5. Results

5.1 Summary

Big data are transforming the world (Mayer-Schönberger & Cukier 2013) and organizations will deal with this transformational wave. It is leveling the playing field and everybody has access to nearly all information today. With the current developments of 3D printing and automatization, organizations are facing an even more comprehensive change that may shake the foundations of the construct corporation. Coase (1937) was puzzled by the question about the nature of the firm and he tried to explain it by transaction costs. There is an inherent reason to organize within a firm and that is if an organization has lower costs than the costs on the market (under the assumption of an imperfect market). Although the argument is still valid, technological progress changed the reason for the existence of firms quite a bit.

Information is freely available and organizations are endangered by the ease of being copycatted (Hota et al. 2015): One file in the wrong hand is enough and the competitive advantage of some technical gain is gone. In the future of 3D printing, everybody could produce everything, and suing everybody for their intellectual property is not the solution. An example is the fight of music companies against file-sharing (John 2014). Companies like Apple or Spotify realized that people did not want to pirate music, but have easy way to access it (Richardson 2014), and that furthermore they were willing to pay for the music. Organizations still exist as a result of the human factor (Zuboff 2014). Using a music example again, in the wake of the piracy discussion, many musicians engaged with their customers in a more direct way. They improved their social media performance and focused more on live performances. In the abundance of today's music, those musicians stand out in a crowd. Coase (1937) talked about the benefits of organizing resources within a firm and that is still the truth, however, the focus is on binding people, both employees and customers. Employees make organizations unique, so customers stay loyal to the organizations. Employees are transforming big data into a competitive advantage. In times where everybody can produce everything, the human touch will be the difference, and keeping that spark within organizations will be a strong reason that these are still firms in the future.

A general question we need to discuss is: Why and how will an organization tackle big data? Using big data will be mandatory for any organization in order to survive. Davenport (2014) states that any industry within the following categories will be reshaped: an industry that "moves things, sells to consumers, employs machinery, sells or use content, provides service, has physical facilities or involves money" (Davenport 2014: 33). It seems that any industry falls under one of the categories and we already see that any industry can benefit from big data. It is, therefore, crucial that any organization specifies its big data strategy and does not let it remain an unclear technology (Cohen et al. 1972). Not using big data will lead

to a significant competitive disadvantage: if there is useful information available, the competitors will use it. In the Moneyball example, the Oakland Athletics had the advantage as innovators (first mover advantage) for one season, but afterwards, everybody used their statistical approach. In order to keep up and not fall behind, organizations will use big data and will implement big data structures. By becoming standardized, those organizations will keep up, but will generate a competitive advantage only by accident. Big data need to be introduced in organizations to support and augment the people. In this way, organizations will be fundamentally transformed into homeodynamic organizations.

Big data will have an impact at the social, organizational and individual levels. Big data are everywhere (George et al. 2014) and big data influence everything. Although big data are rooted in the digital world, the current developments reveal that the digital world and the real world are moving towards each other, and will merge more and more. There is however, a dangerous assumption here. Big data are objective, and therefore far superior than people's subjective gut-feeling. There are various reasons for the subjectivity of big data. Big data are gathered from various sources and so are embedded in a certain context. Even though big data are big, they are not big enough and will never depict a complete picture of everything. There are blind spots, there are errors, there is subjectivity (be it introduced by people or algorithms), and, consequently, big data may not be used autonomously for data-driven decisions in any way. Big data are also personal, and any organization may view big data that way. Outsourcing may seem profitable, but will lead to a standardization of organizations. It is important to take into account that although the way that big data are solving our problems sounds magical (Reeves et al. 2015), putting big data into a black box is a new source of risk (Pasquale 2015). One error in an algorithm doing flash trading (Buchanan 2015) led to a disruption in the Dow Jones Index that day. The market got off fairly lightly, the organization behind the error was snapped up cheaply. The error was discovered quickly but big data and especially artificial intelligence are developing as fast as they work, and we *do not* understand them (LaFrance 2015, Adams in Byrnes 2016).

Big data are ubiquitous and influence everything, but are opaque, distort reality, and will be biased. Many companies that utilize big data are claiming that the subjectivity of people is harming them, and big data are less biased. Recruiting can be used as an example. C. C. Miller (2015) complains that hiring decisions are often biased and many potential candidates are dismissed for personal reasons. The tendency to overconfidence increases as people rely on data for hiring, but the algorithm could be discriminatory, so there is a paradox at hand. Although big data are able to find more potential employees, in the end these selections will rely on some bias predicted by correlations within big data. If we look at Silicon Valley, it becomes abundantly clear that there is a diversity problem (Pittinsky 2016), however the data may reveal the following correlation: young white male engineers are the best candidates, as the majority of engineers are young white males. Although the correlation sounds weird, it will probably be highly significant. Furthermore, every person employed on the basis of that correlation will increase the significance

level. Over time, the correlation will influence the structure of organizations and shackle them in a certain direction. Big data roaming freely through organizations will not be beneficial and, therefore, people will deal with it.

Big data act like a force, depending on their use and how people are utilizing big data, however, big data, as the name implies, are huge, and therefore depend on intensive change within organizations. I have proposed the concept of homeodynamic organization which deals with the influence of big data within organizations and enables organizations to harness the positive force of big data. On the basis of that assumption, I conceptualized new tasks and consequently new structures within organizations, namely the HR daemon and the HR centaur, implying that the HR department would be most capable of utilizing big data in order to achieve a competitive advantage. But why will the HR department be accountable for the HR daemon and HR centaur? Both concepts sound relatively technical. The IT department would be capable based on its knowledge, but they are the executors of big data. Although the technical element will still rely heavily on the IT department, and it will stay that way, it would be difficult to handle the implementation and deal with the social and ethical impact on organizations as well. There is a clash of interests, as big data within organizations will not always be implemented in the most feasible way. Giving employees access to big data may sound like an interesting idea, so as to enable employees to be innovative, but from a cybersecurity perspective it sounds like a nightmare. There is a reasonable tendency for the IT department to minimize the freedom of employees and standardize their applications (Sahay 2003). The accounting or finance department would mostly focus on the expense and would have difficulties balancing the interests of employees and the company. Using big data in the proposed way may be a gamble, as organizations wager that their employees might generate a competitive advantage through big data, so that organizations invest resources in order to customize big data use in the most fitting way. When many companies are trying to release organizations from the burden of dealing with big data, it may be not favorable to let these departments be accountable. The organizational department would be a fitting department; however, in recent years they have become cannibalized in companies by IT, HRM, and general management, so that they are now seldom part of a typical organizational structure (e.g. Thom 2006, Stein 2010a). The legal department lacks the ability to cover the emotional elements of leadership that are linked with sensitive ethical questions. Following the legal rule at the moment would also lead to an over-regulated system that does not enable tinkering with big data at all. Finally, the company's top strategic management would also be enabled, however due to the magnitude of changes and their constant interaction with big data it is questionable whether they have the time to deal with it. The HR department therefore seems to be the most fitting department, especially as the focus is on people and not on big data. Big data are transformed in a certain way so that people can generate the innovations needed for achieving a competitive edge.

By appointing the HR department as the integral driver of big data and consequently the enabler for the homeodynamic organization, the importance of the HR

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department is strengthened. It may be the last chance the HR department gets to take a strategic position within organizations. Current trends (e.g. Cappelli 2015) reveal a loss of importance, however, if people are the competitive advantage in the future the HR department will step up its game. Interestingly, the tasks and functions envisioned in homeodynamic organization are not novel for a HR department. Big data enable organizations to uncover hidden things and get a more concise view of fuzzy elements, and therefore, big data can act as a catalyst for a professionalization (Stein 2010b). Interestingly, the gamification introduced in the HR centaur is also considered an activator for professionalization (Stein & Scholz 2016). If technology is no longer the differentiation factor on the market but people are, networks will be increasingly important. Big data are capable of discovering informal networks and utilizing them, be this formal or informal, and it can be beneficial as well. There is an even stronger interest in supporting emergent hidden networks and disguising shadow networks (Stein et al. 2016). The HR department is capable of monitoring the use of big data so that employees can utilize them quickly. It can generate trust and uphold it, train employees adequately, and exploit big data in the mutual interest of organization and employees.

The HR daemon is probably the most alien feature of the data-augmented homeodynamic organization, however, it is critical to minimize the potential distortion of big data. It also adds scalability capacities within organizations. Big data may be vast, but dealing with big data is often relatively narrow. It seems sometimes that there is an underlying assumption that every big data set can be dealt with by the same algorithm, however, if algorithms are creating their own reality, organizations can get stuck with a distinct data-constructed reality which may or may not be fitting. This may or may not be baloney (Sagan 1996) and, consequently harmful for organizations and the people within them. It is also possible that data collection will be neglected and organizations depend on one certain data supplier, assuming the context of this certain data supplier. There is the tendency to destroy the variety of big data because it is already too big, however every step leads to a certain distortion and increases the power of a construction of reality through data constructivism. The data farm sounds highly technical and the HR department will need the support of the IT department, however from a strategic perspective, it is essential to establish acceptance within organizations for such data farms, and that is a typical HR task. The fog of big data is similarly dependent on the knowledge of statisticians and the risk department, however, balancing both extremes is again a strategic dimension that needs to be discussed with the relevant people. Finally, the big data watchdog is the natural task of any HR department, although supported by the legal department and in extensive corporation with the works council (Hoeren 2014). The HR department, therefore, needs to learn several new skills and roles, but they are already experts in the most critical skills: enabling people to commit to organizations to their fullest potential.

The interface between big data and the work of employees will be interesting in the future (e.g. Chan 2015). The digitization of work will increase even further in the next years. Wearables and sensors will make the employee fully transparent,

and although the HR daemon generates trust, all this data is not a one-way road. There are ways to use big data to support employees, especially through tools like augmented reality. The example of gamification is not that far-fetched. HR developments in combination with big data and wearable technology (Park & Jayaraman 2003) sound promising. People can be trained and learn from their mistakes. The information from training can be used to improve it, by focusing on areas where people are struggling. Apps on the computer, smartphones, and wearables (although employees can produce them on their own) will be supplied by the HR department. There are already examples where the shift schedule is processed automatically and incorporates personal constraints. The HR centaur can be designed to be real-time and the HR department to act as a gamification designer. Many elements used in video games sound extremely close to their counter-parts in HRM (Scholz 2013b, Stein & Scholz 2016). Programming those tools is apparently less difficult and it is a habit of players in video games to alter their game (Roncallo-Dow et al. 2013) and customize their user interfaces (Taylor 2009). Somebody however supplies the platform, monitors the fairness and maintains the HR centaur.

This leads to the new role of HRM within organizations. As already stated, big data are a chance to strengthen the position of the HR department and make up lost ground. Big data from a strategic perspective is not about big data in general, but the interaction of big data with employees within a homeodynamic organization, and the new role at a meta-level, is quite similar to the new roles of Ulrich et al. (2013). They are specified slightly differently to those roles by Ulrich et al. (2013), but the general idea is similar. It may be that these new tasks are a bit outside the comfort zone of HRM, but they are essential for reaching the point of utilizing big data. Many of the new roles reveal a certain tendency towards a technology affinity, and in order to fulfill this new role the HR department dismantles the HR-IT barrier and actually achieves a certain form of integration. On the basis of the proposed roles, the HR department will not evolve into big data enthusiasts but uphold the importance of the human factor. It is undeniable that everything is getting more technical, and the HR department develops "awareness of the choices they face, a desire to exploit the information capacity of the new technology, and a commitment to fundamental change in the landscape of authority if a comprehensive informating strategy is to succeed" (Zuboff 1988: 392).

All of these elements contribute to a homeodynamic organization, a theoretical construct that seems only achievable through big data and the humane utilization thereof. Such an organization will be more dynamic and will constantly change. Despite being a loosely coupled and free-floating resource, big data also show that such organizations will gravitate and fluctuate around some form of consensus at the edge of both chaos and order. As the Dartmouth survey revealed (Wang et al. 2014), there is something unique within any organization (Stein et al. 2016). This organizational signature will be influenced by the organizational culture, identity, history, and most importantly by the people within the organization. They often choose to apply to a certain organization based on the organization's appearance and will perform self-selection. Employees will stay and commit to organizations

if there is an overlap between individual identity (not the hyperidentity or stage identity) and the organizational signature. Big data unearth the organizational signature in a relatively precise way and thus, contribute to the understanding of organizations. Having knowledge about organizations is not necessarily new, but it becomes more precise through big data. The signature is also something that will not change drastically over time and organizations, in order to stay in the homeodynamic Goldilocks zone, will gravitate around the organizational signature.

Big data will have an impact on organizations and the HR department. There are many ways to deal with big data, but ignoring big data will be fatal. Big data will lead to many discussions from a social, ethical, and legal perspective, however, most emerging out of the fear that people, in this case users, customers, and employees, do not know what is happening (e.g. Dwork & Mulligan 2013, Aradau & Blanke 2015). Making the employee part of big data use will not make those problems go away, but taking the actors within organizations on board will create a solution for this distinct organization. In the interest of surviving on the market, organizations will not try to cheat and prey on their employees, but will want to find meaningful solutions. Big data will decrease the potential to contribute to change and competitive advantage over time, but big data will increase the importance of the employees within an organization to make the essential difference.

5.2 Limitations

Big data are vast and big data are never objective. Big data will create a certain data-constructivist reality or enable a social-constructivist reality through social programming. Those are general assumptions derived from my research and utilized in this theoretical experiment in imagination, however, there are currently around 167,000 hits for big data (May 2016) on Google Scholar and those are only the hits for the exact use of the term 'big data'. There are many other sources (e.g. books, conferences, blog posts, business studies, and newspapers) that contribute to the discussion. Google finds 57 million hits for big data. My research is mainly influenced by the data-constructivist influence of search algorithms and by the social-constructivist influence of my social environment.

This distortion in big data knowledge and my stance towards big data may explain my confidence about the impact of big data and their ability to transform the way we work, although there are many who believe the same (e.g. McAfee & Brynjolfsson 2012, Davenport 2014, Mayer-Schönberger & Cukier 2014). My confidence in the HR department being able to answer the challenge, however, is shared by only few other researchers (e.g. Pentland 2010, Huselid 2015). The general idea of looking at the potentials of big data within organizations follows the proposition of J. H. Miller (2015) to *think* of all possibilities of a new technology before substantiating the social and ethical borders in society. Consequently, I expanded my research into science fiction literature, which can help as "reminders about scientific fact" (Dourish & Bell 2013).

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Big data are already transforming society and the governments, IT companies, and marketing are especially driving the big data change. They are admittedly doing a great job in putting big data into a black box. It is understandable that the NSA or Target will not share their algorithms with society. The reaction of society is also understandable; people believe that Big Brother and Little Brother are watching them everywhere and all the time. Big data has a reputation problem, especially as these social and ethical borders are still vague or non-existent. A major problem is that big data apparently have a life of their own, or at least in the perception of society. On the one hand, resistance to big data increases, but on the other hand, powerlessness increases as well. It will, thus, be questionable whether any organization is able to implement such free and transparent use of big data. The HR department deals with the general mistrust of big data and the task of convincing people that big data are not used to surveil or control them.

There is a general question about using technology these days. The proposed form of organization relies heavily on the relevant knowledge concerning big data. Basic knowledge about statistical analysis is essential in order to critically reflect on big data analyses (Dalton & Thatcher 2014). The trend to question the boundaries is also beneficial for the process of knowledge discovery, however understanding complex systems is difficult to teach and to learn. Due to the current information overload that people are already facing, there may be the tendency to *not* deal with big data extensively in the sense I envisioned here.

The concept of homeodynamic organization is heavily rooted in organization theory, and therefore there is a chance that it is an unrealistic, theory-driven vision. This is a problem that all underlying theories need to tackle. Cybernetics, systems theory, population ecology theory, and complex systems theory all describe organizations in a highly abstract way. Homeodynamic organization has the same limitation. Furthermore, emergent behavior and self-organization are an integral part of those theories. These organizations are not controllable in the narrow sense, and big data will not magically make an organization steerable. Organizational inertia will remain. The question that arises is whether the benefits of becoming a homeodynamic organization infused by big data, and data-augmenting employees, really outweigh the costs. The HR department may be able to answer the question, but they need to use big data to prove the efficiency of big data. They trained the people within organizations to be skeptical and to question big data. This sounds like a difficult quandary.

Big data are currently perceived as something that will lead to a surveillance state in the sense of Huxley or Orwell, or to some form of utopia. There is apparently nothing between those extremes. The proposed application of big data within organizations tries to highlight the relevance of people and the potential of big data to augment this. It is, however, a rather positivistic view on big data. The technology of big data has evolved quicker than the reaction of society to big data. The scientific community in particular struggles with social and ethical solutions to big data usage (e.g. Barabási 2013). This thesis attempts to provide a solution within organizations, however, it relies heavily on a transparent, honest, reliable,

and ethical way of utilizing big data. This may be possible within an organization, and maybe only possible within organizations of certain sizes, but thereby is creating potential solutions for the general public. There is a highly contextualized solution for dealing with big data in a certain organizational environment, but it works there and nowhere else.

Another element I deliberately neglected in the thesis is the legal implication of big data. The topic is complicated and elements like privacy or copyright will be challenged by big data. There are ways to implement such legal requirements, but they demand a tradeoff. Personal data that can only be used for a distinct purpose will contradict big data, but this is currently the EU legislation. It will be interesting to see if there are other solutions within organizations. These solutions could mimic the psychological contract (Rousseau & Tijoriwala 1998) and include a fair use agreement between organization and employee, however in order to generate the essential trust, organizations are obliged to be in compliance with the law. Consequently, the legal perspective will be a restriction for big data within organizations and the definition of an adequate solution will be a task for labor law researchers.

There are several limitations in this thesis, but the limitations also highlight the essential need for an organization to deal with big data at all and most importantly on their own. Big data are influencing society and the effect will grow with the digitization of society. People and organizations have growing data shadows and these data shadows can be changed in a similar way to a stage identity. It seems that the analogy to big data as a force is quite fitting. There is a majority that is influenced by the force but cannot deal with it. Some feel the force and only a few can use the force for the light side or the dark side. Although this is a strong limitation, it may give better understanding of big data altogether.

5.3 Implications for Human Resource Management

Derose (2013) reports that the HRM professionals of Google have stickers with the mantra: "I have charts and graphs to back me up. So f*** off." It is quite a strange slogan and it may be a sign of data-driven HR, but the sticker may throw people off track, as the goal is to "complement human decision makers, not replace them" (Setty in Derose 2013). The analyses Google are performing are apparently rigorous, and they want to help "HR get a seat at the table" (Jackson 2014). Many things are still unknown about Google's use of data and the company is not known for its transparency, however it has talked about its Project Oxygen and stated that a good leader is a good coach or someone who has a clear vision and strategy (the complete list can be found here: http://goo.gl/CPXIpR), and those results are apparently unimpressive. Since then, Google has launched the platform re:Work and shared at least some of its knowledge, however considering the organizational signature of Google it is reasonable that its HR department will need data to convince people in organizations. Interestingly, the company realized that big data would augment the work of HRM and that HRM decides:

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> "Google was founded by, and is still dominated by, engineers. So as it started to hire thousands of people and needed to think more deeply about management over the last few years, it took an intensely data-centric approach. But not everything can be distilled down to an algorithm: even for Google's engineers, automation has its limits" (Nisen 2014).

This challenge is sometimes described as a trap. Luca et al. (2016: 97) claim that "algorithms need managers, too". They claim that algorithms are literal and are black boxes, and consequently, "the challenge for us is to understand their risks and limitations and, through effective management, unlock their remarkable potential" (Luca et al. 2016: 101). However, what will an organization actually do? Big data within an organization are a big challenge but it has become necessary for any organization to deal with big data. The current state of the HR department for example is dire:

> "Number-crunching is easier said than done. Some human-resources departments lack the statistical talent to design and run, say, a multivariate regression analysis, which examines numerous data streams. A number of enterprise software vendors say they provide tools to automate data collection and calculations, but human intelligence is usually necessary to tease out which data are meaningful" (Silvermann 2012).

Although, it seems obvious that HRM will play a key role in the implementation of big data in organizations, the HR department will face a fundamental transformation of its perceived role. However, the first implication is to make the HR department capable of understanding and dealing with big data. Consequently, it is critical to close the big data gap in the HR department. It will not be sufficient to hire a bunch of data scientists (Davenport & Patil 2012), as these people often lack the HRM background. Therefore, the HR department requires big data literacy, consisting of computational thinking, statistical thinking, and skeptical thinking alongside the required business skills, human resource skills, and the knowledge of the organizational context.

Any technological change will trigger some sort of resistance. As discussed in chapter 2.4 this resistance will also happen in the HR department. Big data implementation will lead to an emotional discussion. Consequently, there may be people who resist such a change and need to deal with this resistance (Ford et al. 2008) and to achieve acceptance towards such a change (Sagie et al. 1990). The HR department needs to deal with this resistance and to create acceptance towards big data (Drumm & Scholz 1988). It is essential that the HR department is on board with the organizational changes provoked by big data. The people of the HR department will act as promoters of change and change agents (Caldwell 2001). Bladt and Filbin (2014) categorized four types of employees based on their attitude to big data: data enemy, data skeptic, "data?", and data friend. Using this terminology, the HR department has to be a data friend, in order to persuade the rest of the organization.

Furthermore, big data could lead to an increase in the HR-IT barrier and detach the HR department even more from the rest of the organization. However, big data are only at first sight a technological phenomenon, actually, big data are a social

phenomenon. Understanding big data as a technological driver may lead to a retreat of the HRM from the big data problem and handing over the responsibility to the IT department. However, the example of Google already revealed that this is not a path accepted by the employees. The HR department thinks about its role in context of big data. But, it could be that it is forced to step up its game. Due to digitization, it becomes evident that the task of HRM will be highly entangled with big data and consequently that neglecting big data will intensify the basic necessity of HRM in organizations altogether (Cappelli 2015, Charan et al. 2015, Stone et al. 2015). Dealing with big data will increase the survivability of the HR department and, more importantly, transform the big data topic into a social topic.

Big data will transform the way organizations are built and how people work. Big data are a people topic. Smart factories will not work without big data, however, they are already driven by data. However, the biggest transformation is within the people and their place in modern organizations. Many jobs will be transformed by digitization and require new skills. Today there are more secretaries than ten years ago, however, the skill set has changed drastically over time (Bessen 2015). Big data will increase the velocity of change. Big data will, therefore, also increase the velocity of HRM and add up to the various reasons for becoming more dynamic (Stein 2012). The impact of big data is far more comprehensive concerning the people in any organization and, therefore, HRM needs to make big data a people's topic; HRM has to be part of any decision made about big data implementation and, even more, of decisions derived from big data.

Only if the HR department is convinced of the usefulness of big data and is part of the big data implementation, the big data strategy as well as established required structures, can it promote big data within the organization. People will be skeptical about any big data in the organization and the changes accompanying big data. The HR department will be a capable promoter of change and will have convincing arguments for these changes. It is convinced of the changes, it shares responsibility, it understands big data, it recognizes the impact of big data on the employees, and it has the competences to persuade the employees. Furthermore, from all departments involved in such change management, the HR department will be the most fitting department for leading such change. The HR department will have overcome many obstacles concerning employees in the process of the big data implementation. Other departments like the IT department will not see certain obstacles as they have a different orientation to tackle the task of big data implementation; but the HR department is behavior-oriented rather than algorithm-oriented (Scholz 1984) and consequently focuses on the employees.

Finally, big data will augment the work of HRM as well as increase the complexity, especially if the HR department accepts its duty in terms of big data and its impact on the organization and the people. The HR department will transform its role and requires new competencies, however, big data and digitization will release the HR department from pure operative and simple tasks and let it focus on strategic tasks. Therefore, the importance of the HR department will increase as well as the impact of its decisions. Consequently, the HR department moves towards a

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more professional approach in terms of expertise, differentiation, continuity, and governance (Stein 2010b). In terms of expertise, the HR department requires relevant and up-to-date knowledge about big data and current trends of big data in HRM. Differentiation means that the HR department will follow a differentiated approach depending on the context and situation. Furthermore, it also means a differentiated view on big data and the influence of big data. Though continuity seems to be difficult in terms of big data and the move towards homeodynamic organization, the HR department will focus on continuity or keeping the organization within the homeodynamic goldilocks. Aspects like the organizational signature will stay stable over time. So, continuity will be seen as a differentiated topic. Finally, the aspect of governance highlights the relevance of the HR department in terms of big data. The HR department achieves visibility in the topic of big data in the organization and assumes responsibility for big data within the organization and the creation of homeodynamic organization.

5.4 Implications for Research

It becomes clear that big data require a big theory (West 2013, Monroe et al. 2014, Boellstorff 2015) and rely on various theories (Mayer-Schönberger 2014). Big data will not herald the propagated "end of theory" (Anderson 2008), but quite the opposite. Theories are required to grasp the implications of big data in all multifaceted elements. Everybody will be influenced and, depending on their scientific context, big data may impact them differently. Big data, thus, need a big, overarching meta-theory and additionally many field-specific theories. The goal is to spark a discourse about approaching big data from a theoretical perspective. It would be fatal, however, to conduct big data research without any theoretical framing. It is a rather empiricist view of big data that counterfeits a general objectivity (Silver 2012), but big data are subjective, big data will be influenced by the subjectivity of people, and big data will influence this subjectivity. There is data-constructed reality, social-constructed reality, and a mix of both realities. Without understanding big data theoretically and with the lenses of the respective fields, big data will distort reality in a way that researchers cannot comprehend.

However, from a technological perspective big data are a self-runner, especially with the current evolution of algorithms, artificial intelligence, and data processing power. It seems that either the sky is the limit, or there will be a dystopian fear of the Skynet from Terminator, in which the computers rise up against humanity. Quite the opposite case applies to the social perspective. In the course of this thesis it became evident that big data are a social phenomenon and, therefore, have an extensive impact on society, organizations, and individuals. But without an overarching umbrella theory, big data will have vast implications on basic research as well as applied research.

Basic research will be influenced by big data; many research streams analyze the fit between their theories and big data. In chapter 2.2 it was shown that big data can be linked at the socio-technological level and that big data intensify the reciprocal

relationship between big data and society. It is no longer possible to analyze technological phenomena from a deterministic point of view. Consequently, the research stream of science and technology studies will deal with a blurring border between society and technology. Society influences big data and big data influence society at the same time. New and old topics gain momentum. Big data can discriminate. Outliers are neglected and there is a tendency to the mean. The definition of the mean, or what is the standard, is not that objective and can be influenced in various ways. Although it is clear what average means, the question of what the average is becomes unclear. There are many ways big data are not portraying the real situation and are unsocial and unethical, although it will be debatable what social and ethical means and such discourse will be critical. Currently, however, the social and ethical elements are under-researched, even though the impact of big data on people and society is clearly visible. Qiu (2015: 1089) describes the situation between technological progress and the current ethical lag as follows: "Just because it is accessible does not make it ethical."

Another research stream tackled in this thesis is the research in organizational theory. Many theories in that field predate big data and in this thesis cybernetics, systems theory, and population ecology theory were analyzed; furthermore, the unifying theory of complex systems, although this theory is vaster and so more extensive. All these theories as well as the entirety of other organizational theories (for an overview see Kühl 2015) do not deal with big data. I presented several links between some theories and big data, yet it is to be debated if these conclusions are describing the relationship between organizational theory and big data precisely. The effects of big data on organizations are still unclear and there are ways to incorporate big data into existing theories. But, in order to understand big data, a discourse about their relation towards organizational theories is required and essential for moving big data towards a more basic theoretical comprehension.

One important aspect of HRM is to close the research to practice gap (Huselid 2011) and, consequently, allow us to envisage it as an applied research stream. Thereby, big data force HRM to redefine itself extensively. At first it will be essential to research the importance of big data in HRM. As stated in chapter 2.4 there are two polarizing views and both are not beneficial for HRM. Consequently, aspects like the augmentation view as well as overcoming the HR-IT barrier need research to find ways to achieve these aspects. Research on electronic HRM will become even more important, however, not only on the operative perspective in digitizing the work of HRM. HRM will focus more and more on strategic work and less on operative work. This is a chance to demonstrate the strategic capabilities of HRM in dealing with the implementation of new technologies and especially with big data. Big data are rooted in the social level and, therefore, HRM will need to create solutions for this new situation. Another aspect that is linked with HRM is intercultural management. Instruments and methods may work in a distinct cultural environment, but will not work in different countries. Furthermore, culture is not solely linked to nations or regions, but also with other cultural influences. In the context of big data, some will have a strong impact on the big data within an organization, such

as hacker culture (Scholz & Reichstein 2015), gamer culture (Stein & Scholz 2016), and IT culture (Scholz 2012). Big data will not make intercultural management obsolete; quite the opposite, intercultural management will influence big data within organizations considerably.

Furthermore, HRM will look for novel solutions for their implementation of big data. Big data transform the organization and the working world of every employee, however, big data do not present sufficient ideas for the implementation and usage of big data. Gamification and augmentation, for example, are less often utilized in the context of HRM. Gamification can be categorized as an emergent trend within HRM, although most applications are just off the shelf and detached from organizations. Gamification could potentially be far more than just some operative thing. I introduced a form of radical gamification, and with trained employees and a working HR daemon and HR centaur, people will tinker with big data and their working environment. Everything becomes more dynamic and more customized. Augmentation and applications for augmented reality will influence the working world in the future even more. Technologies like Magic Leap will mix reality and the digital world even further. It may be possible, in the near future, to have a complete fusion of the digital overlay with the real world. That increases the possibilities of big data drastically and may fundamentally change the way we work. Technology and especially big data open all possibilities, but HRM will be the research stream that develops fitting concepts for this new working world.

5.5 Implications for Teaching

Big data are part of our social world, but at the moment big data are often only taught in specialized data science degrees. Due to the comprehensive impact of big data and the proposed potential gain for everybody, having only some experts may not be sufficient. Above all, we are already facing a shortage of people who can deal with big data at a rudimentary level (Ahalt & Kelly 2013). The big data literacy proposed earlier will be part of the general studies of every curriculum (Lane 2016). Its extent can vary from the basics to in-depth knowledge.

This big data literacy will vary slightly from the big data literacy that is provided within an organization. The focus is on creating a long-term foundation in dealing with big data. The first objective is to overcome the big data phobia (Telgheder & Brower-Rabinowitsch 2016) many people are suffering from, especially as the current perception within society tends to be slightly negative due to stories about governmental over-surveillance (Jagadish et al. 2014). That is one element which needs to be discussed in the curriculum, so as to have an informed perspective on the current big data landscape rather than relying on media interpretation. If big data are part of general studies, people who fear numbers or hate mathematics will resist such teachings. It is essential to take the irrational fears of those students and reveal to them that big data can be fun, but at the very least, something they need to deal with, as big data will be part of their future jobs.

The next element is about the development of computational thinking. There are already several people (e.g. Wing 2006, Lee et al. 2011) who demand more efforts in teaching computational thinking in all academic fields. Wing (2006: 33) highlights the claim that "computational thinking is a fundamental skill for everyone, not just for computer scientists". The goal is, thus, to teach students the logic behind programming (Shein 2014), but this does not necessarily require them to learn programming (Conti 2006). "Thinking like a computer scientist means more than being able to program a computer. It requires thinking at multiple levels of abstraction" (Wing 2006: 34). Consequently, computational thinking will be a critical element in times of big data and digitization, but it grows from the fundamental logic behind computers and big data as well as the tools to deal with big data from an intellectual perspective. Without computational thinking, big data will stay in the black box and even look like something magical. Such computational thinking will be beneficial for potential radical gamification and for the fusion of the digital world and real world through augmentation.

Statistical thinking is, as the name suggests, about the ability to understand and conduct statistical analyses (Wild 1994). It can be defined as follows: "Statistical thinking involves an understanding of why and how statistical investigations are conducted and the "big ideas" that underlie statistical investigations. These ideas include the omnipresent nature of variation and when and how to use appropriate methods of data analysis such as numerical summaries and visual displays of data" (Ben-Zvi & Garfield 2005: 7). In times of big data, such skills are more needed than ever before and there is a need to build a solid foundation of statistical competence for any student in the future (Wild & Pfannkuch 1999). Big data will be driven by statistics and, although there is some complexity involved in statistics (Greer 2000), without any extensive knowledge of statistics people will be steered by a data-driven algorithm.

The final component in big data literacy is the skeptical thinking suggested by Sagan (1996), though this can be compared to critical thinking (Ennis 1962). Big data are complex, subjective, and influential. It may be difficult to understand big data and their impact meaning that it will be especially relevant to teach the idea of challenging big data analyses and questioning decisions given by big data. People will need a skill-set to ask the right questions (Davenport 2013) and request alternatives (Barton & Court 2012). Skeptical thinking is not seen as the constant questioning of big data, but the ability to think of new methods and to think outside the box. This creative thinking is realistic, however, and not a simulation of pipe dreams. Big data can simulate everything probable, but not everything is possible. The algorithms in particular will depend on skeptical thinking. They depend on the human ability to be reasonable and to challenge algorithms (Mainzer 2015).

Although many researchers (e.g. Frey & Osborne 2013, Brynjolfsson & McAfee 2014) expect that big data or new technologies in general will make several jobs obsolete, it becomes evident that some skills will be more important and others will be less relevant. In a study by the World Economic Forum (Gray 2016), the following skills are seen as essential in the future: complex problem solving, critical thinking,

creativity, people management, coordinating with others, emotional intelligence, judgment and decision making, service orientation, negotiation, and cognitive flexibility. All these skills are demanded by a data-augmented homeodynamic organization and are required by all employees to a certain degree, but mostly for the HR department. The curriculum in HRM will find a way to train their students in big data literacy and teach them the competences for these skills.

5.6 Outlook

Big data are here to stay and we will deal with them. Big data will have an undeniable impact on society, organization, and the individual, however, it seems that big data will not become more objective over time, but rather blurrier with time (Bendler et al. 2014). Big data are influenced by one data-constructivism and external social-constructivism and those effects will become more influential over time. With every iteration the distortion will become more fossilized (Scholz 2015a). There are two developments in computing that may intensify the impreciseness of big data further. On the one hand, there is approximate computing (Mittal 2016), in which the computer will tolerate some loss in correctness in order to become quicker or more energy efficient (Han & Orshansky 2013). Big data will not be exact. On the other hand, there is quantum computing, the deviation from the binary principle and the introduction of the uncertainty principle (Heisenberg 1927). Although these computers will be faster and more secure (Preskill 1998), there will be an even more complex black box, putting more pressure on the question of accountability in this new data world (Nissenbaum 1996).

This thesis is a theoretical work, but hopefully it will spark further discussions. Big data will transform our organizations and the working world. Research is required to contribute a theoretical understanding of these changes. Big data are complex and organizations are facing an increasing complexity in their environment. Big data may be a young phenomenon, but its social impact is already hefty and challenges current research at every level.

Mainzer (2015) coined the German term *Technikgestaltung* (shaping) and focused on the idea that big data will be shaped and designed in a certain way. This shaping will be influenced by big data, but people are already working on the shaping of big data within organizations. Big data help to build smart factories (James 2012), smart offices (Le Gal et al. 2001), improve the working environment and support employees. As in the other industrial revolutions, people will find a way to harness the power, acquire new skills and adapt their work to the new situation. It will be interesting to see how big data augment the work of all employees and are potentially able to give employees more space to unfold their talents. Big data, designed in the right way, will give employees the freedom to data-source operational tasks and focus on more creative and innovative tasks.

A homeodynamic organization will face an increase in tension through big data and transformational power, however, big data can help to deal with those tensions. A data-augmented homeodynamic organization can be compared to the following

statement: "Step in the same river twice? We don't even have that river anymore. We paved it over back when the rain stopped falling" (Wilson 2015). Organizations will become more dynamic and face more drastic changes from the outside than ever before. The world is perhaps not more dynamic than in the past, but, big data enable every organization to share *all* available information in nearly real-time. Such interaction between data will constantly create new challenges for the homeodynamic organization. Through this interaction, there will be constant new challenges, and those challenges will remain shrouded within big data. The advice of Morin will be more relevant than ever before:

> "Don't forget that reality is changing, don't forget that something new can (and will) spring up" (2008: 56).

Big data will continue to be a strong influence on organizations and on society, however, there is a real chance that they will be beneficial at the end, at least within organizations. Currently, technological progress envisions a future where the human factor will become the competitive advantage that organizations will keep in order to differentiate from other organizations. The success of Apple is an example. It does not derive from technological progress any longer, many other smartphones are far superior. Rather, it is how Apple makes their product special and how they attract their customers. The people working for Apple make reliable products, their customers trust Apple, and the marketing department is outstanding. Why is it that people are still making the difference in today's world? The way big data are used depends on people, but big data will enable people to do a better job and focus on their creative and innovational potential. The source of competitive advantage in times of big data will be the people within organizations. People will matter more as they are augmented by big data and can then focus on their core talents. At least for big data within organizations, I think the words of Douglas Adams are quite fitting: "Don't Panic!" (Adams, 2009: 6).

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