail incorporates and describes many ways of doing disruption and how these go into certain contexts weather it is entrants or incumbent companies. They also describe

disruption as a norm in the sense, that technological acceleration and information/digitalization enables disruption opportunities.

The examples of extending the theory are present, but cannot be said to be 100% a theoretical correlation to disruptive innovation. I think, that exponential organizations integrates the term disruption and their interpretations of it – maybe to support their work even further by adding some ethos to the concept on the form of referencing the famous Clayton Christensen.

5.3 Reflection

If I were to fill out of the wholes between the theory of disruptive innovation and exponential organizations I would probably seek permission to write a Ph.D project. As this is a report at candidate-level with the purpose of demonstrating skills within the field of interactive digital media while also weighing the educational perspective, I can confirm that the matrix-model with inductively derived data is not a good match for testing correlations because table-content needs elaboration and are open for interpretation. It cannot be boxed up as variables, no matter how hard I try. The method of parting up short-term and buzz-words into categories has a strong resemblance to qualitative methods such as grounded theory. I am surprised that I thought of working with statistical methods before the one of grounded theory, but reflecting upon the choice I made, I may have had a strong wish to reach an answer to the hypothesis.

Regardless of this result, I would like to set up some of the things that I have been able to confirm through my analysis:

We can be confirm:

- 1.) The statistics on Google search-hits on the term disruptive innovation have been growing from 2004 and forward, which points to the popularity of the term and theory.
- 2.) The works of Clayton Christensen (1997, 2003 & 2011) is explicitly referred to in the concept of exponential organizations*, which proves that the theory has been taken into consideration while developing the concept.
- 3.) Clayton Christensen is unsatisfied with the fact that others are using the term disruption or disruptive innovation in contexts, to where the specific kind of disruptiveness that he describes in the theory, does not apply to.

*the term *disruption* should then entail Christensen's notion of the theory of disruptive innovation is implicitly when he stands as a reference, but this cannot be confirmed knowing that the problem expressed in part 3 is of later date than the publication of the concept. Therefore it is

uncertain, unless we directly ask Sir Clayton Christensen himself. (Ismail, 2014 – C.C Reader, 2015)

I will not be able to give finite answers (deductively) – here is why: I pursue a deductive analysis by framing the data in a matrix, now if the data were derived from say quantitative studies and were of numeric values one could work deductively with a cross-tabulation method as used within statistics. Now, the data I use are derived from an inductive research process. This means that they have been taken out of contexts and are of literary value, which means open to interpretations. With the chance of assumptions derived from interpretations occurring this would instantly devalue the findings and conclusions based on these findings.

6. Discussion

6.1 *The factor of time*

The thing that mostly is being overlooked when authors and researchers go onto working in the digital realm and using the term disruption is that they ignore when and how, they came to the conclusion as to why disruption is being assessed as the new norm. If they were to elaborate and deductively prove how the theory is relevant to their frameworks, it would make a lot more sense to everyone, as to why disruption is being mixed into the realm of digital technologies and futuristic prediction-oriented realms of the literary field. Firstly, it seems fair to say that Christensen pursued a predictable theory on disruption by writing his book *The Innovators Solution*. This book was a natural step from the innovators dilemma, because it created a step from a paradox to a problem-solving arena. When he began building theories of causality (normative theory) he moved to *explaining* phenomenon of disruption while only *describing* the phenomenon before. Therefore the book became more of a *survival oriented guide* to senior managers who worked in larger and established (successful) firms¹⁰. The book is trying to provide the target readers with context-based guidelines, as to how to deal with the standing threat of disruption in accordance with their specific situation as a firm (demand-side of disruption). The first part of the concept of exponential organizations deals only with the describing what is happening in the world. The second part is aimed at persuading the reader to recognize the fact, that a new breed of organizations in all sectors will be unavoidable. They utilize the term of disruption combined with the works of futurist Ray Kurzweil and the

¹⁰ In accordance with the theory of disruptive innovation a company need to be successful in order to become disrupted or being in danger of this (Gans, 2016)

connection to Singularity University, to back up their claims (or add some ethos to their production). The third part is aimed at providing tools to ultimately survive the same future challenges that they have warned for. They look holistically on the picture of disruption, but mostly from the perspective of the entrant firms – maybe because talking about possibilities are more appealing than talking about the fear of becoming obsolete from a certain market or losing dominance.

6.2 Connections and open ends

There is a long way from proving a theoretical connection between a theory developed over a period of 22 years or so, to a concept aspiring in connection to future-prediction based on graphs of exponential growth in computing and technology. Firstly, the concept have different rules than theories, they seek to inspire and creatively construct innovative ideas and frameworks inspired by ideas about the future, while theory is purely based on data of the past, and is highly focused on academic validation and spotting anomalies. The controversy, in my opinion, is the role of Singularity University in this context. The problems confronted at Singularity University are primarily that the world is moving from a scarcity problem to an abundance problem – where incumbents have problems moving to the new world. The Singularity University is different from other academic institutions because 80% of the curriculum is focused on the future, rather than the past (MIA, t: 6.50-7.12, 2016). This can, indeed, be viewed as an example of how the architecture of future educational programs may look like and how the information-based paradigm (digital, the metaphysical, the abstract, the non-materialistic) will become the new structure of education.

The information-enabling and digitization of attributes connected with an agile and cross-educational, on-demand industry, society is predicted to meet abundance.

Currency of state *development speed* enables the theory to accumulate and transpire over many fields, not just technological related fields of development or others as in the ones that Christensen explored. The common ground between the concept and the theory, is that it explains how *linear thinking has proven to be a hindrance for growth in the future* – both in terms of economy and technology. Ismail tries to prove the actuality of the exponential growth as a force, to be taken seriously and not to be ignored. He then refers to Christensen as a confirmation of prior warnings in regards to disruption. And yes, it may seem crucial to the survival of companies to, at least, be aware of its relevance in a firm perspective. This may entail bringing in the attributes presented to them, securing that they expand their core organizations and scale for abundant model and not a scarcity model. Looking back, the most eye-catching

thing in the research process was, that the factor and measurement of time is what separates the two most.

The theory then becomes more relevant to build businesses upon because of the time-factor/resource factor (time-price-performance); The “little time, little price, high performance”-tendency is growing exponentially. The theory gets important in the notion of *disruption is the new norm*, because it has never been so easy, accessible and safe to disrupt mainstream markets by taking collective intelligence, breaking down materialistic things into information, trace the algorithm behind all variables involved in a certain action - a purpose, big or small, “getting the job done” or building a “MTP”.

7. Conclusion

Once more, we recap the problem formulation: **How can a literature study be used to bridge the theory of disruptive innovation with the concept of exponential organizations?**

To answer to this specific problem formulation I will recap the results I have encountered through my research.

A literature review is good at capturing the very essence of the core dilemma/paradoxes and comparing these to one another. The unexpected part and lesson to be learned during this research process is that regardless of how well you plan out a process to find the essential correlations between to areas of particular interest, the answer will either be somewhere in the middle or way out of the ring. In this case I can argue for both cases; the hypothesis could not provide any conclusive evidence other than the point, that are already clear to the reader – or can be found in the literature without much analysis or speculation. Although, testing the deductive method have pointed to a more gestalt picture of the in-between issues at hand; like the fact that the complexity of problems that occur when fusing theoretical work based on observations and assumptions (about the future) can be quite immense. In reality the concept of exponential organizations will be of very little value as it is published from a university in which the student curriculum is 80% based on assumptions (aka. The future), while the theory, slowly moving forward – but continuously improving, is of much more value academically. The assumptions in exponential organizations can easily go wildly of chart and confuse readers, while the theory (which might seem a bit more conservative and not so colorful and fun) holds on to causalities that are independent of factors like time (as they are described as natural occurring processes in market-history).

I would personally agree to the fact, that in order to move forward, we have to look backwards, because with no fundamental knowledge of why we got to where we are in the first place, a secure bridge for crossing into the realm of the unknown cannot be constructed.

8. Source-list

- Anderson, P., & Tushman, M. L. (1990). Technological discontinuities and dominant designs: A cyclical model of technological change. *Administrative science quarterly*, 604-633. (29 pages)
- Becker, R. H., & Speltz, L. M. (1983). Putting the S-curve concept to work. *Research Management*.
- Bower, J. L., & Christensen, C. M. (1995). Disruptive technologies: catching the wave. (12 pages)
- Christensen, C. M. (1992). Exploring the limits of the technology S-curve. Part I: component technologies. *Production and Operations Management*, 1(4), 334-357. (23 pages)
- Christensen, M. C. (1997). The Innovator's Dilemma. *Harpers Business*. (287 pages)
- Christensen, C. M., & Overdorf, M. (2000). Meeting the challenge of disruptive change. *Harvard business review*, 78(2). (22 pages)
- Christensen, C. M., Raynor, M., & Verlinden, M. (2001). Skate to where the money will be. *Harvard business review*. (20 pages)
- Christensen, C. M., & Raynor, M. E. (2003). Why hard-nosed executives should care about management theory. *Harvard business review*, 81(9), 66-75.
- Christensen, C., & Raynor, M. E. (2003). The innovator's solution: Creating and sustaining successful growth. *Research-Technology Management*. (303 pages)
- Christensen, C. M. (2006). The ongoing process of building a theory of disruption. *Journal of Product innovation management*, 23(1), 39-55. (16 pages)
- Christensen, C. M., Alton, R., Rising, C., & Waldeck, A. (2011). The big idea: The new M&A playbook. *Harvard Business Review*. (18 pages)
- Christensen, C. M & Wessel, M., (2012). Surviving disruption. *Harvard Business Review*. (16 pages)

- (Christensen 1.1, 2015) Christensen, C. M. (2015) *The Clayton M. Christensen Reader*, Boston, Massachusetts: Harvard business Review Press. > *What is disruptive innovation?* P.157-192 (35 pages)
- (Christensen 1.2, 2015) Christensen, C. M. (2015) *The Clayton M. Christensen Reader*, Boston, Massachusetts: Harvard business Review Press. > *Reinventing your business model* p. 81-102.(21 pages)
- Crouch, S. & Housden, M. (2003) *Marketing Research for Managers* (3. Ed.). Oxford: Butterworth-heinemann. (s. 1 - 21).
- Danneels, E. (2004). Disruptive technology reconsidered: A critique and research agenda. *Journal of product innovation management*, 21(4), 246-258. (12 pages)
- Dosi, G. (1982). Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change. *Research policy*, 11(3), 147-162. (15 pages)
- Diamandis, P. H., & Kotler, S. (2012). *Abundance: The future is better than you think*. Simon and Schuster. (413 pages)
- Elting, M., & Hammer, S. (2014). *Ledelse og Organisation*, 2. udgave Forlag: Samfundslitteratur. (431 pages)
- Fischer L. H. & Oosterbaan, M. (2011) *Digital Multimedia Management – A holistic approach*. 2nd edition, Nyt Teknisk forlag.
- R. N. Foster. (1986). Innovation: The Attacker's Advantage. *McKinsey and Company, New York*.
- Gans, J. (2016). *The Disruption Dilemma*. MIT Press. (166 pages)
- Gjerding, A. N., Rasmussen, J. G., Larsen, M. V., Engsig, K. J., Nielsen, R. N., Lindgaard, R., & Gelsing, L. (2013). *Ledelse i moderne organisationer*.
- Harari, Y. N. (2014). *Sapiens: A brief history of humankind*. Random House. P. 3-43. (40 pages)
- Hein, Tune & Honoré, Thomas (2016) Udgivet: 09-05-2016, *Disrupt eller dø. En guide til din digitale ledelsesudfordring*. Forlag, ArtPeople / Peoples Press.
- HENDERSON, R. (1988), *The Failure of Established Firms in the Face of Technological Change*, Ph.D. dissertation, Harvard University, Cambridge, MA.
- HENDERSON, R. AND K. B. CLARK (1990), "Architectural Innovation: The Reconfiguration of Existing Systems and the Failure of Established Firms," *Administrative Science Quarterly*, 35, (March), 9-32. (21 pages)

- Ismail, S., Malone, M. S., & Van Geest, Y. (2014). *Exponential organizations. Why New Organizations Are Ten Times Better, Faster, and Cheaper Than Yours (and What to Do About It)*. Diversion Books. (320 pages)
- Jensen, L. K., & Dinitzen, H. B. (2010). *Organisation og ledelse i teori og praksis*. Hans Reitzels Forlag.
- Kurzweil, R. (2004). The law of accelerating returns. In *Alan Turing: Life and Legacy of a Great Thinker* (pp. 381-416). Springer Berlin Heidelberg. pp. 381-416. (35 pages)
- Kurzweil, R. (2005). *The singularity is near: When humans transcend biology*. Penguin. (603 pages)
- Mead, C.A. (1966). "Schottky barrier gate field effect transistor". *Proceedings of the IEEE*. 54 (2): 307–308.
- L. C. Megginson, (1963) June, *Southwestern Social Science Quarterly*, Volume 44, Number 1, Lessons from Europe for American Business (Presidential address delivered at the Southwestern Social Science Association convention in San Antonio, Texas, April 12, 1963), Start Page 3, Quote Page 4, Published jointly by The Southwestern Social Science Association and the University of Texas Press.
- McLuhan, M. (1994). *Understanding media: The extensions of man*. MIT press.
- McQuivey, J. (2013). *Digital disruption: Unleashing the next wave of innovation*. (171 pages)
- Miller, J. D. (2013). *Singularity rising: Surviving and thriving in a smarter, richer, and more dangerous world*. BenBella Books, Inc..(288 pages)
- Møller G. (1965) Vi eksperimenterer med transistorer og sjov elektronik. P. 5-17. Høst og Søns forlag, 1965. (12 pages)
- Pearson, K. (1904). *Mathematical contributions to the theory of evolution* (Vol. 13). Dulau and co. (34 pages)
- Ridley, D. (2012). *The Literature Review: A Step-by-Step Guide for Students* (Second Edition). Sage Publications Ltd
- Rifkin, J. (2014). *The zero marginal cost society: The internet of things, the collaborative commons, and the eclipse of capitalism*. Palgrave Macmillan.
- Rogers, E. M. (1962). *Diffusion of Innovation*. New York, NY: Free Press
- Rowan, David (May 6, 2013). "On the exponential curve: inside Singularity University". *Wired*. Retrieved 26 September 2014.
- Royce, W. (1970, August). The software lifecycle model (Waterfall Model). In *Proc. WESTCON*.
- Sahal, D. (1981). *Patterns of technological innovation*. Addison-Wesley.

- Schaller, R. R. (1997). Moore's law: past, present and future. *IEEE spectrum*, 34(6), 52-59. (7 pages)
- Shanahan, M. (2015). *The technological singularity*. MIT Press.
- Whitworth, B., & Ahmed, A. (2013). Socio-technical system design. *The Encyclopedia of Human-Computer Interaction, 2nd Ed.*

LINKS:

- (USI, 2015) <https://www.youtube.com/watch?v=FNQSM4ipZog> Accessed on 11/4 2017 at 20.00 pm.
- (WGS, 2014) <https://www.youtube.com/watch?v=Mx8qYmkV5NQ> /Uploaded 2nd of March 2014. Accessed on 3/4 at 20.30 pm.
- (Maxwideman, 2017) <http://www.maxwideman.com/guests/s-curve/progress.htm>
Accessed on 29/3 2017 at 21.32 pm.
- (QI, 2014) <http://quoteinvestigator.com/2014/05/04/adapt/#note-8823-1> / Accessed on 10/4 2017 at 23.30 pm.
- (S.U, 2017) <https://su.org/about/team/leadership/> Accessed on 11/4 2017 at kl. 17.45 pm.
- (MIA, 2016) <https://www.youtube.com/watch?v=LqIBXANdgyI&t=493s> / Uploaded 23rd of February 2016. Accessed on 18/5 2017 at 11.50 am.
- (TEL, 2014) <https://www.youtube.com/watch?v=q7KZc96HHwc> / Uploaded 14th of November 2014. Accessed on 18/5 2017 at 15.30 pm.