Towards an Understanding of Data's Influence on Leadership

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Abstract. In an increasingly digital world, companies collect a growing amount of data on their customers, processes and employees. While many contributions focus on the integration of data in new business models and processes, little attention is paid to the use of new insights for leadership. Therefore, we investigate the influence of employees' data on the leadership functions of "interpersonal", "information processing" and "decision-making". We apply a qualitative, explorative research approach and conduct two case studies with companies, one being advanced in the use of data for leadership and the other just starting its transformation process. Combining the insights from both case studies with previous findings from literature, we provide three propositions on how employees' data affect the different facets of leadership.

Keywords: Digital Transformation, Leadership, Data-driven Management, HRIS, Qualitative Case Studies.

1 Introduction

During the last years, the influence of data on markets and organizations, resulting in digital transformation, has become clearly visible [1, 2]. Not only business models and production processes are object of digitalization activities, but also leadership is impacted by digitalization [3]. Two main drivers enable the change in leadership: first, the needs of companies in a globalized world are changing, leading to new forms of communication, new value structures and a higher demand for participation and transparency. Second, the technological framing conditions are adjusting and the growing amount of data on employees enables novel leadership-related analytics [4].

Though the use of data in the context of leadership is not completely new, the range of functions of leadership-related IS increased rapidly within the last 80 years and changed the role of HRM [4]. We define HRM as administrative functions conducted to "attract, motivate, and retain employees in their roles" [4]. While in the 1940s-1950s HRM functions relied on basic technologies like payroll systems, HRM-specific software tools were introduced in the 1960s, leading to early versions of Decision Support Systems (DSS) to facilitate leadership decisions in the 1980s and 1990s [4]. This trend triggered new metrics to evaluate the employees' performance and advanced people analytic tools which impact managerial leadership [4]. These

15th International Conference on Wirtschaftsinformatik,
March 08-11, 2020, Potsdam, Germany

https://doi.org/10.30844/wi_2020_q3-gierlich

tools are referred to as human resource information systems (HRIS), "system[s] used to acquire, store, manipulate, analyze, retrieve, and distribute information regarding an organization's human resources to support HRM and managerial decisions" [5]. Today, the use of data in HR departments is mainly focusing on descriptive analytics [6]. 40% of the HR managers prefer descriptive dashboards, although the shares of predictive analysis (13%) and big data analytics (12%) are increasing [6]. These technological advances set new framing conditions for leadership in the digital age.

Literature in the area of IS research predominately covers the technical perspective of human resource information systems like people analytics, e.g. the logic behind applied algorithms [7]. Researchers investigate the topic in the light of technology acceptance and examine factors for HRIS's successful use and potential outcomes [8]. In contrast, research in the field of management and HR is concentrating on leadership concepts and potential changes through digitalization [9]. Emerging trends like e-leadership are discussed from a conceptual point of view [9]. However, "scholars may need to go beyond traditional leadership theories to explain the impact digitalization exerts on leadership" [3]. In sum, consequences of using data in the context of leadership are scarcely analyzed in both disciplines and researchers identify a "lack of theorization about the impact of technology on leadership" [3].

We aim to bridge the gap between management research and IS research and thus propose the following research question: *What is the influence of employees' data on different functions of leadership?*

To answer this question, we describe our theoretical background that is based on the different functions of leadership. The work further follows an explorative, qualitative research approach, consisting of two case studies with companies. After a brief within-case analysis, a cross-case comparison provides insights into our results on the influence of employees' data on leadership. Next, we discuss the results in the context of previous findings and point out theoretical and practical implications. Lastly, the limitations and the outlook for future research complete the picture.

2 Background

2.1 Leadership and the Impact of Data

Advances in leadership-oriented information systems drive changes in leadership. Therefore, we first specify our understanding of leadership and next outline the technological progress in the field.

Understanding of Leadership. Leadership definitions have changed over time and are controversially discussed in different fields. Despite the vivid debate on the difference of leadership and management [10], leadership functions are closely related to managerial roles [11]. As the distinction between both terms in the field of IS is often not defined selectively, we are using "leadership" and "management" synonymously. Still, we emphasize the interpersonal level of leadership that is not analyzed in most contributions on management. In our work, we define leadership as the making of decisions, the processing of information and the interpersonal level of managing teams in order to fulfill a firm's operative and strategic goals [12].

https://doi.org/10.30844/wi_2020_q3-gierlich

Leadership-related Information Systems. Driven by the availability of data, new technologies change HR processes and leadership. While numerous information systems evolved in the context of firms over time, we want to focus on leadership-related systems dealing only with the employees' data. Employees' data are defined as data "directly related to the employee's job duties, salary, performance and general employment history" [13]. With this intention, we consciously exclude process or customer-related data from our analysis.

Whereas in the 1950s leadership-related technologies were restricted to simple reporting functions, advanced ERP systems opened the field for new use cases, further leading to an area of intelligent HRIS [4]. As special type of HRIS, HR Analytics (synonyms are People Analytics or Workforce Analytics) emerged. HR Analytics rely on employees' data with the aim to "provide data-rich insights into organizational resources, processes, people and their performance, hence allowing managers […] to make decisions and manage people in a more informed, objective, and effective manner" [14]. The application areas for HR analytics cover operative tasks like recruiting management, controlling activities like new KPI systems, as well as strategic workforce planning and optimization [4]. In summary, the functionalities of leadership-related information systems extended from reactive reporting to prescriptive analytics, with different facets of leadership being impacted by the technology-driven change.

2.2 Theoretical Foundations

As we consider the generic theories on leadership to be too abstract to derive hypothesis on the impact of employees' data [3], we aim to conceptualize leadership by breaking it down into different leadership functions. Having revised different approaches on disaggregating leadership tasks and functions [15], we choose Mintzberg's well-established framework. The framework uses a generic, yet systematic approach, it has established in research over the decades, yet being seen as contemporary [15], and its applicability in the context of IS research has been shown by numerous, even recent, publications [16, 17]. In his contribution Mintzberg distinguished between decision-making, information processing and interpersonal roles [12]. While certain researchers criticize the roles' selectivity and the study's validity, others highlight the framework's reliability by pointing out options to measure the different roles in quantitative surveys [15, 18]. Thus, we base our further investigations on Mintzberg's roles.

Decision-Making. The decision-making function of leadership concerns using information for decision [12]. Management decisions can be distinguished by the nature of the problem (operational, management control, strategic) [19] and the degree of structure of the problem (unstructured, semi-structured, structured) [20]. In the context of decision-making in HR, nine different types of managerial actions can be determined along the two dimensions [21]. These actions range from operational, structured problems like the enrollment of benefits, to strategic workforce planning in a semi-structured context (see Figure 1) [21].

https://doi.org/10.30844/wi_2020_q3-gierlich

Problem Structure	Management Decision Making Levels: Operational Control	Management Control	Strategic Planning
Structured	Benefits Enrolment	Recruitment Efficiency	HR Supply Analysis
Semi-structured	Applicant Screening	Monitoring Succession Plan	Strat. Workforce Planning
Unstructured	Unexpected Absenteeism	Implementing an HRIS	Mergers & Acquisitions

Figure 1. HR Decision-Making (adopted from [21])

The influence of data on the task of decision-making has been strongly investigated in the fields of management information systems (MIS) and decision support systems (DSS). One important research focus is on the technologies' ability to support different decision-making problems. While MIS focus on structured problems like providing standardized reports [22], DSS are able to cover unstructured problems [23]. This literature base contains valuable insights on the leadership dimension of decision-making, which we take into consideration in our analysis. However, we consider the previous research to be narrowed and thus aim to provide a more holistic view by examining all three functions.

Information Processing. The level of information processing addresses the leader's duty to communicate at different levels of the company and to manage information [12]. This level is strongly affected by data. On the one hand, the quantity of data is increasing rapidly, potentially leading to an information overload [24]. On the other hand, big data analytics facilitate the management of data pools and help to avoid information overloads [24]. Information processing is simplified, and managers are particularly well informed about their employees.

These findings from literature are supported by Organizational Information Processing Theory (OIPT) [25]. OIPT states that firms aim to decrease uncertainties by enhancing the information flow. Consequently, companies have certain information needs which can be satisfied by information supply, but only on the assumption that the firm has suitable information processing capabilities to make use of the data [25]. In times of vast amounts of data, the needs for information processing rise and new information systems evolve to support managers [26]. As OIPT suggests, data help in reducing uncertainties, and new technologies assist in building up information processing capabilities. Thus, as a first proposition, the function of information processing is influenced by data.

Interpersonal. The interpersonal level compromises the people-oriented side of management such as leading a team and cultural aspects in the company [12]. We consider this perspective to be a crucial core of leadership but the impact of data on the interpersonal level is difficult to measure. In emerging leadership concepts, the focus is on technologies as enablers for new ways of collaboration [9]. However, in most approaches the link to using employees' data is missing [3]. To our knowledge,

https://doi.org/10.30844/wi_2020_q3-gierlich

scarce evidence on the interplay between data and the interpersonal function can be found.

Following Agency Theory, the employees' data should have an impact on the relationship between principal and agent [27]. Building on agency theory, data can lead to a higher level of transparency in the relationship between manager and employee [28]. Former monitoring expenditures, such as investments on management information systems, and signaling costs, like inefficiencies due to reporting obligations, get less relevant. We take this as an indicator for the influence of data on the interpersonal level since information asymmetries decrease.

Overall, prior contributions focus mostly on one, fragmented leadership function. Hence, from our point of view, it is worth investigating the influence of employees' data on all leadership functions in an integrative, sound approach.

3 Method: A Multiple Case Study Approach

3.1 Choice of the Method

We aim to explain the influence of employees' data on leadership in a qualitative way since empirical evidence from previous research is lacking. Furthermore, we consider it not intuitive to quantify the influence of data on leadership and therefore strive to highlight the relation between both constructs in a qualitative, explorative approach. An exploratory approach defines "questions, constructs, propositions, or hypotheses to be the object of a subsequent empirical study" [29]. Our research question can best be analyzed in a natural setting, which is not manipulated by the researcher. As a suitable method, positivist case studies take the existence of fixed relationships between certain constructs as granted [30] and aim to develop novel theory from the observed setting [31]. In our work we can benefit from the following characteristics of case studies: Case studies address the organization as a whole, they collect real-life data from experts, they drive new solutions and ideas and aim to provide explanations on phenomenon that have scarcely been researched [32].

As we aspire to develop a general theoretical contribution based on cross-case analysis without limiting on one revelatory case [32], we follow the multiple case study approach by Yin [33]. The level of analysis is specified as "entire organizations" [32]. We carefully considered established principles that address rigor in positivist IS research, like construct validity, external validity and reliability [31, 32].

3.2 Sampling Criteria

When selecting the cases, we were looking for variant examples and applied stratified purposeful sampling [34]. This sampling technique facilitates in finding information-rich cases for comparison [34]. We decided to sample for companies with a strong technological focus as we expect those to be impacted most by digital leadership approaches. Due to their advanced internal use of technologies and their openness

https://doi.org/10.30844/wi_2020_q3-gierlich

towards innovative working environments, like agile methods, we anticipate insightful results from this industry. Moreover, we looked for differently sized companies, as leadership is depending on hierarchies and the size of the teams. Smaller companies and start-ups were excluded from the sample due to their volatile leadership functions.

Further, the extent to which employees' data are used for leadership in the companies was considered as an important sampling criterion. One case should illustrate a mid-sized company on the way to integrate data for leadership, the other case should cover a company being advanced in HRIS technologies. The heterogeneous cases enhance the study's external validity [33]. Having collected background information on suitable companies, like firms being nominated for innovative leadership awards, we contacted different firms. Table 1 provides an overview about the two final cases.

Table 1. Overview of the cases

	Case Alpha	*Case Beta*
Industry focus	Technology corporation	IT industry
Market	B2C / B2B	B2B
Revenue	> 80€ bn.	> 0.8€ bn.
Employees	> 300.000	> 4.000
Data usage in leadership	Separate department for HR analytics	Early stage, no HR analytics department
Number of interviews	6 (3 managers, 3 employees)	6 (3 managers, 1 team leader, 2 employees)

3.3 Data Collection and Analysis

Data collection was conducted between May and June 2019. Managers and employees were interviewed. To enable flexibility but assure the comparability of the results, we used a semi-structured interview guideline [35]. We built the open-ended questions around our theoretical foundation and the perspectives from the managers' view (e.g. "What type of employee data do you use for your daily decisions?") and the employees' perception (e.g. "Do you perceive changes in leadership during the last 5 years?") were covered. The questionnaire was pretested and discussed with different researchers to increase the study's rigor [30]. The duration of the interviews varied between 30 and 90 minutes. We recorded the interviews, assured confidential treatment of the data and transcribed them in an anonymous way to ensure the reliability of the study.

For the analysis, ATLAS.ti was used and two coding cycles were conducted. As recommended by Benbasat et al. (1987), a second researcher was involved in the coding procedure [32]. The first coding cycle covered descriptive codes and was conducted independently by both researchers. Next, the initial codes were discussed and exploratory codes were developed that helped to identify categories [34]. We

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applied our theoretical base of the three functions of leadership as main categories for the coding and developed subthemes accordingly (see Table 2) [30]. In the last step, we triangulated our primary data using secondary data sources (e.g. press releases or external presentations of the companies) to increase the study's construct validity [33].

Table 2: Illustration of the coding scheme

Category	*Theme*	*Example*
Decision making	Strategic - structured	"I can see what types of skills we need within the organization in the future."
Information Processing	Transparency	"The employee gets more visible." [translated]
Interpersonal	Collaboration	"We work less face-to-face but more in virtual teams." [translated]

4 Results

4.1 Within-Case Analysis: Company Alpha

Context. Company Alpha operates in different branches of technology and is placed as a global leader for B2B and B2C solutions. Besides the digital transformation of the business model, the company focused on the improvement of the leadership experience by founding a separate people analytics department in 2014. The team's work is supported by an external HR analytics software, which covers basic reporting functions and first predictive analytics. Statistics are aggregated at teams' level and analysis on the individual level are restricted by legal framing conditions.

Next to legal limitations, the implementation of the people analytics department and connected software tools was first hampered by different challenges. On the cultural level, employees and managers had to be convinced of the solution's advantages. There was no demand for increasing organizational transparency and managers were afraid of an information overload. On the technical side, Alpha had to overcome media disruptions by defining interfaces and by consolidating different tools. Nowadays, Alpha is advanced in using employees' data for leadership on all three levels.

Decision-Making. Regarding decision-making, data take a core role in making decisions faster, more comprehensive and fairer. Data replace subjective biases and serve as "basis for discussion and justification" (Alpha, manager in the field of advanced analytics). For operational tasks, ranging from structured to unstructured levels, Alpha relies on established technologies. Routine tasks like assigning holidays, reporting team structures and employing new employees are enabled by descriptive

https://doi.org/10.30844/wi_2020_q3-gierlich

analytics. Software tools also support less structured tasks on the operational level, like managing parental leave, or screening applicants.

On the stage of management control, data about the employees, like their skills, wage and extra hours worked, are monitored, saved in the individuals' profile and serve for the yearly evaluation and development of the employees. New KPIs are introduced to measure success in creative work environments. Even unstructured, managerial problems, like the implementation of health prevention measures based on registered cases of sickness, are driven by data.

When it comes to the strategic level of decision-making, the technologies' range of functions has expanded drastically within the last years. Innovative HR analytics tools facilitate HR supply analysis and workforce planning. Alpha defines its target population for recruiting activities precisely based on long-term forecasts about the company's needs and the market prediction. The current workforce is analyzed to gain insights into potential dropouts or available skills. From a technical perspective, strategical and less structured problems can be solved by relying on software tools. However, individualized features require the employees' informed consent.

Information Processing. Transparency is the main result that Alpha achieved through employees' data and their analysis. Data about employees can be processed easily, they are "democratized" (Alpha, employee of people analytics team) and "employees get visible on a holistic level" (Alpha, manager in the area of leadership). In contrast to the processing of information on the management level, the processing between leaders and employees is still considered opaque. Managers might "obtain certain information advantages", so the mentioned information asymmetries between principal and agent remain (Alpha, manager in the field of advanced analytics). The perception of those information asymmetries highly varies between different employees. While some assess the current level of transparency as adequate, others underline the need to share more information. The potential of creating a transparent organization and thereby reducing agency costs, is not fully exploited until today.

A reason for maintaining information asymmetries can be found in concerns about a future information overload. Though data are regarded as useful, they "could become a burden with growing team sizes and increasing granularity" (Alpha, manager in the field of leadership). Eventually, data lead to growing transparency within the firm and support information processing, though some advantages are not put into use yet.

Interpersonal. The impact of data on the interpersonal level can be observed in new forms of collaboration, the employees' empowerment and a cultural change in leadership. "Trust had to be established" (Alpha, employee of people analytics team) and next to data, leadership had to be based on empathy (Alpha, manager in the field of leadership). Conference systems and collaboration tools enable innovative ways of work, like virtual teams. First, these systems replace face-to-face communication and support the interactive exchange of ideas. Second, the empowerment of employees is enabled through insights into the individuals' journey. Due to a rising level of transparency about the employees' skills and needs, employee-specific approaches lead to mature individuals which participate in frequent engagement surveys and debates.

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Lastly, despite the growing influence of data, Alpha stresses the need for employee-centric leadership approaches that "treat employees as humans and not as a resource" (Alpha, manager in the field of advanced analytics). The importance of empathy, communication and fairness as counter players in a data-driven environment increases. Furthermore, establishing a culture of trust and managing team conflicts is in the responsibility of the managers and can hardly be supported by data. In short, employees' data facilitate collaboration and empowerment on the interpersonal level, but the "softer side" of new leadership concepts is not built on data to create an opposite pole next to the data-driven approaches.

To sum up the results of Alpha, the company is very advanced in using data on all three functions of leadership. Decision-making gets more fact-based. Information can be processed easily within the firm due to HRIS systems, leading to an increasing level of transparency. On the level of interpersonal tasks, new ways of collaboration are enabled through data and employees are empowered. Still, the core task of managing interpersonal relations remains subjective.

4.2 Within-Case Analysis: Company Beta

Context. Beta is offering IT solutions for B2B customers. Though the company has expertise in the field of data analytics and digital transformation, HR analytics are only used to a small extend. However, the use of employees' data in the field of leadership should be leveraged according to the company's new digital strategy.

Until now, challenges at legal, financial, cultural and technical side keep Beta from advancing in digital leadership concepts. First, concerns on data protection regulations arise. The level of data aggregation is discussed critically since breaking analytics down to the individual's level is problematic. Second, from financial perspective, investments in infrastructure for new forms of collaboration were lacking during the last years. Third, at cultural level, incentives for a new solution are currently missing, as managers prefer relying on their experience and "using data for guiding employees [is seen as] superfluous" (Beta, manager in the field of HR). Thus, managerial support for the new technology is partly lacking. From technical perspective, media disruptions keep the company from integrating all employee-related data in one tool. With the recent implementation of the new HR tool, the software landscape will be harmonized and new ways of using data get feasible. With regard to these challenges, Beta just started the digital transformation of leadership. Still, first impacts on leadership get visible.

Decision-Making. In the field of decision-making, Beta is using employees' data mainly on the levels of operational and management control but not for strategic purposes. Dashboards keep track of the status quo and serve as monthly "snapshots" (Beta, manager in the field of R&D). With the single departments at Beta using different tools for reporting functions, standardized processes are lacking. For semi-structured tasks, like managing holidays or sickness, only some departments work with HR tools.

We found similar structures on the level of management control. In the case of semi-structured problems, data are generally available but "in the yearly feedback

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sessions and goal setting talks about career paths and training opportunities nothing happens with the data" (Beta, manager in the field of HR). Only in some cases, aggregated data on the teams are used to evaluate the team's progress.

For strategic decisions, interviewees underlined the necessity to rely more on data. HR supply analysis is driven by the managers' experience. For strategic workforce planning, managers need to be informed about the future development of their team, its skills and opportunities for development. Due to legal restrictions within the firm, this information is not available today though the technical realization would be feasible and internal demand is increasing. Finally, the supportive potential of data for decision-making is not exploited so far.

Information Processing. Transparency is considered as a key to improve information processing functions of leaders. The established level of transparency varies a lot between different departments at Beta. On the one side, development and technical support functions are "transparent from employee to the end customer" (Beta, employee). Process steps, such as the handling of support tickets by the team, can be traced in real time and are available for every team member. These data are not supposed for controlling activities, but the employees can conduct their daily tasks more efficiently by using them. In contrast to that, data on employees are processed in comparably restrictive ways in HR functions though "it would be helpful if employees had access to their data and could optimize their daily routines" (Beta, team leader in the field of development).

Managers keep some information asymmetries, by sharing data only on management level and leaving the employees in the dark. We perceived an enormous difference in the employees' perceptions of the remaining information asymmetries. While some argue, "employees should definitely know, who owns which data" (Beta, manager in the field of R&D), others state that "everyone already knows which data are available and how they could potentially be analyzed" (Beta, employee).

Interpersonal. On the interpersonal level, we identified challenges in the areas of collaboration, empowerment and leadership. Regarding collaboration, tools for communication facilitate working in virtual teams. Next to communication tools, technical solutions support process and project management in a way that repetitions are avoided and transparency about the team's status is generated.

Beta uses this increasing transparency to empower its employees. Since tasks, responsibilities and processes are displayed in a transparent way, employees can organize themselves in their daily jobs. In contrast to data-driven leadership approaches, managers at Beta barely rely on automated performance controlling. "Working together for many years, managers trust on their experience about the employees […] and there is little need for advanced analytics" (Beta, manager in the field of HR). "New leadership approaches are missing so far" (Beta, employee). The interpersonal level of leadership is scarcely influenced by employees' data.

Summing up these findings on Beta, the company took the initial step towards making use of the employees' data. First results are visible, like for example an increasing level of transparency and empowerment. However, the firm cannot yet benefit from certain potentials, especially in the field of decision-making. It is up to debate, if Beta aims to achieve the same integration of data as Alpha.

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4.3 Cross-Case Analysis and Discussion

Comparing both companies, their different stages on new leadership concepts get visible. Alpha has gained more experience in using HRIS tools and changing its leadership concepts accordingly. Beta is starting to integrate employees' data in the context of leadership. Both companies seem to aim for different levels of data-driven leadership since the managerial support for the new solution differs between them. Based on our initial theoretical foundation of Mintzberg's managerial roles [12], we were able to identify the following data-driven changes.

Decision-Making. For the function of decision-making we observe different levels of implementation at the two firms. While Alpha makes use of advanced people analytics for different types of problems, Beta mainly relies on basic reporting functions and the system landscape is fragmented. The focus for Alpha is on strategic workforce planning and monitoring through data, so data lead to more evidence-based and objective decision-making. "Leveraging fully out of data, [we] have been able to get the level of data that is critical to decision-making" (Alpha, manager in the field of HR).

Today, digital recruiting processes or systems managing holidays have become a commodity at firms like Alpha, whereas making use of data in strategic problems is a competitive advantage for leadership. We find evidence for the observed expansion in the functionalities of HRIS and their progressed use for decision-making in literature. As technology advances, the support of HRIS is not only restricted to structured and operative tasks but the attention is shifting to more complex decisions [22].

However, these new functionalities are not used to full extend in the firms. The managers' personal experience is still considered as extremely important and data is often treated as an optional add-on to evaluate the personal, still subjective, decision. We summarize this finding in the following proposition:

Proposition I – Decision-making is influenced by employees' data in a way that less structured and more strategic decisions are supported well, so that decisions get more transparent and objective.

Information Processing. Regarding the dimension of information processing, we observe an increasing level of transparency in both cases. Technologies facilitate the analysis and aggregation of data and thereby reduce the risk of an information overload. Due to the software tools, information about employees get visible, which reduce the need to communicate them explicitly. As information processing capacities are strengthened, organizational uncertainties can be reduced, leading to a high-quality information base for informed decisions. These findings are in consistence with previous findings in the context of OIPT on how data combined with analytic functions improve information processing [25, 28].

Moreover, the increased level of transparency is mostly used to empower employees instead of establishing strict control mechanisms. The employees' data are protected from misuse as many data are only processed at the aggregated level of teams or with the employees' informed consent. Thus we suggest:

Proposition II – Information processing is influenced by employees' data in a way that by combining data with analytic tools, information processing capabilities as well

https://doi.org/10.30844/wi_2020_q3-gierlich

as the level of transparency increase, while the risk of information overload can be minimized.

Interpersonal. On the interpersonal level, new ways of collaboration are enabled due to the use of data. Virtual teams become a necessity and technologies assist in replacing face-to-face meetings. As Alpha is more advanced in using HRIS tools, some impacts on the leadership style can be observed. Leadership is developing in the direction of participative leadership styles that empower employees, e g. by conducting frequent employee surveys and implementing their feedback on leadership approaches (Alpha, secondary source). Yet, we could not find evidence for mainly data-driven leadership concepts, though they would be feasible from a technical point of view. Instead, personal traits and the individuals' development are taken more into account.

Examining these findings in the light of the agency theory, the relationship between employee and employer changes as a result of the growing availability of data. Monitoring and signaling activities are reduced since information asymmetries between both actors decline [27]. This leads to a higher level of trust in the relationship and to more employee-centric leadership approaches [28]. We deduce:

Proposition III – The interpersonal level is influenced by employees' data in a way that more trust between manager and employees is generated, leading to sinking agency costs and participative leadership approaches.

5 Conclusion

5.1 Theoretical implications

Guided by the research question - *What is the influence of employees' data on different functions of leadership?*- our work contributes to literature by providing an empirically derived and theoretically grounded explanation on the influence of data on the different leadership functions. Based on the two case studies we develop propositions for each function. The more objective, managerial functions of decision-making and information processing are supported by employees' data as the range of HRIS' functionalities is increasing. However, the more subjective, interpersonal level is barely data-driven. From a theoretical point of view, our study makes two major contributions.

First, we offer a novel perspective on data-driven leadership approaches by bridging the gap between the perspectives of Management/HR research and IS research. "[Prior] contributions have accumulated in a fragmented fashion across various disciplines" [3]. On the one hand, the construct of leadership is deeply rooted in the field of HR [9]. However, these contributions remain very generic regarding the influence of data and mostly build on established leadership concepts though new approaches are required [3]. On the other hand, contributions from IS mostly focus on one specific leadership function, e. g. decision making being impacted by technological change [22, 23], but they lack the more abstract level of leadership. We

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distance our study from traditional leadership theories and contribute to a novel field of leadership-related research in IS.

Second, we extend the framework by Mintzberg [12] and reflected its applicability in the context of changing working environments. The defined managerial functions are still relevant, yet being influenced by the use of data. Reflecting the framework in the light of agency theory and OIPT, both theories are applied in a novel, leadership-related context. They both help in deriving propositions on how the different leadership functions are impacted by data and their key assumptions can be confirmed in our research context. Thus, our study provides a basis for further investigations on data-driven changes in leadership.

5.2 Practical implications

From a practical point of view, the study gives a structured overview on how employees' data could be used for leadership and what functions of leadership might be affected. The use of data for decision-making and information processing is not a new trend in industry but has already become a commodity. However, most firms focus rather on supporting operational HR tasks by data instead of strategic decisions. Thus, the technologies' potential is not yet fully exploited. Data-driven leadership approaches are a competitive advantage in a dynamic labor market, but they are often problematic regarding data protection regulations. In order to prepare for a digital transformation of leadership, the employees' concerns have to be addressed in the early phase of the implementation. We see most potential in individual solutions that are based on the employees' approval. Moreover, firms should consider potential media disruptions, since they hinder the digital transformation of leadership

In summary, the influence of employees' data on leadership and connected processes in HR is growing. Managers are challenged to re-define their daily work by balancing insights from data and their implicit knowledge. HR departments have to adopt a more data-centric mindset.

6 Limitations and Future Research

The findings contain certain limitations. Though we thoroughly followed the principles for conducting and analyzing case studies and aimed to ensure the validity and reliability of the study, the results might be restricted to the analyzed industries or company sizes. The dimensions of leadership might be highly dependent on the companies' location or even the different functions within the firm. Moreover, the analyzed functions of leadership might not always be complete selectively. We captured a snapshot of the status of the firms, whereas the transformation of leadership is a long-term process and it would be insightful to cover a longer time span. Furthermore, the impact of data on leadership is hard to quantify and the findings are restricted to qualitative propositions.

To address the mentioned limitations, we suggest the following steps for future research. First, investigating larger and more diverse samples would help evaluating

https://doi.org/10.30844/wi_2020_q3-gierlich

the robustness of the results. Second, collecting longitudinal data of firms on their transformation process would shed light on the implementation, related challenges and ways to master the different phases of the process. Third, this longitudinal perspective could be enhanced by a quantitative survey, evaluating the integration of data in the leadership functions before and after the transformation process. Finally, we want to stress the need for further investigations on the individual leadership functions, especially on the interpersonal one, since we only covered them on a holistic level but expect promising insights for practice and theory from their in-depth analysis.

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