3rd Conference on Production Systems and Logistics

Development Of A Pre-Competitive Business Model For AI-Based Autonomous Technology Scouting

Stefan Leachu[1], Florian Clemens[1], Volker Stich[1]
[1] *FIR, Institute for Industrial Management at RWTH Aachen University, Aachen, Germany*

Abstract

Technology management can significantly influence the strategic decisions of a company and thus cause success or failure. Basic templates for technology management are technology radars as well as the determination of the technology readiness level (TRL) to be able to evaluate the maturity of newly deployed technologies (e.g., newcomer vs. established). The radars, as well as the TRL, are identified in time-consuming, manual research by subject matter experts from external consultancies. This process is often repeated due to the further development and new development of technologies so that the necessary research becomes an ongoing task. The *TechRad* research project, therefore, aims to automate the identification of the TRL as well as technology radars using web crawling and Natural Language Processing (NLP). To commercialize the pre-competitive prototype, the development of a pre-competitive business model is the goal of this paper. Based on customer analyses, a target group definition is created. Based on user interviews, the precompetitive business model will be detailed in a four-step approach using a business model canvas and a value proposition canvas.

Keywords

Technology Management; Technology Scouting; Technology Radar; Business Model; Business Model Canvas; Value Proposition Canvas

1. Introduction

1.1 Challenge

The number of devices using different digital technologies is increasing and will have more than tripled compared to today by 2025 [1]. Next to that, the number of new technologies is constantly growing [2]. Furthermore, the time until a technology is known to many users is decreasing [3]. It hints that the frequency at which both users and companies are exposed to new technologies is rising. Hence, managing technologies and innovations is a crucial component for entrepreneurial success as it will ensure a company's market position [4]. Staying ahead of the market and managing the sheer number of technologies available is becoming more and more of a challenge for both, large and small enterprises. Being unable to oversee the growing technology market endangers companies to lose their market position and may even result in bankruptcy. Many popular examples such as Nokia and IBM have unveiled the gravity of identifying the right technology trends [5].

1.2 Solution

The *TechRad* research project, therefore, aims to automate the identification of the technology readiness level (TRL) as well as technology radars using web crawling and Natural Language Processing (NLP). The

solution will improve the technology-scouting process for enterprises, especially SMEs, and assist in building sustainable business growth. To commercialize the prototype developed in the research project, this paper will develop and discuss a pre-competitive open-source business model. The goal of the paper is to enable the commercialization of the prototype either by the project partners or foreign entrepreneurs.

1.3 Structure of the Paper

In the beginning, the paper gives a summary of the implemented prototype, business model, and value proposition canvas. Afterward the general approach for the derivation of the business model is presented in section 3. In section 4 the authors describe the business model and value proposition to commercialize the solution. In the end, there will be a discussion of the feasibility of the commercialization of the solution.

2. Related Work

The proposed business model relies on a solution that enables automated technology monitoring and management. The following paragraph will introduce the solution topics to develop a common understanding of the elements used to develop the business model.

2.1 Autonomous Technology Radar

The solution comprises the gathering, storage, analysis, and visualization of unstructured text data (see Figure 1).

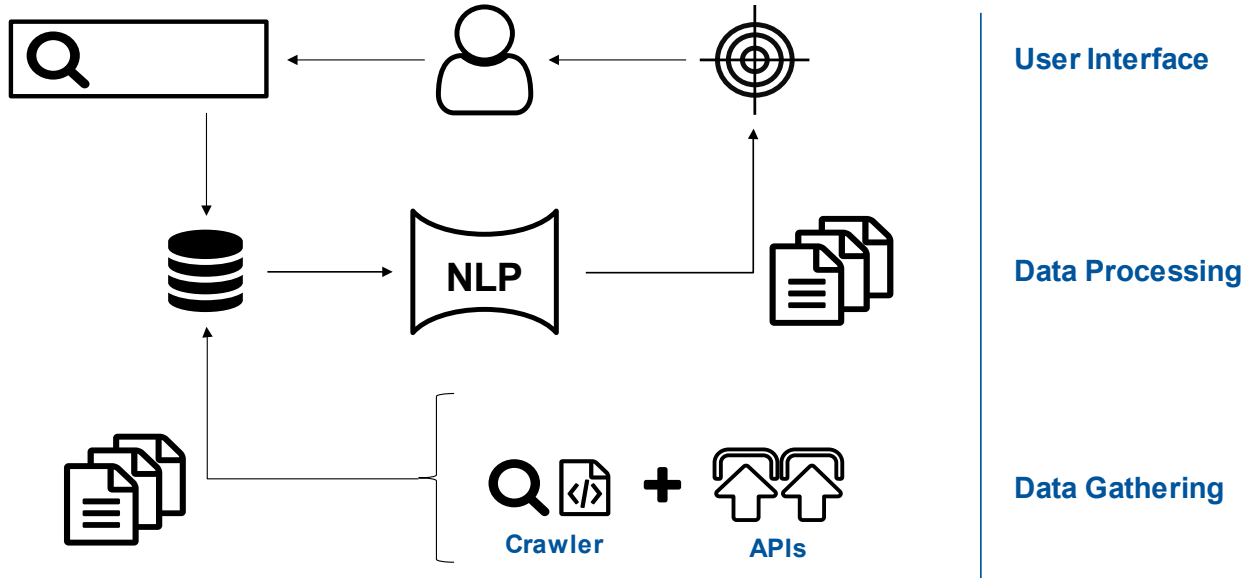

Figure 1: Data Flow of the Solution [6]

The data for the technology radar and TRL is gathered in both ways through API queries and Web-Crawling. Both steps are triggered through search keywords, which are entered by the user. Much information about technologies is available through restricted databases (e.g., *Wikipedia*) which are accessed via API queries. The topic that the user wants to research is passed as an argument to the interfaces to retrieve tailored results. Thus, the query process resembles an up-scaled, automatic version of using the traditional search function on a web page. Next to the API access, an automatic crawler identifies documents from a free web search. Here it needs to be assured to access only content in compliance with current laws and authority. Two distinct kinds of information streams are extracted from the sources. The metadata of the documents as well as information needed to build a crawl index is stored in a permanent database. The full-text versions of the documents are managed differently: Due to considerations of storage space and copyright guidelines, permanent storage of full-text copies is suboptimal, as it may conflict with copyright laws. After the pre-

processing step of data analysis, the full copies are discarded, as the necessary information is stored in a high-dimensional vectorized form. It is also necessary to reduce the number of acquired documents as soon as possible. Spam as well as documents with low credibility are discarded. The vectorized texts undergo an analysis step that scores their relevance to the subject and the maturity of the described technology itself. The maturity assessment is performed with NLP. The previously trained model calculates the sentiment of the data based on the spatial distance to other vectorized text samples. That is, if a document in question has similar features to a certain subset of training samples, the resulting spatial distance to these samples will be comparatively low and the model will give it a similar maturity score. The features needed for said assessment are identified by the machine learning algorithm during the training phase. In the end, the results are sent back into the permanent database to aid future related queries. After defining the maturity of the technologies and clustering them into groups in a last step, all the necessary information for building the diagram of the technology radar is available. Supplementing information to the graphic, e.g., hyperlinks to the sources and keywords for further research, finalize the result presented to the user. A second database stores the technology radar in a pool of historical searches to accelerate the fulfillment of future requests. [6,7]

2.2 Business Model Canvas

A business model is a highly simplified and aggregated representation of the relevant activities of a company. It explains how the value creation component of a company generates information, products, and/or services. In addition to the architecture of value creation, the strategic, as well as the customer and market components, are considered to realize the overall goal of generating a competitive advantage. [8]

The business model canvas (BMC) consists of nine elements and is used to define and document a business model [9]:

- **Customer Segments:** The definition of market segments and target groups is the core of any business model, on which all other elements depend.
- **Value Proposition:** The product and its value for the customer must be defined for the respective target group.
- **Channels:** Communication channels and distribution channels are a prerequisite for customers to learn about and purchase the products.
- **Customer Relationships:** The customer relationship describes how the business relationships with the individual customer groups are structured.
- **Revenue Streams:** The goal of every business activity is to generate profit. The revenue streams define how revenues are generated. Together with the cost structure, profitability calculations are possible.
- **Key Resources:** Key resources describe which resources are required to fulfill the value proposition and to serve the customers.
- **Key Activities:** Key activities describe the main activities and competencies to realize the business model.
- **Key Partnerships:** In most cases, a company needs partners to successfully implement a business model. This section lists, for example, the suppliers needed.
- **Cost Structure:** All the costs incurred to realize the business model are compiled and estimated here.

2.3 Value Proposition Canvas

The value proposition canvas is divided into the areas of *customer needs* and *value proposition*. The areas are juxtaposed with each other to show in detail how the value proposition addresses customer needs. A value proposition canvas (VPC) is developed for each customer segment that was identified in the BMC. Customer needs are captured through three perspectives [10]:

- **Customer jobs:** Customer jobs describe tasks and problems that customers want to perform or solve. For this purpose, the functional, emotional, and social needs of the customers are considered.
- **Pain points:** Pain points are challenges that prevent customers from performing customer jobs or solving their problems.
- **Gains:** Gains provide information about how the customer feels, how they describe their sense of achievement, and what they gain from completing the task. Gains also consider functional, emotional, and social aspects.

After the needs and expectations of the customer group have been described, the value proposition is developed against the pains and gains of the customers. Three perspectives are also elaborated for this purpose [10]:

- **Products and Services**: Products and services are selected functions or performance features that support customers in performing tasks and achieving their goals. A distinction is also made between functional, social, and emotional aspects.
- **Pain relievers**: Pain relievers are the aspects of a product that address and resolve the customer's frustrations and problems.
- **Gain Creators**: Gain creators are extras that generate additional and unexpected value and enthusiasm among customers.

3. Methodology and research goal

The overall goal of the underlying research project is to build a prototype to automate the development of technology radars. A business model is needed to commercialize the resulting prototype as a productive application. Therefore, the focus is set on the development of an open-source business model for the automated technology radar. Thus, the applied methodology (see Figure 2) focuses on creating a business model utilizing the BMC and VPC based on the results of qualitative data analysis [11]. The required data was gathered through expert interviews with potential user groups and the project team. Within the next chapter, the derivation of the elements of the business model based on the described approach is explained in detail. Afterward, the gap between the business model and prototype is discussed.

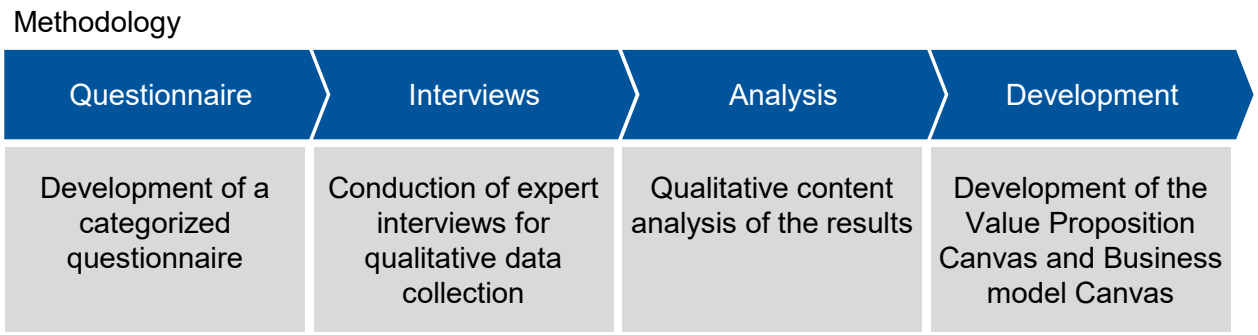

Figure 2: Methodology

4. Pre-competitive Business Model

The BMC and the VPC serve as the basis for the precompetitive business model. As a base of information customer workshops were performed to obtain the following information. In the context of the *TechRad* project, these models are detailed, and the results are described.

4.1 Business Model Canvas

In the following, the nine elements of the BMC are presented (see Figure 3):

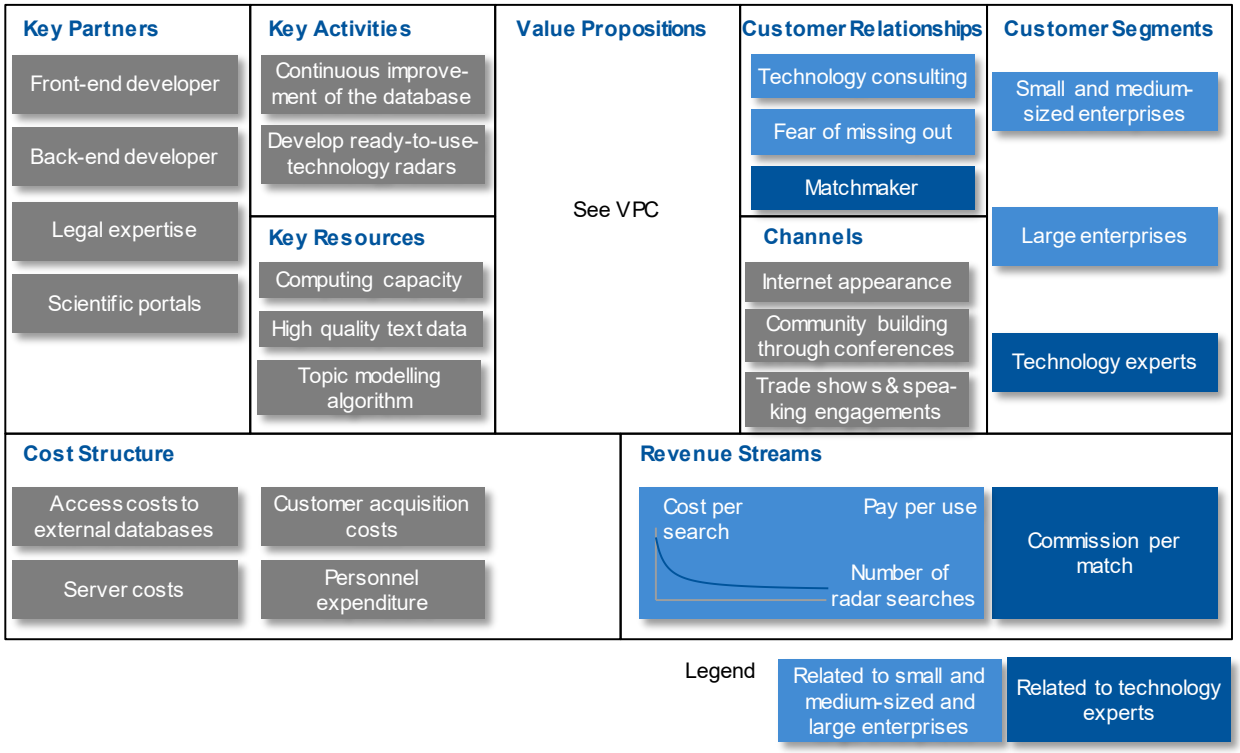

Figure 3: Pre-competitive business model canvas for autonomous technology radars

- **Customer Segments:** The business is targeted to the following groups of customers. They are described by the frequency of use i.e., the number of searches per year. In general, the willingness of SMEs to pay is low due to their infrequent use, i.e., they rarely perform the activity of *scouting* from technology management. Whereas large companies with their technology unit show a high willingness to pay, as these actively perform m*onitoring, scouting,* and *scanning* (cf. Customer jobs in VPC 4.2). Therefore, the potential for saving time is much higher in larger companies. Additionally, technology experts and providers are also addressed with the *TechRad* platform since they can link their expertise on specific technologies to the technology radar.
- **Value Proposition:** The gained value is discussed in detail in the VPC (see Figure 4).
- **Customer Relationships:** The interaction with potential customers is planned in the platform concept with community possibilities. This means that e.g., a forum is provided as an opportunity for interaction within the community. Moreover, the generated technology radars will have a contact person from the platform team for further problems and questions. After passing through the intended use case of the platform, the automated generation of a technology radar, the feedback of users is played back for internal optimization. In general, there is a second customer group, technology experts, and providers. The interaction with this group is done by additional intermediary contracts to act as a broker when customers searching for technologies and get at the same time recommendations for these experts and providers

- **Key activities:** The main aspect of the *TechRad* platform is the distribution of the actual product, the automated Technology Radar. However, the required activities also include continuous development to increase customer satisfaction. On the one hand, the data basis must be constantly expanded, and on the other hand, the algorithms must be maintained and improved. The basis for this can be customer feedback and performance indicators of the algorithms. In addition, a continuous review of the legal principles is required, as external information from a wide range of portals is processed.
- **Key partners:** From an internal perspective, key partners are for front-end development (user interface), for back-end development (AI algorithms), for technological background knowledge, and for legal expertise. External support is provided by portals where technologies and trends are discussed. These range from scientific perspectives (e.g., *ScienceDirect*, *ResearchGate*) to popular scientific publications such as blogs (e.g., *TechCrunch*, *Gartner*) to standards and patents (e.g., *DIN*/ *ISO*).
- **Key resources:** Essential resources can be divided into four groups. First, computing capacity is required in the project to be able to establish constant topicality. In addition, algorithms are also needed for the realization of the project. These include two major AI components, topic modeling algorithm (identification of a topic of a document) and technology readiness level algorithm (identification of a TRL). Basis of all computations is the documents respectively the data basis, which make up the third group. Furthermore, the AI competencies, as well as research competencies are relevant for the design of the platform concept.
- **Revenue Stream:** In parallel to the customer segments, the level of sales is scaled to the size of the company. High revenue is generated by larger companies with frequent use, whereas lower revue is generated by less frequent use by SMEs. The profit is generated by new queries for autonomous technology radars or the update of existing radars. A pay-per-use [12] model is used for this purpose. However, sporadic use is more expensive than frequent use of the platform. The more often a company requests a new radar or updates existing radars, the more favorable these requests will be. In addition, a new branch is opening through the planned referral commissions to technology experts and providers that are associated with the radar.
- **Cost Structure:** Ongoing costs are fundamentally made up of the costs for the data. This includes partnerships with portals and the costs of API accesses. Secondly, the costs of maintaining the infrastructure i.e., server and personnel costs. In addition, there is a further budget for the acquisition of new customers needed.
- **Channels:** Key partners, as well as customers, are reached via several channels. On the one hand, is the online way. A large target group is addressed via blog articles as well as social and display advertisements. For support affiliate programs are used. In addition, search engine marketing and search engine optimization are used to access a larger audience. As a hybrid way of online and offline, community education via conferences is aimed as well as speaking engagements at trade shows. Moreover, direct sales are performed by using demos and training.

4.2 Value Proposition Canvas

In this section, the VPCs six elements are given. Thereby, the elements are split in the customer profile and value map. The VPC shown (see Figure 4) is modeled exemplarily for the customer segment with the highest expected revenue. In this case, these are large enterprises with frequent use of the platform.

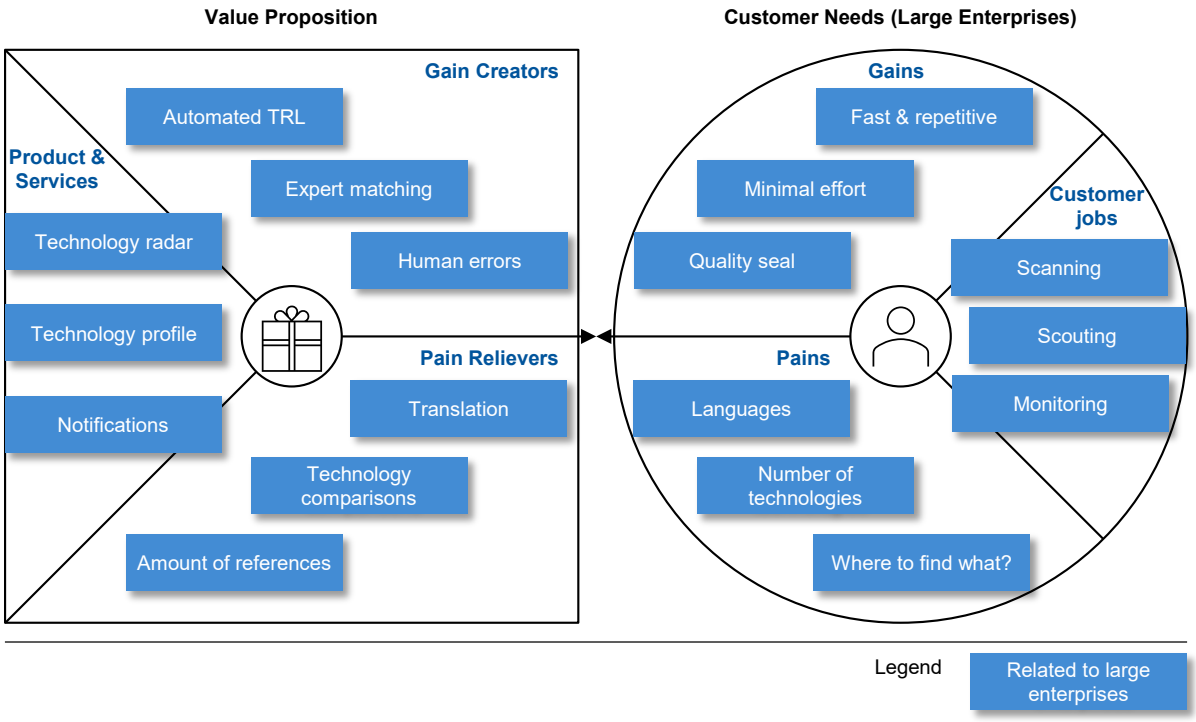

Figure 4: Value Proposition Canvas for the customer segment of large enterprises

Customer Needs:

- **Customer jobs:** Customers generally want to validate their trend analyses in the context of technologies. There are three main jobs that must get done that are part of the technology management processes. First, there is *technology scanning*. This job aims to discover new technology trends. The target image is broadly diversified where the whole market is scanned to early identify new technologies. Thereby, in the business context competing technologies from the perspective of a company are identifiable. Second, there is *technology monitoring*. This job covers monitoring specific technologies to track their evolution. It aims at the one hand to determine the right time to use a technology, on the other hand it is used to observe concrete technologies from competitors. Third, there is *technology scouting* which is used to point out a suitable technology for a specific use case. In other words, it performs a detailed search for predefined criteria. On this base, it can be checked whether technology is appropriated for a purpose. Besides, all gathered results should be manageable and individualizable from a single source.
- **Pains:** When performing the given jobs manually, customers are facing barriers. On the one hand, they reach the limits of their language capabilities. These are comprehension problems caused by foreign languages paired with specialist domain language, for example in patents. Moreover, technology management is recurring and time-consuming work. If you don't know where and how to look up and start, it costs even more time. However, missing technology expertise, in general, leads to the problem of not knowing whether one's status quo in the company also corresponds to the state of the art. It is therefore unclear which technology must be used to hold one's own against competitors on the market. This is how the experience gap arises when a solution is already in use, but the company is not satisfied with it and does not know what alternatives are available.
- **Gains:** The aspects of quick evaluations of the results, which are provided recurrently and continuously, predominate the gains since technology management in general needs a lot of resources (personnel as well as experience). Therefore, a major gain is to facilitate easier access to these results to enable a simple and fast overview of technologies. Moreover, these intense resources cause human errors which must be reduced because every TRL assessment is manually performed

and leads to a summation of errors. This implies the need for a quality seal when results are gathered to ensure trust in the results.

Value Proposition:

- **Products & Services:** The focus of the platform is on the identification and comparison of technologies. The automated generation of technology radars is mainly used for this purpose. The automated identification of TRLs is also fundamental to be able to generate individual radars with any technology. For each technology, profiles are generated in any language to make foreign languages and domain language understandable. In addition, the user experience is enhanced with additional functions. Personal comments are possible for each individually generated radar. The generated radars can be saved and opened again. Also, suggestions are given to already generated radars from the community, which could fit personal preferences. Moreover, special references can be white and blacklisted to customize the automated rating processes. Technologies can also be compared in pairs. In addition, subscription or newsletter functions are available to send emails or customized notifications in the event of changes in trends or technology. Next to the comparison of technologies, the product provides the possibility to display technology experts in the radar and supports the establishment of contact with them.
- **Pain Relievers:** The following problems are addressed by the *TechRad* platform. First, it reduces the time required for technology management, especially research. This is achieved by automatically crawling the internet for sources and interpreting them in the same way to present domain language and foreign languages in a comprehensible way. Furthermore, human errors in the interpretation of these results are reduced, as the identification of a TRL is automated by a standardized process. Overall, quick, and easy access to technology research and its results is offered, making the current state of the art and technology trends transparent.
- **Gain Creators:** The added value of the product is created by automating the previously manual processes, which are time-consuming and require experience. Software packages for technology management already exist to generate technology radars, but the evaluation of the technologies is still the responsibility of the user. Therefore, alternative products are outperformed by *TechRad*, since no continuous and automated TRL determination exists yet and *TechRad* enables this. Similarly, there are no summarized technology profiles, which are generated by *TechRad* in basic language. All information is based on a variety of references, so a wide database exists. Conversely, these sources can also be viewed in the technology radar to enable the traceability of the TRL assessment. In conclusion, information extraction is automated and brought to the users in the broad masses cost-effectively and understandable for everyone without increased effort.

5. Discussion

The business model is based on the assumption that the results of the technology radar are of high quality. That means that they meet the expectations of an expert in the respective domain. SCHUH ET AL. have shown that the results of *TechRads* prototype are acceptable, but the quality still needs improvements [7]. Moreover, not only the quality, but also the time factor proved to be essential in the user workshop. The willingness to pay for the *TechRad* platform has been shown in the fast delivery of the results. The users have specified fast in the range of up to one hour. Due to the fact that the processing in the current prototype phase takes about one day, further development is required in the context of efficiency. However, if the quality and efficiency requirements are not met, commercialization would not become an option.

Furthermore, an autonomous technology radar improves the technology scouting process by reducing the research efforts. This is significant for large companies with technology and innovation management departments. Small companies do not make use of such processes because they do not have technology

management departments. Rather, they monitor new technologies until they are mature and then use them to maintain their competitiveness. To ensure that the business model also offers incentives for SMEs, monitoring functions must be developed in further research.

Based on the qualitative content analyses of the results from the expert interviews also experts have been identified as a user group for a technology management platform including the use of autonomous technology radars. The prototype does not include functions to match experts with SMEs or large companies yet, why there is also a need for further development and research in this area.

In summary, data is essential for business models based on AI applications. Therefore, aspects from the key activities, partners, and resources are required as a blueprint in any business models from this area. In fact, these are the continuous further development of the algorithms, legal framework conditions (especially in the European Union), the application infrastructure (frontend and backend), and the IT infrastructure to support the product. Overall, the technical competencies are always needed to implement the goal efficiently and sustainably.

Acknowledgements

This project has been funded by the Leitmarkt.NRW program (EFRE-0801386) and the European Union in the European Regional Development Fund (EFRE) under the name *TechRad*. The authors wish to acknowledge the EFRE for their support. We also wish to acknowledge our gratitude and appreciation to all the *TechRad* project partners for their contribution during the development of various ideas and concepts presented in this paper.

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Biography

Stefan Leachu (*1996) is a researcher at FIR at RWTH Aachen University in the department of Information Management since 2021. With his degree in computer science, he enjoys linking the technical issues of various technologies with the value-added potential that can be achieved in the business world.

Florian Clemens (*1993) received his M. Sc. degree in industrial engineering at University Paderborn. He is a researcher at FIR at RWTH Aachen University since 2019 in the department Information Management, working on the transfer of AI to production.

Prof. Dr.-Ing Volker Stich (*1954) is head of the Institute of Industrial Management (FIR) at the RWTH Aachen University since 1997. Prof. Dr.-Ing Volker Stich worked for 10 years for the St. Gobain-Automotive Group and led the management of European plant logistics. Also, he was responsible for the worldwide coordination of future vehicle development projects.