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Starting an ML journey - A case study of an organization's digital transformation through the lens of sociomateriality

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Abstract

Jägersro is a horse racing track situated in Malmö, Sweden. A public body funded this organization to start its Machine Learning (ML) journey. Jägersro wants to use this opportunity to initiate its journey towards a digitally transformed organization. During its ML journey, the institution will face different barriers. This study aims to analyze the start of the organization's journey. A sociomaterial perspective is applied during the analysis to generalize the findings. A project like this is an ideal start for a digital transformation as ML is a well-defined area. Results indicate a strong need for making implementation efforts visible and material to spark further development of a DT.

Keywords

Sociotechnical, Sociomaterial, Digital Transformation, ML

1. Introduction

Cognitive technologies, such as Artificial Intelligence (AI), Machine Learning (ML), or Machine Reasoning (MR), are increasingly being implemented to solve business issues such as automating business processes, analyzing data, and engaging with stakeholders. (Davenport & Ronanki, 2018). Jägersro is a trotting sports institution, which was established in 1907. It received public funding to experience the introduction of ML into its operations. Also, it is on the brink of remodeling its physical buildings. All these aspects sparked interest in embarking on a digital transformation journey. To secure external capabilities, the organization partnered up with the author to support its transformational journey.

Historically, DT is a rather young research field. Reviews claim a superior amount of case studies as a research method in DT (Reis et al., 2018), which still indicates a phase of exploration. DT can be seen as adjacent to information systems. For research on information systems and organizations, Orlikowski and Scott (2008) propose the perspective of sociomateriality to develop the research field further.

Looking at definitions of DT, a technology introduction needs to impact the value creation of the implementing institution (Wessel et al., 2021). Therefore, this paper takes up sociomateriality as a perspective for research on implementing an ML solution. Only if its materialization in its social context is studied, the impacts become visible. Thus, the research questions are: How is the ML solution becoming material during its implementation? How are organizational and individual barriers regarding ML affected during its materialization?

The author aims to answer the research questions through a canonical action research approach combined with case study elements induced by a sociomaterial perspective during the research project (Barata & Da Cunha, 2018). For this approach, the main terms ML, DT, and sociomateriality are conceptualized. After, the methodological approach and data collection is revised. Currently, this work is research-in-progress. Thus, preliminary results are presented and discussed. Finally, the paper closes with a preliminary conclusion and outlook. Although this study is based on a specific case, generalizations can be drawn for the start of DT journeys. Firstly, it contributes to overcoming barriers at an early stage of DT. According to a literature review, a sociomaterial perspective is rarely used in research on DT. Secondly, it contributes methodologically to further promote this research perspective.

2. The ML Experiment

Trotting in Sweden is famous and attracts a huge audience every week. 33 racing tracks organize over 8000 races each year (Svensk Travsport, 2022). Each trotting track publishes calls for participation before each competition to invite crews (horse, owner, trainer, driver) for races. The aim is to set up exciting and interesting races for the audience. Also, the tracks must satisfy the horse owners' business needs for prize money. The track's Sports Director manually puts together calls - so-called propositions - for licensed crews in each competition. As previously won prize money is the most vital criteria, it leads to the fact that the subjectively assessed range of horses does not match real opportunities. Namely, the same horses tend to appear repeatedly in competitions due to human shortcomings in the selection and proposal process. However, the lack of breadth cannot be linked to a lack of horses available. The Swedish Trotting Association's national database contains almost 12,000 licensed horses. The trotting track's Sports Director can choose horses from this database and construct propositions before each competition. The selected crews receive the propositions and can reject or accept them.

The ML experiment intends to streamline and democratize the selection process and develop opportunities to increase the breadth of competition with ML. Thus, the project strives to achieve improved quality in each race simultaneously as the public excitement increases. For the implementation, supervised ML procedures similar to setting up teams (Alkan et al., 2018) or predicting the positions of different horses within races (Armerin et al., 2019) will be applied. The advantages of supervised ML are its usage of relatively low computing power as well as structured and understandable procedures. Therefore, a project within supervised machine learning is a good candidate as a first project in an organization without cognitive technology experience.

3. ML and Digital Transformation

Ahmed et al. (2021) classify cognitive technologies into Artificial Intelligence (AI), Machine Learning (ML), and Machine Reasoning (MR). ML adopts human learning behavior to make decisions and predictions. Cognitive technologies are part of digital transformation (DT) (Vial, 2019). DT includes technology such as Information Systems (IS). Nolan and Wetherbe (1980) define IS as a system between men and machines to provide information to solve different tasks for an organization. O'Brien and Marakas (2011) add information products' data input, processing, and output.

Often, firms show an organizational separation between IT and business functions, which became integral to their values and beliefs. This separation is a hinder to DT. Building up digital capabilities as a fusion of IT and business tasks requires an innovative culture, a common language, and expertise in value creation technology. On a small scale with an agile approach, iterative experiments with digital technologies need to be conducted. In the case of success, will be scaled up to the rest of the organization. An adaption to the long-term goals needs to be done. At the same time, changes in the environment need to be monitored (Vial, 2019).

DT is a relatively new area, which has become a topic of interest in academic research in recent years. Reis et al. (2018) review and analyze different definitions. The common ground for defining DT is the usage of digital technologies to realize business improvements and impact customers' lives. This definition relates to three elements: (1) technology, (2) organization, (3) customer. Vial (2019, p. 121) develops a conceptual definition of DT as "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies." DT is based on social media networks, mobile devices, data analytics, cloud services, and the internet of things. Other technologies, such as internet connections, software, blockchains, and AI, are less visible in research results. Although classifications of technology exist, they will not be used stand-alone. For a successful DT, different technologies need to be combined. E.g., users generate data through social media participation, which companies can analyze to decide upon marketing activities (Vial, 2019).

4. Sociomateriality

Sociomateriality is a perspective for research on Information Systems (Leonardi, 2012). Sociotechnical system (STS) is the older term coined by Trist and Bamforth, who are arguing for an interrelation of technological and social systems. STS is a common approach in IS and organizational studies (Cecez-Kecmanovic et al., 2014). It generally recognizes a non-simultaneous interconnection between social and technical elements on an abstract level. In addition, sociomateriality is the specific entanglement of artifacts and their creation with the social environment they are implemented in. The social environment consists of institutions, norms, discourses, roles, etc. At the same time, materiality is defined as the composition of the features of a technological system (artifact) with its features somewhat stable over time and significant to users. Sociomateriality is the imbrication of the social agency and the material agency, which both influence the social subsystem and are influenced by it (Leonardi, 2012).

5. Usage in the academic literature

The Scopus database was researched in December 2021 to review the usage of sociomateriality in literature. Table 1 shows the keywords and different spellings. Otherwise, no time, language, or other limits were set.

Table 1. Scopus search results

#	Search string	Results
1	sociomaterial* OR socio-material*	1,668
2	"digital transformation" AND (sociomaterial* OR socio-material*)	6
3	(AI OR "Artificial Intelligence" OR ML OR "Machine Learning) AND (sociomaterial* OR socio-material*)	4

Results from the second and third search include a case study of a bank, in which the author proves that digitalization comes with the image of non-profit and democracy. This image hinders the bank's organizational development (Hensmans, 2020). Skjælaaen and Bygdås (2019) show socio-material management procedures for a digital transformation in newsrooms. Bento et al. (2019) present an Agriculture 4.0 research project using smart sensors, machine learning, and augmented reality. They emphasize the importance of a user-centered design, an ecosystem of suppliers and customers, and data usage to add value. Barat and Da Cunha (2018) examine transformations towards Industry 4.0 by using an action research approach to explore how product life-cycles materialize through roadmaps. Flyverbom and Murray (2018) find that data manipulation procedures, as part of knowledge production, influence data and are materialized by actions taken by users. Karafillidis and Weidner (2018) see human-machine configurations as directly connected to materialized digital processes. Van Rijmenam and Logue (2020) draw on sociomateriality to explore the impact of AI agency, capability, and governance. Klischewski (2019) uses a sociomaterial perspective to research the interconnection between human action and technology performance. With a framework grounded in sociomateriality, McCoy and Rosenbaum (2019) explore the usage of dashboards as a tool for institutional decision-makers.

From the results, it becomes visible that there is limited application of the sociomaterial lens within research on DT and ML. When applied, the context is very specific to generate results.

6. Methodological approach and data collection

The author applies a case study approach (Yin, 2014) and weaves in aspects of sociomateriality to explore how the trotting sports organization evolves and how it influences the ML implementation. The study draws on the approaches of (Bento et al., 2019) and (Barata & Da Cunha, 2018), who conducted canonical action research projects connected to Industry 4.0. Furthermore, the building blocks of DT from Vial (2019) will be used to structure the elements influencing the organization. According to the five steps in the canonical action research (Barata & Da Cunha, 2018), diagnosing and action planning were done collaborating with the trotting sports organization.

Jägersro implemented the ML project during spring and summer 2021. The author gathered data from team meetings and personal interviews with Jägersro's board throughout the project. The author transcribed the data and uploaded it to qcmap.org for coding. Furthermore, the project team distributed a questionnaire to the members of the association owning the horse racing track. Further documents to promote the project are a poster to explain the results and a report to the funding agency. During the implementation, random forests and neural networks were evaluated using 1100 previous propositions from 2018 to 2020 and 1200 horses registered at Jägersro. A neural network with four layers classified participating / non-participating horses best and generated an accuracy of 75%. Afterward, regressor decision trees were used to predict the number of horse owners registering for a certain proposition. (Hägglund & Masalkovski, 2021).

7. Preliminary results

Using Vial's (2019) building blocks to structure the results, it is observable how technology is materialized through ML. The Sports Director gets the number of registrations forecasted. He will be able to incrementally adjust the propositions. New propositions and registrations must be added to the database to train the algorithm. Disruptions are expected in the form of more diverse registrations. Also, adding more data might disrupt the proposition work and the cooperation with other stakeholders when it comes to betting. Until now, this project has not triggered a visible form of digital visions and missions but gained attention from the board. One value proposition is about to change for horse owners. The ML system should help create more open propositions and generate more registrations. Employees and skills need to further develop because the system needs to be updated permanently. Also, the role of the Sports Director might change to a more relation-based role. Slight resistance regarding an ML solution was visible in the quantitative data. Inertia might still lead to a non-use of the system. Positive impacts aim at increased efficiency. Negative impacts might evolve from legal requirements, especially in connection with betting.

8. Preliminary discussion

As Jägersro just started its DT, it is not fully-fledged yet. The impact on value propositions and value creation is minor. Thus, the DT is currently more an ITOT (Wessel et al., 2021) in which ML is supporting the value creation but not profoundly changing it. Jägersro shows some degree of openness for digital technologies. According to Klötzer and Pflaum (2017), this openness relates to digital awareness as the first level of maturity on a smart-product application. Still, activities on other aspects such as strategy development are missing. The highest level of maturity is a data-driven enterprise.

9. Preliminary conclusion and outlook

The ML project is a unique opportunity for Jägersro to start its DT. Even if it was sparked from the outside by public funding. Conclusions can be drawn on the start of DTs by analyzing the materialization of the ML project. The project resulted in an app and a poster that made results visible. Insights will help practitioners and academics to better understand the materialization of ML and its impact on an organization in a DT.

Future work for Jägersro will include the development of a roadmap (Tschoppe & Drews, 2022). In addition, from a scientific point of view, it will be beneficial to further follow Jägersro to analyze path dependencies or further develop maturity models.

References

Ahmed, M. U., Barua, S., & Begum, S. (2021). Artificial Intelligence, Machine Learning and Reasoning in Health Informatics—An Overview. In M. A. R. Ahad & M. U. Ahmed (Eds.), *Signal Processing Techniques for Computational Health Informatics* (Vol. 192, pp. 171–192). Springer International Publishing. https://doi.org/10.1007/978-3-030-54932-9_7

Alkan, O., Daly, E. M., & Vejsbjerg, I. (2018). Opportunity Team Builder for Sales Teams. *23rd International Conference on Intelligent User Interfaces*, 251–261. https://doi.org/10.1145/3172944.3172968

Armerin, F., Hallgren, J., & Koski, T. (2019). Forecasting Ranking in Harness Racing Using Probabilities Induced by Expected Positions. *Applied Artificial Intelligence*, *33*(2), 171–189. https://doi.org/10.1080/08839514.2018.1536105

Barata, J., & Da Cunha, P. R. (2018). *Understanding sociomaterial transformations in industry 4.0: An action research study*. International Conference on Information Systems 2018, ICIS 2018.

Bento, C., Da Cunha, P. R., & Barata, J. (2019). *Cultivating sociomaterial transformations in agriculture 4.0: The case of precision viticulture*. 25th Americas Conference on Information Systems (AMCIS), Cancun.

Cecez-Kecmanovic, D., Galliers, R. D., Henfridsson, O., Newell, S., & Vidgen, R. (2014). The Sociomaterialty of Information Systems: Current Status, Future Directions. *MIS Quarterly*, *38*(3), 809–830. https://doi.org/10.25300/MISQ/2014/38:3.3

Davenport, T. H., & Ronanki, R. (2018). Artificial Intelligence for the Real World. *Harvard Business Review*, *Jan-Feb*, 2–10.

Flyverbom, M., & Murray, J. (2018). Datastructuring—Organizing and curating digital traces into action. *Big Data & Society*, *5*(2), 205395171879911. https://doi.org/10.1177/2053951718799114

Hägglund, A., & Masalkovski, M. (2021). *Maskininlärning för propositionsarbete i travlopp* [Bachelor thesis]. Malmö University - unpublished.

Hensmans, M. (2020). How digital fantasy work induces organizational ideal reversal? Long-term conditioning and enactment of digital transformation fantasies at a large alternative bank (1963–2019). *Organization*, 135050842096818. https://doi.org/10.1177/1350508420968185

Karafillidis, A., & Weidner, R. (2018). Support in Times of Digitization. In A. Karafillidis & R. Weidner (Eds.), *Developing Support Technologies* (Vol. 23, pp. 285–295). Springer International Publishing. https://doi.org/10.1007/978-3-030-01836-8_28

Klischewski, R. (2019). Will the Government Machine Turn into a Monster? *20th Annual International Conference on Digital Government Research*, 306–313. https://doi.org/10.1145/3325112.3325221

Klötzer, C., & Pflaum, A. (2017). Toward the development of a maturity model for digitalization within the manufacturing industry's supply chain. *Proceedings of the 50th Hawaii International Conference on System Sciences*, 4210–4219. https://doi.org/10.24251/HICSS.2017.509

Leonardi, P. M. (2012). Materiality, Sociomateriality, and Socio-Technical Systems: What Do These Terms Mean? How are They Related? Do We Need Them? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2129878

McCoy, C., & Rosenbaum, H. (2019). Uncovering unintended and shadow practices of users of decision support system dashboards in higher education institutions: Uncovering unintended and shadow practices of users of decision support system dashboards in higher education institutions. *Journal of the Association for Information Science and Technology*, *70*(4), 370–384. https://doi.org/10.1002/asi.24131

Nolan, R. L., & Wetherbe, J. C. (1980). Toward a Comprehensive Framework for MIS Research. *MIS Quarterly*, *4*(2), 1. https://doi.org/10.2307/249333

O'Brien, J. A., & Marakas, G. M. (2011). *Management information systems*. McGraw-Hill.

Orlikowski, W. J., & Scott, S. V. (2008). Sociomateriality: Challenging the Separation of Technology, Work and Organization. *The Academy of Management Annals*, *2*(1), 433–474. https://doi.org/10.1080/19416520802211644

Reis, J., Amorim, M., Melão, N., & Matos, P. (2018). Digital Transformation: A Literature Review and Guidelines for Future Research. In Á. Rocha, H. Adeli, L. P. Reis, & S. Costanzo (Eds.), *Trends and Advances in Information Systems and Technologies* (Vol. 745, pp. 411–421). Springer International Publishing. https://doi.org/10.1007/978-3-319-77703-0_41

Skjælaaen, G. R., & Bygdås, A. L. (2019). Teaming up with technology: Socio-material managerial approaches for digital transformation. In A. L. Bygdås, S. Clegg, & A. L. Hagen (Eds.), *Media management and digital transformation*. Routledge.

Svensk Travsport. (2022). *Tävlingarna*. https://www.travsport.se/svensk-travsport/travsporten-i-sverige/tavlingarna/

Tschoppe, N., & Drews, P. (2022). Developing Digitalization Strategies for SMEs: A Lightweight Architecture-based Method. *Proceedings of the 55th Hawaii International Conference on System Sciences*, 4869–4878.

van Rijmenam, M., & Logue, D. (2020). Revising the 'science of the organisation': Theorising AI agency and actorhood. *Innovation*, 1–18. https://doi.org/10.1080/14479338.2020.1816833

Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, *28*(2), 118–144. https://doi.org/10.1016/j.jsis.2019.01.003

Wessel, L., Baiyere, A., Ologeanu-Taddei, R., Cha, J., & Blegind Jensen, T. (2021). Unpacking the Difference Between Digital Transformation and IT-Enabled

Organizational Transformation. *Journal of the Association for Information Systems*, *22*(1), 102–129. https://doi.org/10.17705/1jais.00655