A Future Prospect for European Collaboration on Advanced Analytics in Economy and Society

Nicola Below[0000-0003-3388-7958], Dirk Burkhardt[0000-0002-6507-7899], Lukas Kaupp[0000-0001-9411-6781], Kawa Nazemi[0000-0002-2907-2740]

Darmstadt University of Applied Sciences, Human-Computer Interaction and Visual Analytics group, Germany
{nicola.below,dirk.burkhardt,lukas.kaupp,kawa.nazemi}@h-da.de

Abstract. Analytical Reasoning by applying machine learning approaches, artificial intelligence, NLP and visualizations allow to get deep insights into the different domains of various stakeholders and enable to solve complex tasks. Thereby the tasks are very heterogenous and subject of investigation in the different areas of application. These tasks or challenges should be defined by the stakeholders themselves and lead through a deep investigation to advanced analytical approaches. We therefore set up a strategic alliance of research, enterprises and societal organization with the goal of a strong collaboration to identify in a first step these challenges and workout technological solutions for each application scenario. We give in this paper a first draft of current challenges and technological advancements. The main contribution of this paper is next to an accurate description of the current challenges in the analytics domain, also the description of an agenda how these challenges can be solved. Furthermore, a process is explained, how the strategic alliance should act and organize their work to realize beneficial and useful analytical solutions.

Keywords: research collaboration, European network, strategic management, trend analytics, business intelligence

1 Introduction

Analytical Reasoning by applying machine learning approaches, artificial intelligence, NLP and visualizations allow to get deep insights into the different domains of various stakeholders and enable to solve complex tasks. An example for such a complex task could be the identification and prediction of new technologies, upcoming technological and methodical trends and innovations in the different domains of application. This is essential for making strategic decisions for economical and societal challenges. The analytical approaches can be supported through trend mining, machine learning, artificial intelligence, visual analytics and simulation.

To face the named aspects, a strategic alliance is necessary that seriously considers a variety of data and focus in particular on huge amount of data, streaming data and unexplored free data from different resources. But even more, the alliance should not

have only the data as basement in mind, it is much more important to follow the entire data processing pipeline. So that also data storing, data processing and data visualization needs to adequately handled for an effective and efficient analysis.

The main goal is to optimize and use technological and methodological innovations to identify required analytical approaches for politics, business, education and research and to develop adequate solutions to the identified challenges. Therefore, an interdisciplinary European network should be initiated that relies on the expertise of the involved partners, who are internationally renowned in their respective fields. From a technological point of view, methods of digitization, artificial intelligence, natural language processing, visual analytics, data analytics and simulation will be optimized and used for different application scenarios. Thereby, the actors in the respective areas define the challenges themselves, whereby data-driven trends will also be identified. The validation of the results is also carried out by the actors of the respective areas. Therefore, a network of interdisciplinary partners has been established who are able to qualitatively define and assess those challenges and solutions. In this paper we describe the major challenges, particularly in Europe, how the network aims to face these challenges and finally how the network actions will be organized.

2 Challenges in European Collaboration toward Advanced Analytics in Strategic Management

The establishment of analytics and analytical solution is a challenge in most countries. This challenge is often aligned to the digitalization challenge, since wide ranges of current business are still analog. But to face nowadays developments, it is necessary to consider enhancements of products and services to have the address the changed needs of customers.

However, the challenges in using and establishing analytics in daily business and processes requires a more precise understanding. In this section, the intention is to outline a variety of challenges that not only cover technological aspects, but also societal and economical challenges.

2.1 Technological Challenges

Recent advances in technologies and especially artificial intelligence (AI) thrive whole new business concepts in digitizing current labor or is the basis of completely new industries. In the Global Risk Report 2019, the WEF identified the “adverse consequences of technological advances” as one of the major risks [1]. These risks can be seen as challenges for the private sector and society. Disruptive technologies such as AI affect the work of the future. Together, with the trend towards fully-automated smart factories driven by industry 4.0 manufacturing [2] will change considerably. So-called “smart manufacturing” with its new interconnected cyber-physical systems is only one of many examples of technological advances that will affect the labor of tomorrow. If society as a whole does not adapt accordingly, a lot of people may be left behind. The technological challenge may then lead to considerable societal and economical risks

[13]. In our current information age, the spread of information and wisdom is tremendous. The widespread global access to information is deemed to accelerate invention of new technologies. The processing and assessment of information is key to success for current and tomorrow's businesses to develop their strategies which will provide new forms of labor for hundreds of workers for the next decade. Assessment of mass information and their presentation in a manner that is accessible, understandable and therefore usable is one of the great technological challenges of our century. Analytics can help in both challenges to access, assess and help to understand such information masses. The first challenge is to help processing, annotating, identifying errors, visualizing dependencies and connections with the aim to accelerate daily work or internal processes. Therefore, analytics has a considerable potential to support workers sticking with time restraints without letting the learning curve [14] become too steep with regard to the adaptation to new technologies. In consequence, it bears the potential to help leaving nobody behind by technological advances. Moreover, analytics supports identifying trends in the mass information that helps to build sustainable business strategies for the company's future well-being and consistency. Analytics in this context contains in particular corporate foresight. An exemplary research question could be: "How can innovations be created and strengthened and future technologies as well as possible scenarios be predicted by the approaches that are currently at the forefront of technology research in order to make strategic and other decisions in a more targeted manner?"

Due to the rise of a variety of machine learning, Artificial Intelligence, data mining and visual analytics methods, it is necessary and important to evaluate the potentials of all kinds of technologies [12], data and approaches for the so called "data markets". The main research questions in this context are:

- Which kind of data or combinations of data are appropriate for strategic decisions to enhance the potentials of enterprises and local authorities?
- Which models (machine learning and artificial intelligence methods) fit best to support the decision-making process for strategic purposes?
- Which simulation techniques are appropriate to predict and simulate future scenarios for both, enterprises and local authorities?
- Which methods can be applied to evaluate the business value of the gained information?
- Which Visual Analytics techniques enable to involve the "human in the loop" and open at least parts of the black-boxed machine-learning methods?
- Which impact can be measured, if the process of learning and predicting is more transparent?
- Which technologies and approaches will enable the "market-creating innovation" to focus on both societal challenges and industrial competitiveness

2.2 Societal Challenges

The WEF identified "unemployment or underemployment" as one of the many major global risks in their Global Risk Report 2019 [1]. It is in direct relation to "adverse consequences of technological advances", that we focus on. Through automation of

labor and new technologies such as AI that assist the trend in automation the societal challenge of unemployment or underemployment becomes reality. Automation causes the creation of new higher educated jobs as it is the reason for losses in lower educated jobs. To gain momentum against this trend a parallel development should be fostered. Analytics can help to process and assess new information and technologies in a simplified and therefore consumable manner by its users. Having said this, the technology has a potential to help people in lower educated jobs become qualified and prepared for the requirements coming with the transitioning to new jobs.

The Global Risk Report additionally identified the "spread of infectious diseases" as one of the major risks that we are currently facing [1]. Covid-19 has shown that to solve the problem, we rely heavily on traditional care services, which cannot be digitized. However, a variety of contextual aspects might be digitized to at least support the workers in their jobs. Care service in general can be supported with ambient assisted living technologies so that on the one hand people could do many jobs longer self-confident and therewith the nurses do not need to do the task. The challenge in this regard is not only the development of such novel assisted living technologies, it is also about having technologies that support the identification of beneficial services/technologies. Even today a number of solutions exist that might be helpful in the care service sector, but actually they are not known and identified [7]. Smart solutions can help to find synergies.

In an ever more complex world, which develops at an ever-faster pace, governments are struggling to keep up and to address societal problems in a sound and timely manner. This led to a decline in acceptance of government decisions throughout the democratic world, leading to a rise of citizens and associations who are critically questioning democratic governments to the extent that some groups of people are willing to terminate the social contract on their side. To countermeasure this trend societies place their hopes on e-governance and new forms of policy modelling giving stakeholders, from scientists to business associations over civil society groups down to the single individual possibilities to access information and represent their insights and interests in the decision-making processes. However, current policy making is still a highly analog process and technologies are still barely used or not implemented consequently [8, 9]. In fact, most governments miss a plan how new technologies and solutions can be considered and embedded in the entire policy making process. And finally, even if new technologies which might assist the predictive tasks of a decision-making process (for example simulations), they are still uncommon or poorly developed. Analytics has considerable potential to support the decision-making processes by enhancing the understandability of the information at hand, both on the side of the decision-makers and on the side of the stakeholders and therefore accelerating the process and coming to better and more acceptable decisions. Moreover, analytics might help in identifying upcoming technologies (for example simulations, but also transparency and participation enhancing technologies) which might help in coming to better decisions behind the background of uncertainties in an accelerating world.

2.3 Economic Challenges

More and more data are getting digitized and allows new insights into market, technologies, competitors and more [3, 4, 7, 22]. This digitalization trend is particularly important for small and medium sized companies, since a change enables other market players to modernize businesses and can therewith be a high risk for traditional approaches. For enterprises, municipalities and citizens (in terms of consumers), digitalization requires solutions that enable them to identify, understand and apply such new trends. Demand and competition force an increase in market and price pressure. The pressure will enforce the development of even more automation to keep costs short. The challenge to automate everything in every industry to spare costs also accelerates the other challenges (societal and technological) and is an example for the strong interplay between challenges in society, technology and economy.

3 Proposed Objectives & Advancements

Analytics is a way to simplify the assessment of complex data and has the potential to enable, both, the private sector and society to assess, understand and process unstructured data to develop new strategies, in areas, such as corporate foresight and the future of employment with regard to their challenges [10]. In a first attempt of a definition "analytics" contains the entire technologies and models for deciding in a more appropriate fashion for diverse tasks in heterogeneous fields of application. This could be corporate foresight, societal challenges, manufacturing etc.

3.1 Technological Objectives

Data Sources, Processing and Transformation for Analytics
The analysis process requires a number of different steps to allow the application of analytical technologies, e.g. artificial intelligence, machine learning and simulation. It is necessary to investigate the entire digital data transformation, e.g. integrate data, extract information from the integrated data and provide effective and interactive analysis tools. Scientific open access data is maybe one resource that the European Commission will probably address in the new Framework as the current suggestions imply [5]. State of the art in analytical technologies should therefore be investigated. Further the use of various data in particular huge amount of data, streaming data and unexplored free data from social networks may provide better analysis.

Data Mining for Enhanced Analysis and Data Insights
Given data in the web is often incomplete or not well defined. In consequence it is still difficult to identify a given entity in a full-automated and sufficient way. Also, the categorization of data is often not given. To bridge this knowledge gap, data mining techniques are suitable approaches to mine such information with regard to accessible data [15]. It enables the mining of categories, topics or helps to identify entities by consideration of a number of features that are additionally given with the data itself.

Simulation, Prediction and Forecasting through Analytics.
Besides the pre-processing of data, data mining, simulation, foresight and prediction approaches will enable to evaluate the underlying methods and enable considering different approaches of machine learning and artificial intelligence to identify the emerging technologies and trends. It is necessary to evaluate the approaches from the business-perspective [11]. Therefore, in particular approaches from technology and innovation management, strategic management and business analytics and administrations will play an essential role. Here, the diverse methods stemming from diverse scientific fields, for example technology impact assessment and technology related regulatory impact assessment, should be investigated, as well.

Visual Analytics to Perform Trend Analytics
For trend identification as an example for analytics, an encompassing view on the data is essential to "see" upcoming or manifesting trends [22, 4]. The challenge in trend analysis is that the analytical procedures follow no strict procedure. In fact, this means flexible, interactive and mathematical analysis approaches are required to extract and visualize those parts of data that seem promising [3]. Visual analytics enables the coupling of data, (mathematical) models and visualizations for such an advanced analytical environment to facilitate analysts and decision makers the extraction of the required knowledge from the data [10]. Here, the diverse approaches from different fields of sciences should be considered, as well.

Visual Analytics for the Future of Work
Visual analytics helps to view complex information in a simplified manner. Depicting the smart manufacturing example, a lot of technologies are awaiting at the edge, that will disrupt the training, the daily work and the processes within the domain. Trainees have to understand more and more complex cyber-physical systems that are also interconnected and fully-automated. This machinery produces a lot of complex information that is difficult to assess and therewith processes and procedures are difficult to follow and learn from. Besides the training process, the daily work as surveillance and maintenance is also directly affected by this complexity, followed by the internal factory processes. Visual Analytics can help process, annotate, identify errors, visualize dependencies and connections to accelerate training, daily work or the internal factory processes by mitigating complexity and lower the entropy to make systems and processes more accessible. Therefore, Visual Analytics helps trainees and professionals to stick with time restraints without letting the learning curve become too steep with all the new technologies. Consequently, leaving nobody behind by technological advances.

The strategic alliance owns a variety of technologies and expertise in the named fields, however, many of these technologies focus on only a few aspects, yet. Within the action these technologies and expertise should be merged to advance the power and effectiveness and enable a broader usage. The technological outcome will finally lead to new scientific solutions that are fruitful for a wide number of societal and economical use cases, e.g. "visual analytics for policy modelling", "visual analytics for medical

purposes", "visual analytics for smart businesses" or - to frame it more broadly - "visual analytics along specific use cases".

3.2 Societal Impacts

The general topic of analytics is a multidisciplinary area with methods, models and technologies from computer science, mathematics, economics, law, social sciences and more.

Education is the key to withstand the losses in jobs through automation in e.g. smart manufacturing. Analysis helps to assess information simplified and provide suitable information in time in the right proportion. Consequently, the mitigation in complexity helps in education by accelerating training and further education [16]. This enables a faster integration of new technologies.

Technological advances are able to transform **public and societal services** such as health care [17]. Enabling the support of elderly to stay at home for a longer duration or enabling a new level of care-taking. The potential of these new technologies may be hidden in the available mass information. Analytics can cover these traces of information and enable the judgment by the rulers, that insure a faster integration of new technologies in the long run.

Analysis comprises both technology impact assessment and regulatory impact assessment, as they are a major concern of **governmental administration**. The first aims at anticipating possible positive or negative impacts of an analytical result on society [18, 19]. Since laws are an expression of values of a specific society, a concretization of the legal requirements helps to set up criteria to allow an evaluation of societal risks and opportunities stemming from a technology trend [20]. The latter aims at anticipating the current and foreseeable legal framework applying to a technology trend to evaluate risks and opportunities for the technology trend itself.

Moreover, analytics may be applied in a single decision-making process to improve insights to the related problems and questions raised with the aim to improve transparency of such processes for decision-makers and stakeholders, as well, by improving understandability of the data. Moreover, given the fact that governmental decisions are flanked strongly with participation processes aiming to achieve acceptable and therefore better decisions, analytics may also play a key role in improving the participation process itself with regard to the stakeholder involvement, by improving the analytic capacities with regard to the given comments and their uptake, their relation to scientific or political documents, for both the decision makers and the public, as well.

Knowledge from management, such as innovation, technology and information management, but also strategic planning and predictions in companies (corporate foresight) should be considered.

3.3 Economic Impacts

Right on **time** is key in industry. Either if it is the right business decision in the business strategy or if it is the opportunity to educate the professionals to strengthen their personal journey. Analytics has impacts on both sides of industry, society and businesses.

Analytics helps to unveil formerly unknown technologies and their potential to deduct better revised business decisions in terms of long planning business goals. Therefore, help to build up a sustainable business strategy in shorter time is a huge advantage on the market. While the development of enterprise strategies covers longer periods of time (often month or years), there are a number of scenarios where analysis should help to act within hours or month. The transportation and logistics domain have to react in short times if a duty is cancelled or a partner resigns or cancels a contract. Only with smart analytical technologies it is possible to react on those situations and find alternative duties or immediately calculate cheaper or more efficient routes [21]. Finally, analytics affects the leverage of market and price pressures by visualizing and providing information that can help companies stay ahead of the market.

Furthermore, analytics helps train professionals to build faith in their companies as a source of motivation, which affects the company's economic side. So, **effectiveness** is another major aspect of economics. May it be from perspectives of highly skilled and professional employees or may it be with regard to retrieved insights in certain analysis. Only a high degree of professionalism and quality ensures decisions that support enterprises in being profitable. In perspective of data analytics this means that the entire processing pipeline has to be designed towards high data quality in perspective of completeness, cleansing and data interlinking, but also the visualization has to follow strict requirements in perspective of traceability, accuracy and clarity.

Lastly, the **costs** and **earnings** are essential criteria. To achieve these criteria, the impact of an analytical solution must lay on generating higher profits or lower the costs. From the research perspective the intention to increase the profits is often the smarter more creative way since this often comes along with building or entering new markets with new products. And this means, analytical solutions have to show, which markets this could be and what the major entering criteria will be. Since any market entering has a risk, even more analytical solutions are essential that are able to highlight risks (e.g. possible patent or legal problems in the entered market or country). In sum, there is wide range of scenarios where analytical solutions could help to lower the costs and/or increase incomes, and all of them could help companies to stay productive.

4 Macro- and Micro-Level Organization to Enable Advanced Analytics

The organization of the planned analytics collaboration action consists of two main different phases (see Fig. 1).

The first is the proposal and negotiation phase, which also covers the team building that will work together on the specific goals. This first phase can be named as macro-level perspective, since it majorly focuses on the definition and work out the basic goals and objectives.

The second phase is the concrete collaborative work, with the main goal to achieve new insights and technologies. Since the analytics collaboration action is majorly ICT driven, some outcomes will be in form of software prototypes. Due to the heterogeneity of proposed consortium, it is rather challenging to collaborate as far as no common

understanding of use-case requirements are given. This perspective can also be named as micro-level perspective, since it aims to specify concrete use-cases and use-case requirements.

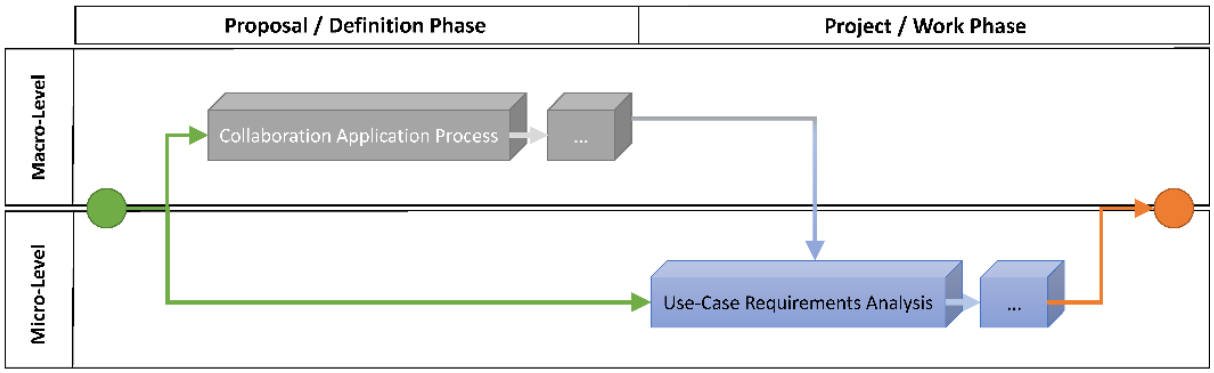

Fig. 1. Overview about the entire project pipeline including different project phases and perspective levels.

The figured process model (Fig. 1) consists about a hard-distinguished macro-level and micro-level perspectives, but it is to mention that in praxis it is usually not possible to split them that strict. Due to changes on project objectives and goals over time, e.g. due to partner changes, contextual changes, new research insights etc. some objectives at the macro-level can change with an impact as well as on the micro-level. So even when the micro-level phase already started, there could be changes on the macro-level as well. In sum, the process model in the presented form shows an ideal process model, which in praxis can regularly underlay some modifications. Furthermore, the process can be seen as an iterative process with the aim to refine analytics over many years in various iterations.

4.1 Macro-Level Perspective

The macro-level perspective is particularly at the beginning of such as proposal phase and at the beginning of an accepted analytics collaboration action of relevance. The intention is to define common goals and objectives and teams to collaborate with to achieve these. At this level specific procedures, technologies, algorithms etc. are of interest and the focus lays only on the intended result and main outcome. This means also, that the knowledge/expertise and collaboration is important.

This principle intention is also considered in our defined analytics collaboration action application process, which is divided into four phases (see also Fig. 2).

Phase 1 aims at promoting discussions on Part B of the present document. The coordinator sends around the present document to inform the partners about the process and gives its proposition on the common understanding (Part B). The common understanding will be updated after comments, additions and requested changes of the proposal. Phase 1 concludes with an online-workshop to discuss and finalize the common understanding, to elect a management board, which will facilitate the drafting of the

technical annex (Phase 2; see Part C) and to give further instructions on the application process (e.g. mode of further operation, answering questions etc.).

Phase 2 aims at drafting the technical annex (Part C), which forms the most sensitive part of the application. The drafting of the technical annex will be highly collaborative and the single members of the management board will be assigned specific tasks to fulfill. The draft will be finalized by the end of September, to allow for an assessment period (Phase 4).

Phase 3, which will be carried out in parallel to phase 2, aims at starting the analytics collaboration action application. This is considered to be the formal side of the application, which gives to the association to assess the conformity of the action and possible overlaps of the action with other actions on basis of a summary. Alterations are still possible in this phase. The coordinator will start the process shortly after and on the basis of the outcomes of phase 1. The partners of the analytics collaboration action will then be electronically invited to provide their contact and institutional information to the analytics collaboration action application. Phase 3 will iteratively inform phase 2 and vice versa.

Phase 4 aims at giving the partners enough time for a last internal assessment phase before the final submission. Here, a generous time buffer is implemented, if one of the other phases might require a longer period.

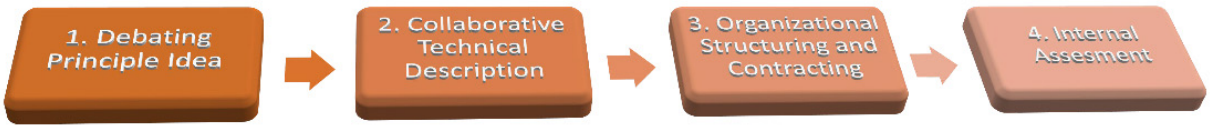

Fig. 2. Macro-level process perspective

4.2 Micro-Level Perspective

While the macro-level perspective is almost considering major goals and objectives and to define principal aspects, the micro-level perspective is to achieve and a final realization, especially in larger collaborating teams. Since in the work within heterogenous teams do collaborate, different opinions and (technical) understandings are a common challenge that we aim to phase with this micro-level process – also named as Use Case Requirement Analysis Model (UCRA) [6]. The UCRA covers all relevant parts to find a common agreement and at the end a successful solution, but before that use-case requirement analysis is elementary to begin a work with common result understanding. The procedure comprises: domain identification, elicitation (categorization, illustration), abstraction (sorting, grouping), specification (description, allocation), review (verification, illustration) and negotiation (consultation, validation, supplement/amendment) (see Fig. 3).

Overall this model can be seen as an iterative approach. After the first round of the UCR analysis and implementation of discussed features, another round can be initiated to refine and extend the system.

One important fact is that this approach should be performed before major developments in perspective of user related features are in progress.

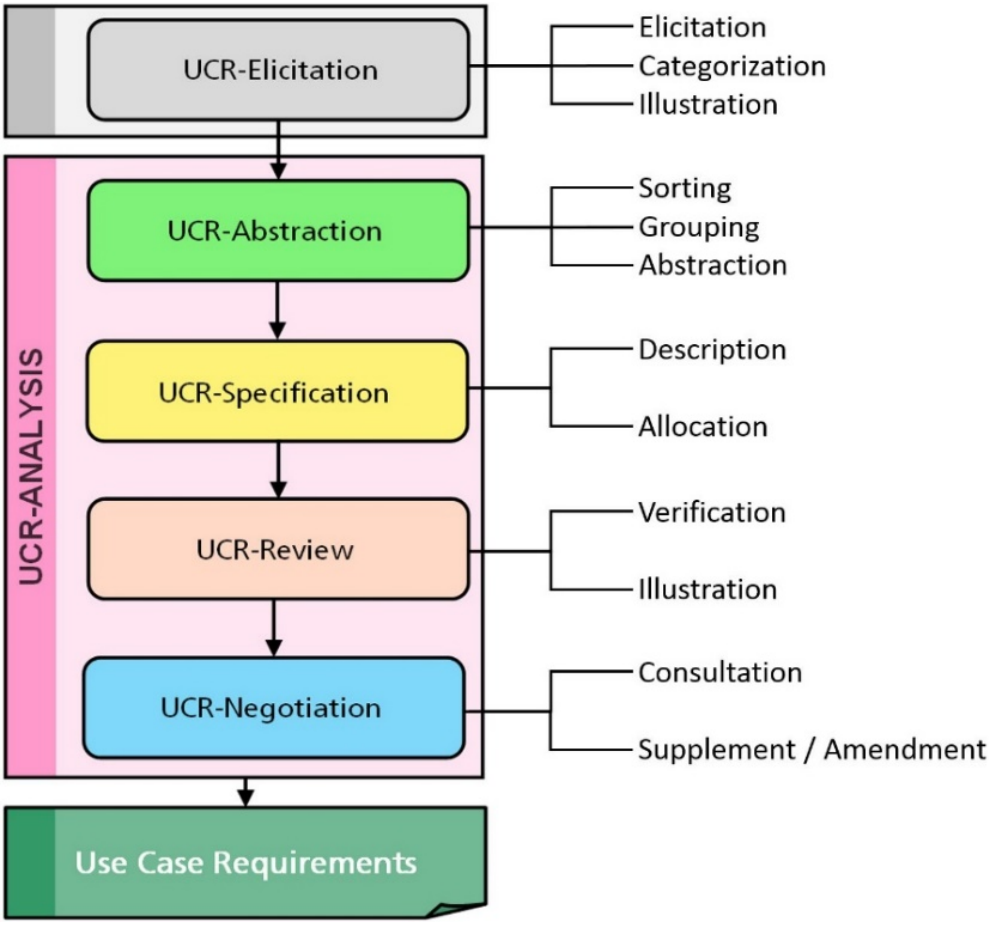

Fig. 3. Hierarchical model of use-case requirements analysis as main part of the micro-level project perspective [6].

5 Conclusion

The paper aimed on describing how a strategic network should be founded that aims on optimizing and using technological and methodological innovations to identify analytical approaches in the areas of politics, business, education and research and to develop adequate solutions to the identified challenges. That strategic network of partners should rely on the expertise of the involved partners, who are internationally renowned in their respective fields. From a technological point of view, methods of digitization, artificial intelligence, visual analytics, data analytics and simulation should be considered to optimize and use for different application scenarios. Thereby, the actors have to respect the named challenges, but can precise and complete them further by themselves, whereby data-driven trends will also be identified. A following validation of the results is also carried out by the actors of the respective areas later on.

Acknowledgment

This work was partially funded by the Federal Ministry of Education and Research under the grant number 13FH020AN9 and was conducted within the research group on Human-Computer Interaction and Visual Analytics (http://www.vis.h-da.de). For further information about the strategic alliance see https://www.vis.h-da.de/network.html.

References

1. World Economic Forum, 2019. The Global Risks Report 2019: 14th Edition. [Online]. Available: http://www3.weforum.org/docs/WEF_Global_Risks_Report_2019.pdf
2. BMWi, 2019. Leitbild 2030 für Industrie 4 .0: Souveränität, Interoperabilität und Nachhaltigkeit sind die zukünftigen strategischen Handlungsfelder bei Industrie 4 .0. Das Ziel: Digitale Ökosysteme global gestalten. [Online]. Available: https://www.bmwi.de/Redaktion/DE/Downloads/Monatsbericht/Monatsbericht-Themen/2019-10-leitbild-2030-fuer-industrie-40.pdf?__blob=publicationFile&v=6
3. Kawa Nazemi, Dirk Burkhardt, 2019. Visual Analytics for Analyzing Technological Trends from Text. Inproceedings of 23rd International Conference Information Visualisation (IV), pp. 191-200, Springer, Cham. doi:10.1109/IV.2019.00041
4. Kawa Nazemi, Dirk Burkhardt, Lukas Kaupp, Till Dannewald, Matthias Kowald, Egils Ginters, 2020. Visual Analytics in Mobility, Transportation and Logistics. Inproceedings in ICTE in Transportation and Logistics 2019, pp. 82–89, Springer International Publishing, Cham. doi:10.1007/978-3-030-39688-6_12
5. European Commission, 2019. Shaping Europe's digital future: Open Science. [Online]. Available: https://ec.europa.eu/digital-single-market/en/open-science
6. Dirk Burkhardt, Kawa Nazemi, Silvana Tomic, Egils Ginters, 2015. Best-practice Piloting of Integrated Social Media Analysis Solution for E-Participation in Cities. In Procedia Computer Science: ICTE in regional Development 2015, Valmiera, Latvia, 77, pp. 11–21. doi:10.1016/j.procs.2015.12.354
7. Reiner Wichert, Beate Mand, 2016. Ambient Assisted Living. Springer, Cham. doi: 10.1007/978-3-319-52322-4
8. Dirk Burkhardt, Kawa Nazemi, Jörn Kohlhammer, 2014. Policy modeling methodologies. In book Handbook of Research on Advanced ICT Integration for Governance and Policy Modeling, pp. 48–60, IGI Global, Hershey PA, USA. doi:10.4018/978-1-4666-6236-0.ch004
9. Susanne Sonntagbauer, Peter Sonntagbauer, Kawa Nazemi, Dirk Burkhardt, 2014. The FUPOL Policy Lifecycle. In Book Handbook of Research on Advanced ICT Integration for Governance and Policy Modeling, IGI Global, Hershey PA, USA. doi:10.4018/978-1-4666-6236-0.ch005
10. Pak Chung Wong, J. Thomas, 2004. Visual Analytics. In IEEE Computer Graphics and Applications, vol. 24, no. 5, pp. 20-21, IEEE. doi: 10.1109/MCG.2004.39
11. Dace Aizstrauta, Egils Ginters, 2013. Introducing Integrated Acceptance and Sustainability Assessment of Technologies: A Model Based on System Dynamics Simulation. In Modeling and Simulation in Engineering, Economics, and Management. MS 2013. Lecture Notes in Business Information Processing, pp. 23-24, vol 145. Springer, Berlin, Heidelberg. doi: 10.1007/978-3-642-38279-6_3

12. Detcharat Sumrit, Pongpun Anuntavoranich, 2013. Using DEMATEL Method to Analyze the Causal Relations on Technological Innovation Capability Evaluation Factors in Thai Technology-Based Firms. In International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies, 4 (2).
13. Tomas Hellström, 2003. Systemic innovation and risk: technology assessment and the challenge of responsible innovation. In Technology in Society, 25 (3), pp. 369-384, Elsevier. doi: 10.1016/S0160-791X(03)00041-1
14. Alec Levenson, 2018. Using workforce analytics to improve strategy execution. In Human Resource Management, 57, pp.685–700, Wiley. doi: 10.1002/hrm.21850
15. Hongyi Peng, Siming Zhu Peng, 2007. Handling of incomplete data sets using ICA and SOM in data mining. In Neural Computing and Application, 16, pp. 167–172, Springer. doi: 10.1007/s00521-006-0058-6
16. Eyal Sela, Yesha Sivan, 2009. Enterprise E-Learning Success Factors: An Analysis of Practitioners' Perspective (with a Downturn Addendum). In Interdisciplinary Journal of E-Learning and Learning Objects, 5 (1), pp. 335-343. Informing Science Institute.
17. Fatemeh Mariam Zahedi, Nitin Walia, Hemant Jain, 2016. Augmented Virtual Doctor Office: Theory-based Design and Assessment. In Journal of Management Information Systems, 33(3), pp. 776-808, Taylor & Frencis. doi: 10.1080/07421222.2016.1243952
18. Dirk Burkhardt, Kawa Nazemi, Jörn Kohlhammer, 2014. Policy Modeling Methodologies. In Handbook of Research on Advanced ICT Integration for Governance and Policy Modeling, pp. 48-60. Hershey, PA: IGI Global. doi: 10.4018/978-1-4666-6236-0.ch004
19. Dirk Burkhardt, Kawa Nazemi, Jan Ruben Zilke, Jörn Kohlhammer, Arjan Kuijper, 2014. Fundamental Aspects for E-Government. In Handbook of Research on Advanced ICT Integration for Governance and Policy Modeling, pp. 1-18. Hershey, PA: IGI Global. doi:10.4018/978-1-4666-6236-0.ch001
20. Dirk Burkhardt, Kawa Nazemi, 2019. Visual legal analytics – A visual approach to analyze law-conflicts of e-Services for e-Mobility and transportation domain. In ICTE in Transportation and Logistics 2018, 149, pp. 515-524, Elsevier. doi: 10.1016/j.procs.2019.01.170
21. Barbara H. Wixom, Bruce Yen, Michael Relich, 2013. Maximizing Value from Business Analytics. MIS Quarterly Executive, 12 (2), pp. 111-123, EBSCO.
22. Kawa Nazemi, Dirk Burkhardt, 2018. Visual analytical dashboards for comparative analytical tasks – a case study on mobility and transportation. In ICTE in Transportation and Logistics 2018, 149, pp. 138-150, Elsevier. doi: 10.1016/j.procs.2019.01.117